

## RESEARCH ARTICLE

# Gender Analysis of Smallholder Farmers' Adaptive Capacity to Drought in Semi-arid Kenya

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## Abstract

The article presents the results on gendered analysis of adaptive capacity to drought by smallholder agricultural households in Makeni county of Semi-arid Eastern Kenya. In spite of the county being semi-arid and over-reliant on rain-fed agriculture livelihoods are more sensitive and hence more vulnerable to recurrent droughts. Drought conditions potentially affect men and women differently and gender dynamics have the potential to influence how people respond or adapt to the risk. The aim of this study was therefore to compare the factors that influence capacity to adapt to drought between men and women. The study involved interviews with 420 rural households that were stratified into either male-headed or female-headed and Focused Discussion Groups. Results of the study showed that women-headed households were less equipped to adapt to drought compared to men-headed households, a situation that made them more vulnerable to droughts. Women's capacity was limited by low levels of education; low incomes; insufficient weather and early warning information; limited ownership of resources; limited access to financial services; and triple role burden in households. Policy and practice implication of this study is the need for innovative and more strategic approaches of integrating gender in management of resources that are necessary for adaptation. We also recommend for more gender-sensitive approaches of disseminating climate information, early warnings and adaptation advisories.

## Keywords

Drought; vulnerability; Adaptive capacity; livelihoods; gender analysis; Kenya

## Introduction

Climate change is currently a global challenge that is threatening achievement of sustainable development goals (Mutai *et al.*, 2010). Globally, climate change has resulted into sharp variations in precipitation and mean air temperatures and the changes are expected to worsen in the near future (Misra, 2014). These changes have also affected patterns of rainfall, sea level and flow of rivers in the world (IPCC, 2008). Agricultural productivity has also not been spared as it has been severely affected by variations in rainfall caused by changing climate systems especially in the arid and semi-arid areas (Misra, 2014; Mallari, 2015). In arid and semi-arid areas precipitation is projected to decrease further by more than 20% in 21st century and occurrences due to climate change such as droughts and floods are estimated to threaten the livelihoods of rural people now and in the future (Ranganathan *et al.*, 2010). According to Easterling *et al.* (2007), such occurrences lower crop yields and livestock productivity in rural areas. Today, occurrence of frequent drought happens to be one of the most important threats to agriculture and food security (Huho & Mugalavai, 2010). Drought is defined as a form of environmental stress caused by an abnormally long period of dry weather leading to moisture

deficiency or hydrological imbalance (Ngaira, 2004; IPCC, 2012). Drought affects close to 60% of global population with approximately 630 million of the population living in arid and semi-arid areas (ASALs) (O'Hare and Sweeney, 1986; Ngaira, 2005) and who rely on rain-fed smallholder farming for their livelihoods (Ribot *et al.*, 1996). Similar to other countries in sub-Saharan Africa, Kenya is highly vulnerable to the effects of drought, particularly the ASAL regions (Herrero *et al.*, 2010; Bryan *et al.*, 2013). This is attributed to the country's over-reliance on rain-fed agriculture, continued widespread poverty, slowed uptake of modern technologies, and under-developed markets and infrastructures (Nyoro *et al.*, 2001; Odhiambo *et al.*, 2004; Kristjanson *et al.*, 2009; Bryan *et al.*, 2013). Rain-fed agriculture is the main source of Kenya's income (Odhiambo *et al.*, 2004; Herrero *et al.*, 2010; Bryan *et al.*, 2013) and contributes 98% of the country's total agricultural activities (UNEP, 2009). Similarly, almost 18 million Kenyans live below the poverty line, majority of who live in the rural areas, and with more than 90 percent relying on rain-fed subsistence or small holder farming to survive (Kenya Agricultural Research Institute (KARI), 2008; Kiumbuku *et al.*, 2018). This poses major threats to sustenance of rural livelihoods especially those that depend on small scale rain-fed agriculture for survival (Phiri *et al.*, 2005). Our area of study, Makueni County, is among semi-arid counties in Kenya whose residents survive through small scale rain-fed agriculture involving food crop farming and marginal livestock keeping. Majority of farmers depend on rainfall for their crop production and for the regeneration of forage for their livestock. The county has however been repeatedly affected by harsh climate conditions with repeated incidences of drought being experienced. Over the last fifteen years four major droughts have been experienced in the county; 2004/2005, 2009/2009, 2010/2011 and in 2015 (County Government of Makueni, 2017). These occurrences have greatly impacted on livelihoods by disrupting crop and livestock livelihood systems in the county thereby placing rural livelihoods at high risks. The situation has been aggravated by relatively high levels of poverty in the County. It is estimated that 67% of rural population in the county live below international poverty line (at US\$ 1.90 PPP 2011, according to Awiti *et al.*, 2018) against 35.6% of total Kenyan population who lived below the international poverty line in 2015/2016 (Government of Kenya (GoK), 2013). Like any other part of sub-Saharan Africa where women constitute close to 50% of agricultural labour force (FAO, 2011; Doss, 2018), women in Kenya are primarily agricultural producers through provision of on-farm labour (County Government of Makueni, 2013). Vulnerability to drought occurrences is not the same to all people but depends on various factors that may include geographical regions, levels of income, means of livelihood, gender among others (Mutai *et al.*, 2010). The most affected are the poor and marginalized people who live particularly in low-income areas (Okereke & Schroeder, 2009; Kaijser & Kronsell, 2013), a characteristic of rural women in Makueni county. Therefore, addressing gender issues in agriculture is inevitable in meeting food security goals, nutritional requirements and agricultural sustainability. Specifically, adoption of gender responsive adaptation interventions to climate risks is necessary to meet the targets of Sustainable Development Goal (SDGs) (specifically SDG 2, SDG 5 and SDG 13). We did this study to produce sex disaggregated information that will help understand the disparities that exist between men and women in their efforts to adapt their livelihoods to drought occurrences. The findings of our study are intended to inform mainstreaming of gender in climate policy among other climate related agricultural interventions in Makueni county and in Kenya.

### Literature review

Adaptation is the process of adjusting to actual or/and expected changes in climate and associated effects, with an aim of moderating damage or to maximize on the resultant beneficial opportunities (IPCC, 2014; Mersha & Van Laernhoven, 2016). Adaptation involves modification of livelihood activities to naturally-varying climatic conditions depending on individual or household's livelihood needs and access to resources and knowledge (FAO, 2007). According to Agrawal *et al.*, (2008) adaptation options can be classified under five categories namely, mobility, storage, diversification, communal pooling and market exchange. Uptake of each of these adaptation options is dependent on specific ability to do so both at individual and household level. At household level, headship of the household may have an influence on uptake of an adaptation option since doing so is dependent on factors that are easily influenced by gender of household head. Specifically, gender disparities have

far reaching influence on how households' access and control resources based on household headship. In Africa for instance, women's access to land is mostly through the family while in Asia women access to land is done through the market. In Kenya, approximately 75% of land is owned under customary tenure, usually administered through historical practices based on cultural norms, lineage or clannism and traditions (Ensminger, 1997; Odeny, 2013). This type of tenure has for long been characterized by gender bias to the disadvantage of women who depend on existence of goodwill of men to access or own land (Allendorf, 2007). In circumstances when women happen to own land, they are denied exclusive rights of ownership but they share those rights with other family members (Wanyeki, 2003; Garvelink, 2012; FAO 2011;). Therefore, women happen to have access to such resources but lack control and therefore cannot make decision over them since they don't own them (FAO, 2011; Djoudi *et al.*, 2013). In our study these documented disparities offered a gendered framework to assess household adaptive capacity (Ribot *et al.*, 1996). This was achieved by collecting sex-disaggregated data that focused on various factors that had the potential to contribute to differentiated adaptive capacities of women and men based on household headship. Hence, in our context of study we considered the following factors as having higher potential to influence a household's adaptive capacity: economic resources; early warnings, climate information and knowledge; physical resources (ownership and control); and equity in division of labour (Djoudi *et al.*, 2013). As such drought was assumed to have an unequally greater effect either on livelihoods for women-headed or men-headed households depending on who had more control over these factors (Carr, 2008; Nelleman *et al.*, 2011; Sultana, 2013; Carr & Thompson, 2014; Huyer *et al.*, 2015; Gonda, 2016).

