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Gender dimensions of climate change adaptation practices: the experiences of smallholder crop farmers in the transition zone of Ghana

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ABSTRACT

This paper discusses the gender dimensions of climate change adaptation strategies among small holder crop farmers in the transition zone of Ghana. A total of 612 farmers (328 females and 284 males) were interviewed using purposive sampling technique. Our results indicate that adaptation strategies are gendered with men mostly resorting to on-farm agronomic practices such as the use of artificial fertilizers and also moving into new cash crops. Female farmers also use similar on-farm agronomic practices particularly artificial fertilizers to boost crop production but most importantly resorted to petty trading in agricultural and consumable goods, an off-farm strategy. This shows women's resilience which has also subsequently improved their decision-making role at the household level, which is an indicator of empowerment. We recommend that institutions that support climate change adaptation initiatives at the local level must take gender differences into consideration and support particularly women to strengthen their resilience and consolidate their empowerment.

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Gender; climate change; adaptation; Ghana; women; men

Introduction

Agriculture continues to play a major role in the socioeconomic and livelihood development in most rural communities in Ghana (Institute of Social Statistical & Economic Research, [ISSER], 2014) but the sector is increasingly being subjected to climatic changes. With Ghana's agricultural sector largely dependent on rainfall, the effect of climate change is seriously impacting on the livelihoods of smallholder farmers. As a result, both male and female small-holder farmers are adapting to the vagaries of climate change (Arku, 2013; Codjoe & Owusu, 2011). The Transition Zone of Ghana occupies an ecotone between the tropical forest to the southwest and the semi-arid areas of the north. The zone remains the nation's breadbasket, making it crucial to the food security of Ghana. Yet the rainfall has changed as a result of global climate change (Owusu & Waylen, 2012, 2013), and subsequently affected food production. It has also been revealed that the short dry spell (July/August) and the minor rainy season (September/October) have undergone significant changes with negative implications for rain-fed crop production. Whereas the rainfall regime during the major rainy season (March-June) is fairly reliable for rain-fed crop production, the minor rainy season has been associated with high risks of

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crop failure even though it has the most potential to reduce post-harvest losses (through sun drying of grains) and provide households with food stock during the long lean season from December to May (Owusu & Waylen, 2013).

The effects of these negative implications on small-holder farmers are gendered with some studies highlighting the vulnerability of women vis-a-vis men due to the challenges associated with climate change (Codjoe, Atidoh, & Burkett, 2011; Yaro et al., 2010). As a result, men and women have different ways and respond differently to challenges associated with climatic hazards due to social processes such as inheritance rules, land tenure systems and lack of support from formal institutions (World Bank, 2009; Yaro et al., 2010). Some studies in Ghana have highlighted the gendered dimension of climate change focusing mainly on perception and adaptation strategies (Abubakari, Lawson, Mensah, Gordon, & Padgham, 2016; Arku, 2013; Codjoe et al., 2011). But as argued by Arku (2013, p. 420) although research on local people's adaptation to climate change is increasing, more research is needed to enable the sharing of different coping strategies adopted by farmers at different places. This study put in perspective the way small-holder farmers perceive climate variability and change, the way their activities are vulnerable to climate change, and what they are doing to decrease their vulnerability. Our paper contributes to the existing literature on climate change by highlighting small-holder men and women farmers' knowledge and experiences on changes in climatic conditions as well as the different adaptation strategies, in the the Ejura-Sekyedumase Municipality in the Ashanti region and the Wenchi Municipality in the Brong-Ahafo region. Specifically, the paper seeks to:

- (1) Examine the gendered perceptions of climate change and its effect at the household level;
- (2) Assess the different adaptation strategies of men and women and its implications on food security at the household level;
- (3) Discuss how adaptation strategies influence the decision-making role of particularly females at the household level.

The paper is divided into five sections. After this introduction, the next section discusses the conceptual issues in relation to gender and climate change. This is followed by the study area and methodology. Subsequently, the findings have been discussed and then the conclusion and policy implications.