Adaptive capacity is a combination of attributes, resources and strength available of a system, community, individual, society or organisation to adjust to adverse stimuli in climate and implement strategies to react to evolving hazards and stresses so as to moderate potential damage, to take advantage of opportunities, or to cope with the consequences (Fussler and Klein 2006; IPCC, 2001; IPCC, 2012; IPCC, 2014; Brooks *et al.*, 2005 in Mckune *et al.*, 2015). Generally, adaptive capacity is important since it enables individuals to adapt or adjust to climate risks, to moderate potential damages, to take advantage of the opportunities or to cope with consequences (Mallari, 2015). In an agricultural system, adaptive capacity is closely related to two paradigms: resilience and vulnerability (Engle, 2011). The first paradigm, resilience refers to the capacity of an agricultural system to withstand disruptions and adapt to them (Folke, 2002; Adger, 2006; Gallopin, 2006; Marshall & Marshall, 2007). A resilient system is one that is able to withstand the impacts of change and therefore be able to live with them (Folke, 2006; Perez *et al.*, 2015). According to Perez *et al.* (2015) there is a thin line between resilience and adaptive capacity since building resilience of a system involves, to a large extent, building adaptive capacity of people and their social organizations. The second paradigm, vulnerability has also been described differently in its relation to adaptive capacity. Vulnerability refers to the susceptibility of the system to risks, and is frequently associated with specific losses or damages (Cutter 2008; Lindoso *et al.*, 2014). The concept of vulnerability is also understood to be a function of adaptive capacity besides exposure and sensitivity of a system (Antwi-Agwei *et al.*, 2017). Broadly, the concept of vulnerability can be looked through three paradigms namely; ecological resilience, political economy/ecology and risk hazard (Perez *et al.*, 2015). In this study we adopted the political economy/ecology paradigm that seeks to explore how social factors make people to be affected differently and the factors that lead to differences in capacities to adapt or cope with climate change (McLaughlin and Dietz, 2008; Miller *et al.*, 2010; Perez *et al.*, 2015). In agriculture, vulnerability has been considered as dynamic and multidimensional and manifested along gender, socio status, poverty lines, exposure of the livelihood system and geographical location (Nelson *et al.*, 2002; Ziervogel *et al.*, 2006; Acosta-Michlik *et al.*, 2008; Cramer *et al.*, 2016). Other studies have highlighted that vulnerability is a product of exposure to that risk and the system's ability or inability to cope with or adapt to the risk (Smit and Pilifosova, 2003; Lonescu *et al.*, 2005; Ziervogel *et al.*, 2006; Babugura *et al.*, 2010; Kakota *et al.*, 2011). Similar to these findings, there is more evidence that vulnerability is compounded by lack of specific capacities that include control and ownerships to resources such as land, incomes, information, markets, farm inputs and education among other factors that enhance production or influence the behaviour of individuals with respect to adaptation strategies

(Mutai *et al.*, 2010; Care International, 2010; Udmale *et al.*, 2014; O'Sullivan *et al.*, 2014; Farnworth & Colverson, 2015; Ngigi *et al.*, 2017; Nyahunda *et al.*, 2020).

### Rationale and framework of the study

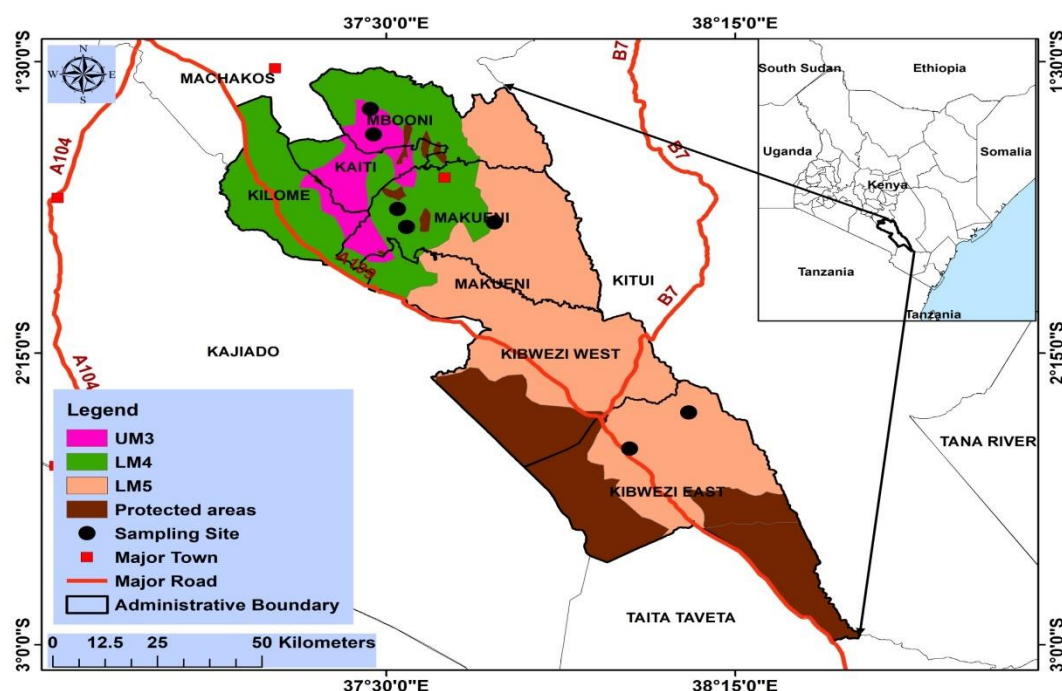
In our study we analysed how gender contributed to differentiated adaptive capacities among households based on the assumption that adaptive capacity is highly influenced by factors such as access to and ownership resources and decision-making capacity that are easily influenced by gender. Gender plays an important role of determining how individuals use different adaptation options by controlling access or ownership of assets or through cultural and social determinants (Meinzen-Dick *et al.*, 2014; Meyiwa *et al.*, 2014; Nyantakyi-Frimpong and Bezner-Kerr, 2015; Perez *et al.*, 2015). This means that disparities due to gender, as in the case for marginalisation of women in Africa has the potential to limit their capacity to adapt to climate risks including droughts. A number of studies have tried to conceptualise the dimensions through which the capacity of women is compromised. Adger (2006) pointed at three drivers which in our opinion have the potential to limit women's capacity to withstand extreme weather conditions, namely; resource distribution, resource availability and regulatory institutions while Davies (1993) highlighted on issues that deal with entitlements, endowments, empowerment and political economy. According to Swanson *et al.* (2007) adaptive capacity is dependent on access to: (1) equity; (2) technology; (3) infrastructure; (4) institutions and networks; (5) information, skills and management; and (6) economic resources. In our opinion all these factors highlighted by Swanson *et al.* are accessed differently based on gender dynamics. Similarly, a number of studies have attributed lack of adaptive capacity to limited access and ownership on natural resources; lack of knowledge and appropriate technologies; lack of financial services; lack of equity in decision making both at the household and community levels; as well as limited market opportunities (Aggarwal, 2003; Swanson *et al.*, 2007; Djoudi *et al.*, 2013; Niang *et al.*, 2014) all of which access is marked by significant gender disparities. While we were cognisant that there has been an increase in the number of studies on how gender disparities affect men's and women's ability to respond to effects of climate change in agriculture, a number of studies have suggested that there is still a considerable gap of knowledge that needs to be filled (Meinzen-Dick *et al.*, 2014; Behrman *et al.*, 2014; Huyer, 2016). Similarly, literature has uniformly highlighted the disadvantaged position of women in dealing with effects of climate change in agriculture but there is notable importance to enrich and update existing data bearing in mind that both gender and climate risks are dynamic both in space and time. According to Behrman *et al.*, (2014) gender is a social construct and gender issues are unique for every society based on cultural differences and they are further bound to change according different societal norms and contexts. According to Meinzen-Dick *et al.*, (2014) each society has its own unique gender issues that are bound to change with over time either within or between cultures. It is therefore necessary to conduct context specific research to be able to address gender issues effectively. With a recognition that there is still need for more sex-disaggregated data to inform proper decision making in agriculture (Behrman *et al.*, 2014), we did the study to generate more data, update existing data and highlight the success of gendered interventions that have been put forward. The study collected information of how gender disparities are affecting the ability of women and men to prepare or respond to the impacts of drought in securing agricultural livelihoods. Our study applied a gender analysis approach to collect the sex-disaggregated data and this enabled us to assess the gendered factors that influenced uptake of adaptation strategies. We assumed that ownership and control of the resources such as land, livestock, technology, crops, skills and information improve adaptive capacity to effects of drought while low access and less control of these resources undermine adaptive capacity. We also assumed that capacity to make and act on household decisions concerning the use of adaptive resources was an important determinant adaptive capacity to droughts. We anticipated that with more capacity to make livelihood decisions individuals were able to take up various adaptation strategies than those with less decision-making capacity.