Gender and climate change vulnerability

The success of a society or individual's effort to adapt to climate variability has been linked mainly to its perception and awareness of the risks and hazards associated with its vulnerability (Adger, 2000). Vulnerability in the context of climate change refers to 'the degree, to which a system is susceptible to, or unable to cope with adverse impacts' of climate change, including climate variability and extremes (Intergovernmental Panel on Climate Change, [IPCC], 2007, p. 781). Vulnerability to climatic risks has been associated with inadequate financial and institutional support (Beg et al., 2002), as well as the availability of natural resources which many societies still rely on for rural livelihoods (Denton, Sokona, & Thomas, 2000). In Ghana, the forest-savanna transition zone has the next highest social vulnerability to climate change following the savanna zones (Yaro et al., 2010). It has been observed that farmers are vulnerable to shocks resulting from extreme events such as flooding, seasonal variation particularly the timing and amount of rainfall and long-term trends such as increased mean temperature (Acquah & Onumah, 2011). Crop farmers thus express heightened concerns about erratic rainfall patterns as these increase uncertainties about planting regimes and may induce diseases and pests leading to mass crop failures (Yaro et al., 2010). In fact, Kemausuor, Dwamena, Bart-Plange, and Kyei-Baffour (2011) note that farmers' vulnerability to climate risks in Ghana arise from abrupt changes in season, droughts, reduced rainfall, increased temperature and floods, for both crops and livestock. Kalame et al. (2011) have summed up the climatic risk to agriculture in the transition zone

as droughts, erratic and late rains, temperature rise, windstorms, and bushfires. Erratic and late rains result in poor crop growth and poor tree seedling regeneration in some cases. Studies that examined farmers' perception of climate change suggest that most farmers perceive changes in various aspects or elements of the weather over time (see for instance Codjoe et al., 2011). Similar findings reported by earlier studies include reduced flow in streams and rivers, prolonged rainfall shortages and drought that led to crop failures, negatively impacting livelihoods, and shortage in water resources (see for instance Gyampoh, Idinoba, & Amisah, 2008).

Within the African and specifically the Ghanaian context, women and men's differential access to resources is one of the key dimensions of gender inequality. Although women depend on natural resources for their livelihood, they have very limited control over resources such as forest products and land (African Development Fund – Human Resource Development Department, [ADF-OSHD], 2008). As a result, there are gender dimensions to climate change vulnerability in the sense that there are differences in the adaptive capacity to the effects of climate change and these differences determine how well men and women respond to climate change. These differences are due to social norms, traditional roles and different power structures and therefore more women than men are likely to lose their livelihoods to climate change and extreme weather events due to their lack of resources (Jost et al., 2016; Wright & Chandani, 2014).

Whilst smallholder farmers draw on ecosystem services in many instances to support their livelihoods, women tend to have limited access to resources creating a situation of vulnerability to climate change (Jost et al., 2016). There are therefore gender differences and preferences in agronomic practices with respect to climate change (Arku, 2013; Codjoe et al., 2011). The conclusion often drawn is that women deserve to be targeted with climate change adaptation strategies and institutional support (see for instance World Bank, 2009).

Again, because women are sometimes not part of the household and community decision-making processes that affect their lives, they are often excluded and underrepresented in decision-making and policy processes regarding climate change (World Bank, 2009). Indeed, cultural biases prevent women from participating actively in group training and extension meetings in certain communities and most often capital intensive technology does not necessarily benefit women (CARE International, 2013). Moreover, rural women farmers are reluctant to accept technological advances whose risks particularly in terms of household food security are not known (Opare & Wrigley-Asante, 2008).

However, it is also argued that women are active agents who have developed locally adapted, appropriate and sustainable coping strategies and responses to climatic shocks. Indeed, their knowledge can influence adaptive mechanisms in most vulnerable areas (Egyir, Owusu, Jatoo, & Wrigley-Asante, 2014; Nhemachena & Hassan, 2007). This implies that women could pursue adaptive mechanisms to limit vulnerability and strengthen livelihoods (World Bank, 2009). In view of this, the study will explore the adaptation measures smallholder farmers in the transition zone of Ghana are using to address their vulnerability and strengthen their livelihoods. The implications of this at the household level in terms of decision-making will also be discussed.