## Methodology

### Sampling and data collection

We used multi-stage stratified sampling technique to arrive at the representative sample (Mugenda, 2011). In order to get representation across the study area we first stratified the county into three regions based on the major contrasting climatic and agro-ecological livelihood characteristics i.e. LM5, LM3 and UM3 (figure 1). We then selected one sub-county from each region and then two wards from each selected sub-county. Households were stratified into either male-headed or female-headed depending on who heads each family in terms of making daily decisions. We initially developed criteria for determining household headship. Households in which men were present daily and were fully in charge of making livelihood decisions for their families were categorized as male-headed (Bryan et al., 2013; Mikalista, 2015; Mersha & Van Laerhoven, 2016). On the other hand, female headed households were considered as those where women solely made farming decisions by virtue of their husbands living away from their homes (de facto female headed households) or by virtue of being single, widowed, divorced or separated (de jure female headed households) (Mikalista, 2015). To ensure representation of women from their de jure and de facto household headships, we divided female headed households into two strata from which we selected our respondents. We were carefully aided to segregate these households by local chiefs and village elders. Finally, we randomly selected households from each stratum and then interviewed the respective household heads. Our final sample comprised of 210 adult female respondents (105 from de facto female headed households and 105 from de jure female headed households) and 210 adult male respondents. Other studies have also focused their analysis on inter-household dynamics by stratifying households into male and female headships before sampling (Bryan et al., 2013; Mikalista, 2015; Mersha & Van Laerhoven, 2016) while others have focused their analysis on intra-household dynamics by focusing on married couples within the households (Ngigi et al., 2017).



**Figure 1. Study area showing agricultural livelihood zones and sample sites (source: authors, 2020)**

Created by the author from ICRAF datasets  
(<http://landscapeportal.org/layers/geonode:kenyaaezones>)

The study sought to collect both qualitative and quantitative sex-disaggregated data. According to Tashakkori and Creswell (2007), use of both quantitative and qualitative data in research helps to gain a deeper understanding of relationships between variables studied and eventual generalization of findings to the entire population. Quantitative methods of data collection were used to gather information from households in order to make generalization

about the population (Kumar, 2014) while qualitative methods gave an in-depth understanding of the quantitative information collected. Therefore, both types of data enhanced the overall strength of the study which is greater than when each method is used separately (Behrman et al., 2014). The respondents from the selected households were interviewed using a semi-structured interview schedules that were filled during the interviews. This was done carefully as the researchers took time with the respondents to ascertain the accuracy of the information given. Keen interest was paid on choice of adaptation strategies with both male and female farmers being required to prioritize their choice of strategies. To understand ownership and control resources respondents were asked open ended questions and they were required to describe the resources owned by the households and how these resources were managed and more specifically how decisions were made around those resources. In addition, we randomly selected respondents to participate in the focus group discussions. In total 12 focus group discussions (2 in each ward); each group consisting of 5-8 participants were conducted. We consulted the discussants before discussions through the assistance of local chiefs and elders. This was necessary in order to set and agree on time of the discussions. Discussions were done in a local language and the scripts recorded in a voice recorder.

## Findings

This section presents the results of our study around two subsections. We first analysed the influence of gender on choice of adaptation strategies by focusing on fourteen most common adaptation strategies used in the area to respond to drought. We then analysed the uptake of adaption strategies by gender against some independent socio-economic factors that had the potential to influence the capacity of farmers to cope with or adapt to effects of droughts. To arrive at the factors, we were guided by frameworks by Defiesta and Rapera (2014) and Smit *et al* (2001) which provided crucial dimensions for assessing household adaptive capacity. The framework highlighted the following important dimensions; human resources, physical resources, financial resources and information. We have therefore presented analysis results of these specific factors based the framework and the research postulates of the study.

### Choice of adaptation strategies

There was significant relationship between gender and uptake of adaptation strategies. Men were significantly able to take up the following adaptive strategies compared to women; accumulate livestock, diversification of livestock, change of livestock breeds, diversification of crops, use of resistant crop varieties, tree planting, and employment (table 1). Diversification of livestock was done through switching to animals that were deemed tolerant or diversifying the ones being kept. Notably, households were shifting from keeping large herds of cows, sheep, goats and chicken to smaller numbers that were perceived easy to feed and manage during droughts. A significant number of households had also switched from rearing cows to keeping goats which were perceived to be more tolerant. It was however observed that there was a difference in the number and composition of livestock between male headed households and female headed households. Compared to Male Headed Households, it was more common for Female Headed Households to keep smaller herds livestock that were composed of a thin range of small sized animals. Most households headed by women reared chicken and small herds of goats or sheep compared to Male headed households that kept bigger herds of a wide range of animals composed of cows, sheep, goats and chicken. Similar observation has been reported by other studies (Okali, 1998; Thornton, 2001; FAO, 2011; FAO, 2013), which was attributed to gender disparities associated with access to resources, gender roles and decision-making capacity. According to FAO (2013) women's constraints in livestock keeping can be attributed to inadequate access to natural resources, financial services, poor technical skills in animal care, lower education levels, marketing opportunities and extension services as well as their limited decision-making powers. These factors have the potential to influence women's access to improved breeds of livestock that may have higher input in terms of capital, technical and veterinary expertise. Therefore, women are forced to remain with local breeds that are easier to maintain although less productive (FAO, 2011).

Similar to livestock, a number of households had shifted from growing usual crops including maize and beans to more resilient crops like sorghum, green grams and fruits, while others depended on irrigated crops. It was also notable that those women exhibited low uptake of drought tolerant and drought escaping commercial crops. This was attributed to the fact that although women were aware of available technologies, decisions of their uptake were dependent on their husbands or any other family member to approve or facilitate. This was well captured by a response from a male discussant when asked to account on who is well prepared to take up drought tolerant species of crops between men and women: -

*“...it is easier for a man to vary the types of crops compared to women...a man may not require any permission to do so or to decide where to grow the crops...a woman also has to wait for the husband to send her money from the city for her to be able to purchase improved seeds... (FGD801)”*

**Table 1. Relationship between gender of HH and uptake of adaptation strategies to drought.**

Adaptation strategy	Men (%)	Women (%)	Diff in %	$\beta$	SE	p-value (95% CI)	Odd ratio
Accumulation of assets	55.7	28.6	27.1	1.388	0.234	< 0.001*	4.006
Diversification of livestock	28.6	18.6	10.0	0.599	0.242	0.013*	1.821
Change in animal breeds	29.5	18.6	10.9	0.616	0.234	0.009*	1.851
De-stocking	63.3	41.4	21.9	0.294	0.172	0.088	1.342
Alternative livestock feeds	23.8	20.5	3.3	0.203	0.241	0.400	1.225
Diversify crop varieties	36.7	20.0	16.7	0.586	0.198	0.022*	1.235
Use of resistant crop varieties	20.5	12.9	7.6	0.627	0.255	< 0.001*	1.255
Use of irrigation	21.4	15.2	6.2	0.519	0.285	0.069	1.681
Water harvesting	45.7	53.3	-7.6	-0.311	0.198	0.115	0.733
Tree planting/agro-forestry	42.9	28.6	14.3	0.657	0.212	0.002*	1.930
Employment	21.4	5.7	15.7	1.506	0.342	< 0.001*	4.509
Investment in social groups	18.1	60.0	-41.9	-1.919	0.228	< 0.001*	0.147
Uptake of formal credit	25.2	7.1	18.1	1.483	0.312	0.001*	8.116
Start-up of business	31.4	26.2	5.2	0.259	0.217	0.234	1.296

\*Male as reference category.

Although uptake of irrigation was not significantly related to gender, there were differences in terms of how women and men applied irrigation as an adaptation strategy in regard to; technology, scale, purpose and crops grown. Women concentrated on small scale irrigation which was meant to grow food for household consumption. They watered their crops manually using hand held equipment. Among the crops adopted for irrigation included kales, cow peas, tomatoes, beans and capsicum. Men on the other hand were engaged in irrigation in larger scale and for commercial purposes. They were able to do this by use of water from rivers, wells, earth and sand dams. Men had access to irrigation engine pumps and pipe connections for irrigation. The main crops grown by men through irrigation were tomatoes, onions, capsicum and fruits whereas women mostly grew green vegetables. Despite

insignificant relationship between gender and adoption of water harvesting technologies used differed between men and women. Women prioritized harvesting water for domestic use while men harvested water for livestock and irrigation. Comparatively, men harvested water on a larger scale relative to women including use of water pans, sand dams and earth dams. Women on the other hand invested on plastic and concrete water harvesting tanks through support of their social groups and non-profit organisation.

Storage of fodder and alternative feeding of livestock was also used as a strategy of adaptation by a number of households. Although storage of supplementary feeds was not significantly related to gender of HH, there were notable differences in the way this was practised. Comparatively, households headed by men were able to grow, purchase and stock feeds in large quantities compared to female headed households that either grew or purchased feeds in smaller volumes besides gathering locally available feeds (opportunistic weeds and crop residues) from the farms. This difference was attributed to a number of factors. Firstly, households headed by men had higher incomes relative to those headed by women. Men were therefore well off financially to purchase commercial livestock feeds from nearby markets. Women were also limited due to lack of capacity to make independent decisions and act on them concerning the crops to grow on their pieces of land.

Migration was also reported as a common strategy of adaptation to effects of droughts. This was particularly done by men to seek employment by particularly moving from their homes. Although women also adapted by seeking employment there was a difference in types of jobs that men and women engaged in. Men were flexible enough to move away from their homes for employment either on bigger farms, townships or urban centres. Women on the other hand were limited by their domestic duties and in case they sought employment they did so around their homes to enable them monitor other duties in their homesteads. Comparatively, more women were in temporary employment which was attributed to limitations in mobility and employability. For instance, inequalities in terms of having more household duties; low levels of education and skills limited their ability to fit in some jobs.

Although there was no significant relationship between gender and adaptation through business start-ups, types and scale of business activities differed between them. Men engaged in relatively large-scale businesses and on a wider range of activities near and away from their homes while women owned smaller businesses that were conducted near their homes. The most common business for women was in the form of small makeshift shops (locally known as *kiosks*) that were located on the roadsides near their homes.

There was significant relationship between gender and uptake of formal credit as an adaptation strategy. Compared to women, men were significantly more likely to secure credit from formal financial institutions ( $\beta = 1.483$ ,  $p = 0.001$ ) including banks and microfinance institutions whereas women depended on credit from informal sources like social groups, friends and relatives. Lack of uptake of formal credit by women was attributed to inequalities against them in terms of employment, household decision making and ownership of assets that could be used to secure loans. To secure credit from formal financial institutions it was reported that one was required to have security in terms of regular salary or legal documents of ownership of physical asset especially land. Fewer women however had such entitlements.

Compared to men, participation in social groups was a popular strategy used by women to deal with the unexpected impacts of drought. Women were more active in social groups and local CBOs that served either economic or environment purposes. In particular, women groups offered resilience through social support during droughts. Through these groups they were able to pool resources that were then advanced to members on rotational basis especially during times of distress. An elderly female participant in Nzaui ward responded by saying: -

*“.... this women group is very beneficial to me since I get some little money almost every month...for instance, by the end of this month I am expecting to receive about one thousand shillings (equivalent to 10 USD) that will help me to buy food for the family (KI52)”.*

Women also used their group membership to pool labour and resources to implement adaptation strategies that required large capital. Community Based Organisations on the other hand were used to initiate collective mitigation, coping and adaptive measures. Most of the groups, although non-formal, acted as conduits of working with external institutions and humanitarian organizations. From KII and FDGs respondents reported that these social groups



enabled women to adapt to effects of more effectively compared to men. Another female in Mukuyuni responded: -

*“we are now working with people from Red Cross Society who are helping us to establish tree nurseries...they are also training us of best farming methods whereby they are helping us to purchase farm inputs...some other times they even give us money to purchase food (FGD1008)”.*

Our findings conformed with other studies about the role played by social organisations in climate adaptation. A number of studies have shown the role of social networks and group-based approaches as ways of adapting (Chiweshe, 2015; Ngigi *et al.*, 2017) and improving resilience of households against extreme events and climate change (Mueller *et al.*, 2013; Bernier and Meinzen-Dick, 2014; Ngigi *et al.*, 2015). The results of this study showed a disparity in participation where women reportedly relied more on social networks to adapt to droughts compared to men. However, although this was the case women participated in women alone groups that were local and non-formal unlike men who, although in smaller proportion (18.1%), engaged in formal networks that had external membership. The results of this study conformed with those of an intrahousehold study done by Ngigi *et al.*, (2017) which showed a disparity in group participation between husbands and their wives where husbands belonged to Community Based Organisations, farmer associations and group-based welfare associations, whereas their wives belonged to local women's groups and microfinance groups. Our results however contradicted with those obtained by Chiweshe (2015) and Kaaria *et al.*, (2016) that indicated that women were significantly excluded from social organizations compared to men.

### **Adaptive capacity: Analysis of factors that influence choice of adaptation strategies**

The following factors were considered important in determining household's ability to adapt to impacts of drought. The factors are also easily influenced by gender of household head. That is, level of education of household head, household income, access to weather and adaptation information, access extension services, ownership and control of adaptive resources, access to credit and financial services and nature of nature of other roles played by household head.

**Influence of income, education level and access to information on adaptive capacity:** Table 2 presents results of the influence of household income, education level and access to adaptation information on choice of adaptation strategy by gender. We obtained the results by comparing uptake of the adaptation strategies by men and women based on their access to each of the three variables. There was a significant relationship between gender and the frequency of access to weather information which consequently influenced adaptation through diversification of crop varieties, water harvesting and alternative feeding of livestock. Notably, men accessed weather information more frequently; either on weekly and monthly basis compared to women whose majority accessed weather information irregularly (table 2). Uptake of adaptation strategies was significantly related to the level of education of household head which was also dependent on gender. Notably, women had comparatively attained lower levels of education with majority (65.7%) having either primary level education or having no formal education at all. This was in comparison to men whose majority had acquired either primary or secondary education (36.7% and 34.8% respectively) in addition to 13.8% of men who had advanced to tertiary level. Influence of education level of choice of adaptation strategy was attributed to the fact that educated farmers were more likely to be more aware of climate trends and available agricultural innovations. They were also more likely to have interest on new technologies and methods of cushioning their livelihood activities (Ali & Erenstein, 2017).

Compared to men, women were earning and controlling less income. Monthly incomes for 68.4% of female respondents were below 30 USD compared to 8.1% of male respondents. Another proportion of men (49.5%) had average monthly incomes of between 30 and 60 shillings compared to 21.1% of women. In addition, 19.1%, 11.9% and 11.4% of men had income of 60–90, 90-120 and above 120 USD respectively compared to 5.7%, 2.4% and 2.5% of women in the same order. Since the level of income significantly differed by gender, it also had a gendered influence on choice of adaptation strategies. Due to larger incomes

male headed households were more capable of adapting through accumulation of assets, adoption of drought resistant crop varieties, uptake of formal credit, use of irrigation and business start-ups. Evidence from other studies has shown that there is a direct relationship between capacity to adapt to risks and level of household income. This is attributable to the fact that wealthy households are more likely to have the ability to invest in new technologies and the capacity to take associated risks of adopting new innovations (Abid *et al.*, 2016; Ali & Erenstein, 2017).

**Table 2. Relationship between gender, HH level of income, education level of HH and access to information on adaption.**

Variable		Access to information						
		Weekly	Monthly	Quarterly	Irregularly	χ <sup>2</sup>	p-value	
Diversification of crop varieties	M	38.3	53.3	1.7	6.7	12.921	0.012	
	F	10.3	69.2	2.6	18.0			
Water harvesting	M	34.4	42.7	10.4	12.4	19.239	0.001	
	F	15.2	37.5	13.4	33.9			
Alternative livestock feeds	M	72.0	28.0	0.0	0.0	23.694	< 0.001	
	F	30.2	39.5	14.0	16.3			
Variable		Level of education						
		Non formal	Primary	Secondary		Tertiary	χ <sup>2</sup>	p-value
Employment	M	13.3	35.6	31.1		20.0	17.494	0.001
	F	16.7	33.3	50.0		0.0		
Adoption of resistant crop varieties	M	15.3	31.0	34.5		19.0	8.635	0.035
	F	24.1	29.3	43.1		3.4		
Start-up of business	M	11.0	28.0	47.6		13.4	8.093	0.048
	F	24.6	31.1	39.3		4.9		
Uptake of formal credit	M	9.4	26.4	32.1		32.1	11.794	0.009
	F	6.0	26.7	46.7		20.0		
Variable		Monthly income (USD)						
		< 30	30-60	60-90	90-120	> 120	χ <sup>2</sup>	p-value
Accumulation of assets	M	6.7	51.3	13.7	17.1	6.0	108.720	0.001
	F	83.1	13.6	0.0	1.7	1.7		
Adoption of resistant crop varieties	M	4.8	51.2	17.9	14.3	12.0	75.249	< 0.001
	F	71.9	19.5	3.5	3.6	1.8		
Start-up of business	M	10.9	76.0	77.8	88.2	83.3	62.113	< 0.001
	F	89.1	24.0	22.2	11.8	16.7		
Uptake of formal credit	M	17.6	16.3	27.5	36.0	41.7	25.508	0.001
	F	7.0	4.5	16.7	0.0	50.0		
Use of irrigation	M	47.1	21.2	12.5	28.0	66.7	13.424	0.043
	F	23.8	15.9	33.3	20.0	50.0		

(a) Frequencies given as percentages of responses within independent variable (adaptive capacity) against adoption a particular adaptation strategy

On the other hand, conditions of poverty are associated with limited adaptive capacity and eventual increased vulnerability for people who live with low incomes (Ziervogel *et al.*, 2006). Living with low incomes and poor access to resources and services means that people are more susceptible to climatic shocks.