The study area and methodology

This paper is part of a broader study conducted in two administrative municipalities that fall within the Forest-Savannah Transition Zone of mid-Ghana (see Figure 1). These are the Ejura-Sekyedumase Municipality in the Ashanti region and the Wenchi Municipality in the Brong-Ahafo region. These two municipalities were selected based on preliminary interactions with the key stakeholders which revealed that the two are major food crop producers in their respective regions. These districts were therefore purposively selected by the United States Agency for International Development (USAID) funded project¹ to implement the climate action for agricultural development programme. Three communities were selected from each municipality, using purposive sampling technique and this was also based on discussions with District Agricultural Extension officials. In the Ejura-Sekyedumase Municipality, Anyinaso, Babasso and Sekyedumase were selected to cover the geographical areas of the

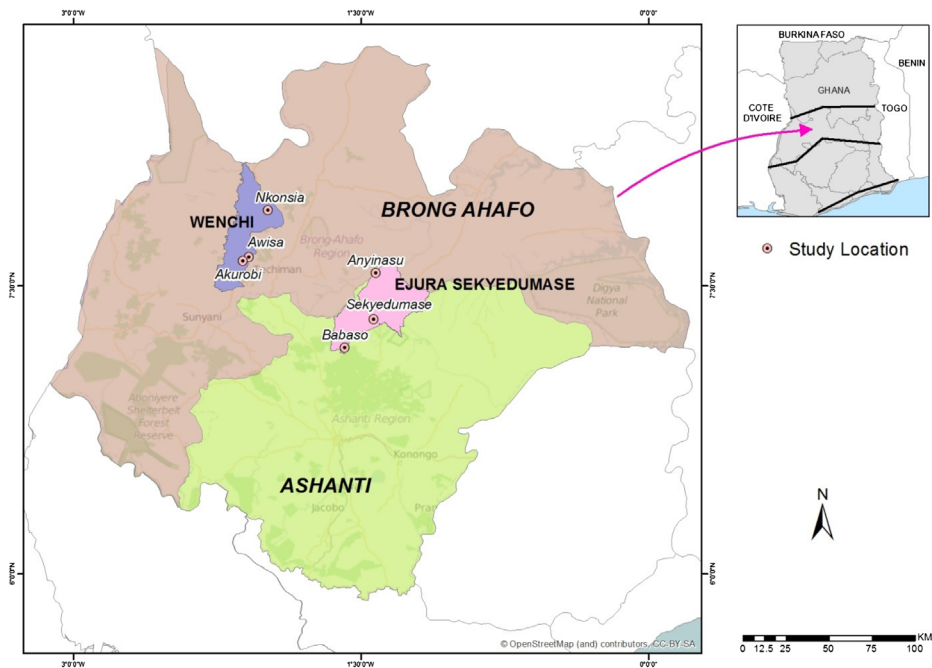


Figure 1. Map showing the study sites. Source: Geographic Information Systems Lab, University of Ghana.

municipality; Anyinasu in the north, Babasso in the south and Sekyedumase in the middle portion of the municipality. Again, Sekyedumase is considered the highest maize producing area whilst Babasso is the least in the municipality. Awisa, Nkonsia and Akrobi, were selected from the Wenchi Municipality, due to the fact that Nkonsia is closer to the Techiman market (one of the largest markets in Ghana); Awisa is closer to Wenchi (the municipal capital) and Akrobi (which is closer to Awisa) was chosen due to the presence of irrigation facility in the community. Awisa and Akrobi are geographically located in the south of the municipality whilst Nkonsia is located in the north.

Information at households and institutional levels was gathered using desk review of literature, individual surveys and focus group discussions (FGDs). Semi-structured questionnaires were used to guide the interviewing of individual farmers and representatives of institutions. An interview guide was developed for the FGDs. A total of 12 field assistants and four technical team members were on the field. The field assistants participated in community resource mapping by observation and individual farmer survey while the technical team members participated in community resource mapping, FGDs and key informant interviews.