**Influence of ownership and control of resources on adaptive capacity:** In this subsection we concentrated on the relationship between gender, control of physical resources

and their influence on choice of adaptation strategies. We focused on four types whose ownership and control we deemed is very crucial for any household to be able to choose adaptation strategies, that is, land, livestock, crops, and credit. Table 3 therefore presents results of the influence of ownership and control of these resources on choice of adaptation strategy by gender. We obtained the results by comparing uptake of the adaptation strategies by men and women based on their control of each of these resources. There was a significant gender disparity in control of land which in turn contributed to difference in adaptive capacities between men and women. Decisions concerning land use were majorly done by men while women had to rely on their husbands or other family members for such decisions. Reportedly, women who had sole control of land use were either widowed or unmarried women who had bought their own land. Control of land by an extended family member, rather than a husband, was also common for young mothers who had been allocated land informally without legal transfer of ownership. This was attributed to cultural bias in the systems of family land allocation. In rare instances where there was joint control of land by husband and wife, such land was purchased through joint contribution of both the husband and the wife but still men had greater rights of control. Control of land was significantly related to adoption of various adaptation strategies (table 3). Since men enjoyed more rights of control of land their households were able to adopt more strategies to adapt to effects of drought.

A significantly higher proportion of men compared to women reported to have sole ownership of livestock and therefore able to make decisions independently concerning them. Similar to land most of the women who solely owned and controlled livestock were widowed or single. Joint ownership of livestock was also reported from more women than men. Ownership and control of livestock resources influenced adoption of livestock-based adaptation strategies significantly. Since men had more control of livestock resources, they had a higher likelihood of using them for adaptation purposes. Respondents who personally or jointly owned and controlled livestock were more likely to adapt to drought through accumulation of assets, livestock diversification, use of improved breeds of livestock, destocking and uptake of credit.

Unlike land and livestock, a significant proportion of women (30.0%) had sole ownership of crops while majority (54.8%) jointly owned crops with their husbands. This was in comparison to men of whom 40.5% owned crops solely while 53.3% had joint ownership with their wives. Although this was the case, the disparity in control of crops by gender was still significant and this influenced adoption of various crop-related adaptation strategies. Respondents who either solely or jointly owned or controlled crops were able to adapt more to impacts of drought through crop diversification and use of drought resistant crop varieties in order to adapt (table 3). Access to credit services from formal financial institutions was significantly related to gender of the household head. Significantly more men had accessed credit compared to women. Access to credit was crucial since loans facilitated farmers to acquire technologies for adaptation. Households that had access to loans were therefore well prepared to handle effects of drought compared to those that had no access. There was a significant relationship between access to credit services and adaptation through irrigation, use of drought resistant varieties of crops, business start-ups and diversification of livestock.

**Disparity in gender roles and division of labour:** To establish how men and women spent their time on different tasks, respondents were able to describe the activities that they undertook on a normal day between 6am and 8pm. From their narrations daily activities were grouped into four roles as; productive roles, domestic and reproductive roles, community/social roles and resting/leisure. This data was then analysed by use of t-test whose results we summarised in table 4.

On average men significantly spent more time (8.43481 hours) on productive roles compared women (5.4238 hours). Their productive activities were done away from their households to earn incomes in order to support their families. In contrast, productive activities for women were based on their farms or nearby their homes so that they could monitor their homesteads. Likewise, this enabled them to multitask among different roles. This corroborated with past studies that have shown on average women engage in productive activities for approximately for 6 hours a day (Carr & Hartl, 2010; Tanwir & Safdir, 2013) although time allocated for different productive tasks vary from region to region (Kaaria *et al.*, 2016).

**Table 3. Influence of ownership and control of resources on adaptive capacity.**

Variable		Ownership and control over land					
		Self	Spouse	Joint	Family	$\chi^2$	p-value
Accumulation of livestock	M	83.8	0.9	0.9	14.5	16.156	0.001
	F	6.7	41.7	8.3	43.3		
Tree planting	M	83.3	0.0	1.1	15.6	11.643	0.009
	F	18.3	46.7	10.0	25.0		
Uptake of Formal credit	M	27.1	0.0	0.0	18.4	16.722	0.001
	F	3.4	6.3	0.5	8.3		
Destocking	M	82.0	0.8	0.8	16.5	16.938	0.001
	F	13.8	37.9	6.9	41.4		
		Ownership and control of major livestock					
		Self	Spouse	Joint	Family	$\chi^2$	p-value
Accumulation of assets	M	59.0	0.9	39.3	0.9	33.638	< 0.001
	F	20.0	15.0	58.3	6.7		
Change of animal breeds	M	59.6	1.2	39.3	0.0	17.048	0.002
	F	18.9	24.1	33.4	3.4		
Diversification of livestock	M	78.3	1.7	20.0	0.0	17.311	0.002
	F	35.1	21.6	40.5	2.7		
Uptake of formal credit	M	71.7	1.9	26.4	0.0	12.266	0.015
	F	26.7	6.7	66.7	0.0		
De-stocking	M	69.2	3.0	27.8	0.0	30.996	< 0.001
	F	20.6	19.5	52.9	6.9		
		Ownership and control of major crops					
		Self	Spouse	Joint	Family	$\chi^2$	p-value
Diversification of livestock	M	36.8	2.6	60.7	0.0	15.423	0.004
	F	28.3	1.7	66.7	3.3		
Diversification of crops	M	41.7	1.7	56.7	0.0	8.918	0.048
	F	42.5	3.8	54.1	5.4		
Use of drought resistant crop varieties	M	33.3	3.6	63.1	0.0	14.297	0.006
	F	19.0	5.2	70.7	5.2		
Formal credit	M	28.3	5.7	66.0	0.0	11.496	0.022
	F	40.0	0.0	60.0	0.0		
		Access to credit facilities					
		Yes		No		$\chi^2$	p-value
Diversification of livestock	M	56.7		43.3		5.676	0.012
	F	59.5		40.5			
Use of drought resistant crop varieties	M	52.4		48.6		4.319	0.024
	F	56.9		43.1			
Start-up of business	M	59.8		40.2		14.698	< 0.001
	F	60.7		39.3			
Use of irrigation	M	54.9		45.1		11.627	< 0.001
	F	69.4		30.6			



**Table 4. Results of independent sample t-test on time spent on different roles.**

Role/activity	Gender	N	Mean time (hrs)	STD DEV	SEM	t-value	p-value
Productive	M	210	8.438	1.393	0.096	20.35	< 0.001
	F	210	5.424	1.633	0.113		
Reproductive/ Domestic	M	210	0.686	1.143	0.079	41.132	< 0.001
	F	210	5.486	1.246	0.086		
Community	M	210	0.724	1.053	0.073	1.169	0.243
	F	210	0.6	1.116	0.077		
Resting	M	210	4.186	1.161	0.08	14.818	< 0.001
	F	210	2.601	0.986	0.07		

On the contrary, women significantly spent more time (5.4857) on reproductive and domestic duties compared to the average time spent by men (0.6857 hours). Despite women spending most of their daily time on domestic duties, such tasks were assumed to be part of their responsibilities hence not rewarded. Women's domestic roles limited their mobility denying them capacity to adopt mobility-based adaptation strategies. Droughts also increased scarcity of resources deemed necessary to undertake domestic activities thereby prolonging the time needed for women to accomplish their tasks. Domestic duties therefore limited the capacity of women to engage in time demanding adaptive strategies especially employment. There was however no significant difference in time spent on community service roles by men and women ( $t = 1.169$ ,  $p = 0.243$ ), although this was done in different ways and for different purposes. Women spent their time in more organized community activities through Community Based Organisations, church groups, women groups, school meetings or chief's meetings. Although men spent their time in similar forums their participation was significantly minimal. Notably women were well prepared to cope with effects of drought through their social groups. In summary, work burden for women limits their adaptive capacity to risk as has been documented in other studies (Quisumbing & McClafferty, 2006; Djoudi & Brockhaus, 2011). It presents an obstacle to women's full participation in various farm and non-farm economic activities necessary to deal with the effects of droughts (Warner et al., 1997). Due to the burden of domestic tasks women were faced with time constraints that made them to miss out on economic opportunities, information and education opportunities, community-based adaptation initiatives and enrichment of personal experiences that migrations could afford (Katherine et al., 2010; Vincent et al., 2011; Berman et al., 2014; Jost et al., 2016).

## Conclusion

The results of this study have shown that there is still a huge disparity in adaptive capacity to droughts between men and women in small holder agriculturally based households. The results pointed out that adaptive capacity of women was weakened since they lacked full access and control of crucial resources that are necessary to build their capacities. This was due to women's low levels of education, lack of adequate information and extension services, low access and control of assets, low access to credits, and household work burden that took most of their time.

Due to observed gender disparities in access to weather and adaptation advisories and varied preferences of information channels, there was need for extensions agents to apply varied and innovative methods of information delivery, early warnings and advisory services in order to target both men and women based on their access. Such climate information should also be tailored to the need of different users. For instance, we recommend that agricultural extension agents increase their outreach through women groups and other social platforms in order to pass crucial climate related information to women. Since group-based strategies seemed to work very well for women in terms of information dissemination and sharing of resources we recommend recruitment of more men into local groups and organisations, and NGO activities. As it was realised during the study there was presence of a number of local vernacular radio stations in the area. Although these stations could reach most homes their

use in dissemination of weather-related information was minimal despite the fact that they can be very powerful for the purpose. We therefore recommend to extension agents to tap into radio and phone-based technologies to reach both men and women. Use of vernacular radio stations to disseminate climate information will also address other barriers to information, for instance low mobility and language barriers that may be posed due work burden and low literacy levels respectively, especially for women.

To build adaptive capacity of women it is inevitable to strategically improve their capacity to own and have control over crucial resources such as land since the study reported a huge gender disparity in their ownership. Although the Kenya national land use policy recognises the need to mainstream gender in land use planning and management (GoK, 2017) the policy does not specify the strategic actions needed to achieve this. Therefore, policy makers and development agents must build new and innovative approaches and incentives of gradually integrating women in land management processes with an eventual goal of their increased ownership and control of land resources.

In addition, there is a need of adequate gender mainstreaming in climate related policies and programmes by county and national government. Although both Kenya Climate Change Action Plan and Makueni County Climate change regulations recognise the importance of considering gender in climate change response, both documents do give clear strategic guidelines on how gender issues could be addressed. This needs to be done to specifically highlight what needs to be done for or by women and men to fully mainstream gender and to ensure equity. Both county and national governments should therefore formulate a framework for streamlining gender integration at different levels. This can be supported through continuous building of capacity of policy implementors on key gender issues that need to be considered when implementing climate change policies.

## References

- Abid, M., Schneider, A., & Scheffran, J. (2016). Adaptation to Climate Change and Its Impacts on Food Productivity and Crop Income: Perspectives of Farmers in Rural Pakistan. *Journal of Rural Studies*, 47, pp. 254–266.
- Acosta-Michlik, L., Kelkar, U., Sharma, U. (2008). 'A Critical Overview: Local Evidence on Vulnerabilities and Adaptations to Global Environmental Change in Developing Countries', *Global Environmental Change* 18, pp.539–542.
- Adger, N. and Kelly, P. (1999). 'Social Vulnerability to Climate Change and the Architecture of Entitlements'. *Mitigation Adaptation Strategies Global Change*, 4, pp. 253–256
- Adger, N. (2006). Vulnerability. *Global Environmental Change*, 16(2006), pp. 268-281.
- Aggarwal, B. (2003). Gender and Land Rights Revisited: Exploring New Prospects via the State, Family and Market, *Journal of Agrarian Change*. 3, pp. 184-224.
- Agrawal, A., McSweeney, C., and Perrin, N. (2008). Local institutions and climate change adaptation. *World Bank Social Development Notes*, 81(113), pp. 1–8
- Antwi-Agyei, P., Quinn, H., Adiku, K., Codjoe, A., Dougill, J., Lamboll, R., & Dovie, D. (2017). Perceived Stressors of Climate Vulnerability Across Scales in the Savannah Zone of Ghana: A Participatory Approach. *Regional Environmental Change*, 17(1), pp. 213–227. <https://doi.org/10.1007/s10113-016-0993-4>
- Allendorf, K. (2007). "Do Women's Land Rights Promote Empowerment and Child Health in Nepal?" *World Development*, 35 (11), pp 1975–1988.
- Ali, A., & Erenstein, O. (2017). Assessing Farmer Use of Climate Change Adaptation Practices and Impacts on Food Security and Poverty in Pakistan. *Climate Risk Management*, 16, pp. 183–194.
- Awiti, C., Allen Curtis, D., Mutie, C., Sanya, S., Umutesi, A., Wankuru, P., Pape, J., Mistiaen, J., Tolchinsky, M., Chengula, Ladisy., Safavian, S., Ramana, G., Khatimba, A., Muthembwa, K., Rosauer, V., Waiharo, R. (2018). Kenya economic update: policy options to advance the Big 4 - unleashing Kenya's private sector to drive inclusive growth and accelerate poverty reduction (English). Kenya economic update; no. 17. Washington, D.C. : World Bank Group.
- Babugura, A. (2010). Gender and Climate Change: South Africa Case Study. Cape Town:

- Heirich Boll Foundation.
- Behrman J., Bryan E., & Goh A. (2014). Gender, Climate Change, and Group-based Approaches to Adaptation. In C. Ringler, A. R. Quisumbing, E. Bryan, & R. Meinzen-Dick (Eds) *Enhancing women's assets to manage risk under climate change: Potential for group-based approaches. Climate change, collective action and women's assets* (pp. 3–8). Washington, DC: International Food Policy Research Institute.
- Bernier, Q., Meinzen-Dick, R. (2014). Resilience and Social Capital. 2020 Conference on Building Resilience for Food & Nutrition Security, 4(May).
- Brooks, N., Adger, W., & Kelly, P. (2005). The Determinants of Vulnerability and Adaptive Capacity at the National Level and the Implications of Adaptation. *Global environmental change*, 15(2), pp. 151–163.
- Bryan, E., Ringler, C., Okoba, B., Koo, J., Herrero, M., Silvestri, S. (2013). Can Agriculture Support Climate Change Adaptation, Greenhouse Gas Mitigation and Rural Livelihoods? Insights from Kenya. *Journal of climate change*, 118 (2013), pp. 151-165.
- Care International. (2010). Adaptation, Gender and Women's Empowerment: Care International Climate Change brief, [Online] available from [www.careclimatechange.org/files/adaptation/CARE\\_Gender\\_Brief\\_Oct2010.pdf](http://www.careclimatechange.org/files/adaptation/CARE_Gender_Brief_Oct2010.pdf), [Accessed 2<sup>nd</sup> September 2015].
- Carr, R. (2008). Between Structure and Agency: Livelihoods and Adaptation in Ghana's Central Region. *Global Environmental Change*, 18 (4), pp. 689–699.
- Carr, M. and Hartl, M. (2010). Lightening the Load: Labor-saving technologies and practices for rural women. *International Fund for Agriculture Development (IFAD)*.
- Carr, E. and Thompson, M. (2014). Gender and climate change adaptation in agrarian settings: current thinking, new directions and research frontiers. *Geography compass*, 8/3(2014), pp. 182-197.
- Chiweshe, K. (2015). Women and Emergence of Grassroots Institutions on Post-fast Track Farms in Zimbabwe. *Journal of gender, agriculture and food security* 1(1), pp. 40-53.
- Cramer, L., Förch, W., Mutie, I., & Thornton, P. (2016). Connecting Women, Connecting Men: How Communities and Organizations Interact to Strengthen Adaptive Capacity and Food Security in the Face of Climate Change. *Gender, Technology and Development*, 20 (2), pp 169–199.
- Cutter, S. (2008). Temporal and spatial changes in social vulnerability to natural hazards. *National Academy of Sciences*, 105, pp. 2301–2306
- Davies, S. (1993). Are coping strategies a cop out? *IDS Bull* 24, pp. 60–72.
- Defiesta, G. & Rapera, L. (2014). Measuring Adaptive Capacity of Farmers to Climate Change and Variability: Application of a Composite Index to an Agricultural Community in the Philippines. *Journal of Environmental Science and Management*, 17(2), pp.48–62.
- Djoudi, H., & Brockhaus, M. (2011). Is adaptation to climate change gender neutral? Lessons from communities dependent on livestock and forests in Northern Mali. *International Forestry Review*, 13(2), pp. 123-135.
- Djoudi H., Brockhaus M., and Locatelli, B. (2013). Envisioning the future and learning from the past: adapting to a changing environment in northern Mali. *Environmental Science Policy*, 25, pp. 94–106.
- Doss, C. R. (2018). Women and agricultural productivity: Reframing the Issues. *Development Policy Review*, 36(1), 35–50. <https://doi.org/10.1111/dpr.12243>
- Easterling, E., Aggarwal, P., Batima, P., Brander, K., Erda, L., Howden, S., Morton, J., Soussana, J., Schmidhuber, J., & Tubiello, F. (2007). Impacts of adaptation and vulnerability. Contribution of working group II to the fourth assessment report of Intergovernmental Panel on Climate change. Cambridge UK: Cambridge University Press.
- Engle, L. (2011) Adaptive capacity and its assessment. *Global Environmental Change*, 21, pp 647–656.
- Ensminger J. (1997). "Changing property rights: reconciling formal and informal rights to land in Africa," in *The Frontiers of the New Institutional Economics*, eds Drobak, N., & Nye, C. San Diego: Academic Press. pp 165–196.
- Farnworth, C., & Colverson, K. (2015). Building a gender-transformative extension and

- advisory facilitation system in Sub-Saharan Africa. *Journal of gender, agriculture and food security*, 1(1), pp. 20-39.
- Folke, C. (2002). Social–ecological resilience and behavioural responses. In: Beijer Discussion Paper Series No. 155. Stockholm: The Beijer Institute of Ecological Economics.
- Folke, C. (2006). Resilience: the emergence of a perspective for social–ecological system analysis. *Global Environmental Change*, 16, pp. 253–267.
- Food and Agricultural Organisation (FAO). (2011). The state of food and agriculture 2010–2011: women in agriculture closing the gender gap for development. Rome: FAO.
- Fussler, H., Klein, R. (2006). Climate change vulnerability assessments: an evolution of conceptual thinking. *Climatic Change* 75, pp 301–329.
- Gallopin, G. (2006). Linkages between vulnerability, resilience, and adaptive capacity. *Global Environmental Change Human Policy Dimensions*, 16 (3), 293–303.
- Garvelink, W. (2012). Land Tenure, Property Rights, and Rural Economic Development in Africa. Washington, DC: Center for Strategic and International Studies.
- Gonda, N. (2016). Climate change “technology” and gender: “Adopting women” to climate change with cooking stoves and water reservoirs. *Journal of gender, technology and development*, 20(2), 149–168.
- Government of Kenya (GoK). (2013). National climate change action plan 2013-2017. Nairobi: Government Printers.
- Herrero, M., Ringler, C., Van de Steeg, J., Thornton, P., Zhu, T., Bryan, E., Omolo, A., Koo, J., Notenbaert, A. (2010). Climate variability and climate change and their impacts on Kenya's agriculture sector. International Livestock Research Institute (ILRI), Nairobi
- Huho, J., and Mugalavai, E. (2010). The Effects of Droughts on Food Security in Kenya. *The International Journal of Climate Change: Impacts and Responses*, 2(2).
- Huyer, S. (2016). Closing the gender gap in agriculture. *Journal of gender, technology and development*, 20(2), 105–116.
- Huyer, S., Twyman, J., Koningstein, M., Ashby, J. and Vermeulen, S. (2015). Supporting women farmers in a changing climate: Five policy lessons. Agriculture and Food Security Programme. Copenhagen, Denmark: CGIAR Climate Change.
- International Panel on Climate Change (IPCC). (2001). Climate Change 2001: Mitigation. Geneva: Intergovernmental Panel on Climate Change (IPCC).
- International Panel on Climate Change (IPCC). (2008). Climate change and water. Intergovernmental Panel on Climate Change technical report IV, June 2008.
- IPCC. (2012). Glossary of terms. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 555–564
- International Panel on Climate Change (IPCC). (2014). Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press: Cambridge and New York.
- Jost, C., Kyazze, F., Naab, J., Neelormi, S., Kinyangi, J., Zougmore, R., Aggarwal, P., Bhatta, G., Chaudhury, M., Tapio-Bistrom, M., Nelson, S., & Kristjanson, P. (2016). Understanding gender dimensions of agriculture and climate change in smallholder farming communities. *Climate and Development*, 8(2), 1–12.
- Kaaria, S., Osorio, M., Wagner, S. & Gallina, A. (2016). Rural women's participation in producer organisations: An analysis of the barriers that women face and strategies to foster equitable and effective participation. *Journal of gender, agriculture and food security*, 1(2), 148–167.
- Kaijser, A. & Kronsell, A. (2013). Climate change through the lens of intersectionality. *Journal of environmental politics*, 23(3), 417–433.
- Kakota, T., Nyariki, D., Mkwambisi, D., & Kogi-Makau, W. (2011). Gender vulnerability to climate variability and household food insecurity. *Climate and Development*, 3(4), 298–309.



<https://doi.org/10.1080/17565529.2011.627419>

- Kamga, R., Tchouama, I., Chandjou, R., Bidogeza, J., & Afri-Safa, V. (2016). Gender inequality in smallholder onion (*Allium cepa* L) production in the far north region of Cameroon. *Journal of gender, agriculture and food security*, 1(3), 83–103.
- Katherine, V., Wanjiru, L., Aubry, A., Mershon, A., Nyandiga, C., Cull, T., and Banda, K. (2010). *Gender, Climate Change and Community-based Adaptation*. New York: UNDP.
- Kiumbuku, S., Baaru, M., and Mutinda, J. (2018). Do Smallholder Farmers Perceive Rainfall Variability the Same and Correctly? Gendered and Spatial Analysis of Perception Versus Actual Trends of Rainfall in Three Livelihood Zones in Kenya. *Journal of Environment and Earth Sciences*, 8 (9), pp 1–12
- Kristjanson, P., Mango, N., Krishna, A., Radeny, M., Johnson, N. (2009). Understanding poverty dynamics in Kenya. *Journal of international development*, 22(7), 978–996.
- Kumar, R. (2014). *Research methodology* (4<sup>th</sup> edition). Los Angeles: Sage.
- Lindoso, P., Rocha, D., Debortoli, N., Parente, I., Eir, F., Bursztyn, M., and Rodrigues-Filho, S. (2014). Integrated assessment of smallholder farming vulnerability to drought in the Brazilian Semi-arid: a case study in Cear a. *Climatic Change*, 127(1), 93–105.
- Lindsey, J., Ludi, E., and Levine, S. (2010). Towards a characterisation of adaptive capacity: a framework for analysing adaptive capacity at the local level: Background Note. London: Overseas Development Institute.
- Lonescu, C., Klein, T., Hinkel, J., Kavi, S., Klein, R. (2005). Towards a Formal Framework of Vulnerability to Climate Change, Newwater Working Paper 2 and FAVAIA Working Paper 1, Potsdam Institute for Climate Impact Research, Potsdam, Germany
- Mallari, A. (2015). Climate change vulnerability assessment in the agricultural sector: Typhoon Santi experience. *procedia-social and behavioral sciences*, 216(2016),pp. 440-451.
- Marshall, N., & Marshall, P. (2007). Conceptualizing and operationalizing social resilience within commercial fisheries in northern Australia. *Ecological Society*, 12 (1), <http://www.ecologyandsociety.org/vol12/iss1/art1/>.
- Mckune, S., Borresen, E., Young, A., Auria-Ryley, T., Russo, S., Camara, A., Coleman, M., & Ryan, E. (2015). Climate change through a gendered lens: Examining livestock food security. *Journal of global food security*, 6(2015), pp. 1–8.
- McLaughlin, P., Dietz, T. (2008). Structure, agency and environment: toward an integrated perspective on vulnerability. *Global Environmental Change*, 18 (1), pp 99–111.
- Meinzen-Dick, R., Behrman, J., Pandolfelli, L., Peterman, A., Quisumbing, A. (2014). Gender and social capital for agricultural development. In: *Gender in Agriculture*. New York: Springer, pp. 235–266.
- Mersha, A. & Van Haerhoven, F. (2016). A gender approach to understanding the differentiated impact of barriers to adaptation: Response to climate change in rural Ethiopia. *Journal of regional environmental change*, 16 (2016), 1701–1713.
- Meyiwa, T., Maseti, T., Ngubane, S., Letsekha, T., Rozani, C. (2014). Women in selected rural municipalities: resilience and agency against vulnerabilities to climate change. *Agenda: Empower. Women Gender Equity*, 28, pp. 102–114.
- Mikalitsa, S. (2015). Intrahousehold allocation, household headship and nutrition of under-fives. *Journal of food agriculture, nutrition and development*, 15(1), pp. 9708–9721.
- Miller, F., Osbahr, H., Boyd, E., Thomalla, F., Bharwani, S., Ziervogel, G., Walker, B., Birkmann, J., van der Leeuw, S., Rockstrom, J., Hinkel, J., Downing, T., Folke, C., Nelson, D. (2010). Resilience and vulnerability: complementary or conflicting concepts? *Ecological Society*. 15(3), pp. 11.
- Misra, A. (2014). Climate change and challenges of water and food security. *International journal for sustainable built environment*, 3, pp. 153–165.
- Mueller, M., Spangler, T., Alexander, S. (2013). *Community resilience: conceptual framework and measurement feed the future learning agenda*. Westat, Rockville, MD
- Mutai, C., Ochola, S., Mukiira, H., Gachimbi, N., Otieno, M., King'uyu, S., and Marigi, S. (2010). *Climate Change and Variability. State of the Environment in Kenya Report*. Nairobi: Ministry of Environment and Natural Resources.

- Nellemann, C., Verma, R., and Hislop, L. (eds.) (2011). Women at the frontline of climate change: Gender risks and hopes. A Rapid Response Assessment. Washington DC: World Resources Institute.
- Nelson, V., Meadows, K., Cannon, T., Morton, J., Martin, A. (2002). 'Uncertain predictions, invisible impacts, and the need to mainstream gender in climate change adaptations', *Gender and Development* 10(2), pp 51–59.
- Ngaira, J. (2004). Basic facts in contemporary climatology. Lake publishers and enterprises, Kisumu.
- Ngigi, M., Muller, U., Birner, R. (2015). The role of livestock portfolios and group-based approaches for building resilience in the face of accelerating climate change: an asset-based panel data analysis from rural Kenya. ZEF-Discussion Papers on Development Policy 205, pp. 29
- Ngigi, M., Mueller, U., & Birner, R. (2017). Gender differences in climate change adaptation strategies and participation in group-based approaches: An intra-household analysis from rural Kenya. *Journal of ecological economics*, 138 (2017), pp. 99–108.
- Niang, I., Ruppel, O., Abdrabo, A., Essel, A., Lennard, C., Padgham, J., and Urquhart, P. (2014). Africa. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Barros, V.R., C.B. Field, D.J. Dokken, M.D. Mastrandrea, K.J. Mach, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1199-1265.
- Nyahunda, L., Makhubele, C., Mabvurira, V., Matlakala, F. (2020). Vulnerabilities and Inequalities Experienced by Women in the Climate Change Discourse in South Africa's Rural Communities: Implications for Social Work. *The British Journal of Social Work*, bcaa118, <https://doi.org/10.1093/bjsw/bcaa118>
- 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, pp. 40–56.
- Nyoro, J., Wanzala, M., Awour, T. (2001). Increasing Kenya's agricultural competitiveness: farm level issues. Tegemeo Institute of Agricultural Policy and Development and Kenya Agricultural Research Institute, Nairobi, and Michigan State University, East Lansing
- Odeny, M. (2013). Improving access to land and strengthening women's land rights in Africa. Paper Prepared for Presentation at the Annual World Bank Conference on Land and Poverty, (Washington, DC: The World Bank)
- Odhiambo, W., Nyangito, H., Nzuma, J. (2004). Sources and determinants of agricultural growth and productivity in Kenya. Discussion Paper No. 34. Kenya Institute for Public Policy Research and Analysis, Nairobi
- O'Hare, G. and Sweeney, J. (1986). The atmospheric system. Conceptual framework in Geography. Oliver and Byod, Harlow.
- Ojwang, G., Agatsiva, J., and Situma, C. (2010). Analysis of climate change and variability risks in the smallholder sector: Case studies of the Laikipia and Narok districts representing major agro-ecological zones in kenya. DRSRS: Rome.
- Okereke, C. and Schroeder, H. (2009). How can justice, development and climate change mitigation be reconciled for developing countries in a post-Kyoto settlement? *Climate and Development*, 1 (1), pp. 10–15.
- O'Sullivan, M., Rao, A., Banerjee, R., Gulati, K. and Vinez, M. (2014). Levelling the field: improving opportunities for women farmers in Africa. Washington DC: World Bank Group.
- Perez, C., Jones, E. M., Kristjanson, P., Cramer, L., Thornton, P. K., Förch, W., & Barahona, C. (2015). How resilient are farming households and communities to a changing climate in Africa? A gender-based perspective. *Global Environmental Change*, 34, pp. 95–107. <https://doi.org/10.1016/j.gloenvcha.2015.06.003>
- Phiri, M., Ibrahim, Saka, A. (2005). The impact of changing environmental conditions on vulnerable communities of the Shire valley, southern Malawi. Lilongwe, Malawi
- Quisumbing, A., and McClafferty, B. (2006). Using gender research in development. In food

- security in practice No. 2. Washington, DC: IFPRI.
- Ragasa, C. (2012). Improving gender-responsiveness on agricultural extension. In A. R. Quisumbing, R. Meinzen-Dick, T. L. Raney, A. Croppenstedt, J. A. Behrman & A. Peterman (Eds), *Gender in agriculture and food security: Closing the knowledge gap*. Amsterdam: Springer.
- Ranganathan, C., Palanisami, K., Kakumanu, K., & Baulraj, A. (2010). Mainstreaming the adaptations and reducing the vulnerability of the poor due to climate change. *ADB working paper*. Tokyo: Asian Development Bank Institute.
- Ribot, J. (1996). Climate Variability, Climate Change and Vulnerability: Moving Forward by Looking Back. In: Ribot, J.C., Magalhães, A.R. and Panagides, S.S. (eds.) *Climate Variability, Climate Change and Social Vulnerability in the Semi-arid Tropics*. Cambridge: Cambridge University Press.
- Smit, B. and O. Pilifosova. (2003). From adaptation to adaptive capacity and vulnerability reduction. In J. Smith, R. Klein and S. Huq (eds). *Climate change, adaptive capacity and development*. Imperial College Press: London.
- Sultana, F. (2013). Gendering climate change: geographical insights. *The Professional Geographer*, (November), pp. 1–10.
- Swanson, A., J. Hiley., H. Venema and R. Grosshans. (2007). Indicators of Adaptive Capacity to Climate Change for Agriculture in the Prairie Region of Canada: An analysis based on Statistics Canada's Census of Agriculture. Working Paper for the Prairie Climate Resilience Project, Winnipeg: International Institute for Sustainable Development.
- Tall, A., Hansen, J., Jay, A., Campbell, B., Kinyangi, J., Aggarwal, P., and Zougmore, R. (2014). Scaling up climate services for farmers: Mission Possible. Learning from good practice in Africa and South Asia. CCAFS Report No. 13. Copenhagen: CGIAR Research Programme on Climate Change, Agriculture and Food Security (CAAFS).
- Tanwir, M. and Safdir, T. (2013). The Rural Woman's Constraints to Participation in Producer organizations. *Journal of International Women's Studies*, 14(3), pp. 210–229.
- Tashakkori, A., and Creswell, J. (2007). Exploring the nature of research questions in mixed methods research. *Journal of mixed methods research*, 1(3), pp. 207–211.
- Udmale, P., Ichikawa, Y., & Manandhar, S. (2014). International Journal of Disaster Risk Reduction Farmers' perception of drought impacts, local adaptation and administrative mitigation measures in Maharashtra. *International Journal of Disaster Risk Reduction*, 10, pp. 250–269.
- United Nations Environmental Programme (UNEP). (2009). Kenya: Atlas of Our Changing Environment. Division of Early Warning and Assessment (DEWA). Nairobi: United Nations Environment Programme (UNEP).
- Vincent, K., Cull, T., Aggarwal, K., Lau, C., Kristjanson, P., Phartiyal, P., and Parvin, G. (2011). Gender, climate change, agriculture, and food security: A Training of Trainers Manual to prepare south rural Women to adapt to climate change. Cali, Colombia: CGIAR Research Program on Climate Change, Agriculture and Food Security (CAAFS). November 2011.
- Wanyeki, M. (2003). *Women and Land in Africa: Culture, Religion and Realizing Women's Rights*. New York: Zed Books Ltd.
- Warner, M., Al-Hassan, M., and Kydd, J. (1997). Beyond gender roles? Conceptualising the social and economic lives of rural people in sub-saharan Africa. *Development and change*, 28(1997), pp. 143-168.
- World Bank. & IFPRI. (2010). Gender and governance in rural services: Insights from India, Ghana and Ethiopia. Washington, DC: Author.
- World Health Organization (WHO). (2011). Gender, climate change and health. Geneva: WHO.
- Ziervogel, G., Taylor, A., Thomalla, F., Takeshi, T., and Quinn, C. (2006). Adapting to climate, water and health stresses: Insights from Sekhukhune, South Africa. Stockholm Environmental Institute: Stockholm.