Among the six communities, Sekyedumase has the highest population and Babasso and Anyinasu have the lowest. The project agreed to have a total sample size of about 600. Thus because each community had more than a 1000 households, the sample size for each community was targeted at 80 or more. Proportionate sampling size was therefore considered in the sense that about 80 or more respondents were targeted in each community. Each community was divided into four based on the north-south-east-west frame to derive a quadrant (Abrahamson & Weaver, 2008). Every 10th house in the quadrant was therefore visited so as to cover the quadrant. In other words, the project agreed that each section and household in the community should have an equal chance of being sampled.

Individual farmers were selected from the households and only adults (above 40 years) who own farms and were major decision-makers of that farm were marked for selection. The 40 years and above criteria was used because the key objective was for farmers to be able to compare the weather changes they have experienced in the last five years with previous two decades. Thus upon entering a house,

the following questions were posed: ‘do you own a farm?’ ‘If yes, how old are you?’ Responses to these two questions aided the selection of respondents. The study targeted individual farmers rather than households. Thus in each household, a farmer, who could be the head, spouse or ward (but should be 40 years and above) was targeted. But there were few instances where both husband and wife were sampled. This was so because in certain cases women also had their own farms and were major decision-makers of these farms and therefore qualified as respondents. Such women were considered in the sample since gender sensitivity was a central theme of the study and therefore was to ensure participation by women farmers.

Altogether, a total of 612 farmers were sampled comprising 328 female and 284 male farmers for the survey (see Table 1). The bias toward women was not planned even though the project avoided the situation where females would be excluded by targeting individual farmers rather than household heads, who were likely to be men and major decision-makers (Opare & Wrigley-Asante, 2008). Another possible reason for more females than males in the sample was as a result of male-outmigration in the communities as a coping strategy to climatic changes. In such instances, females have been left-behind to take care of agricultural work (Hughes, 2012; Wrigley-Asante & Agandin, 2015).

A total of 10 FGDs were carried out with an average of 14 persons in each FGD. Two were mixed groups and the other eight involved four male only and four female only groups. First, the separate sex groups were conducted and then the mixed groups were done in two communities (Babasso and Akrobi) to validate some of the responses derived from the single sex separate groups. For the focus group, any adult farmer (full-time or part-time) willing to participate in the discussion was welcomed. The community representative (Assembly person) assisted in organizing the members of the focus group. In addition, some institutions were also interviewed to solicit more views on institutional support for small-holder farmers.

Key questions used in this paper included farmers’ perceptions of climatic changes, options small-holder crop producers use to adapt to climate change impacts and the gender dynamics at the household level in terms of gender roles and relations. These major themes guided the analyses of the paper. Data was analyzed using SPSS version 20 to generate individual variables and cross tabulations required. This was supported with qualitative quotes derived through the FGDs.

The general characteristics of respondents showed quite a significant variation in personal as well as farming background. The dominant groups were: female farmers (54%), those aged less than 61 years (80%), those without formal education (56%), the married (70%), Christians (81%), natives (67%), full-time farmers (93%), farmers with experience of one decade or more (88%), commercially-oriented farmers, selling more than one-half of harvested produce (69%), farmers cultivating less than 4 hectares (80%), land owners of plots (54%) and solely dependent on farm income (55%).

Table 1. Communities visited and sample size.

Region	District	Community	Sample size for survey
Ashanti	Ejura	Anyinasu	M = 30 F = 51
		Babasso	M = 40 F = 41
		Sekyedumase	M = 47 F = 83
Brong-Ahafo	Wenchi	Akrobi	M = 61 F = 45
		Awisa	M = 46 F = 57
		Nkonsia	M = 60 F = 51
Total			612

Note: M = Male; F = Female.

Results and discussion

Extreme weather effects at household level

As noted, farmers' perception of changes in various aspects or elements of the weather over time have been used as evidence of climatic changes (see for instance Arku, 2013; Djagbletey et al., 2012). In this study, both male and female farmers reported that there have been significant changes in weather patterns in the last 5 years. Late onset of the rainy season, early cessation of the rainy season and decrease rainfall amounts during the rainy season, appeared to be the three key observations among both male and female farmers as shown in Table 2.

In the Ashanti region, both males and females considered reduced rainfall amounts during the rainy season, late onset of the rainy season and uncertain onset of the rainy season as the three key observed changes. Similarly, in the Brong-Ahafo region, whilst men considered late onset of the rainy season, persistent drought and early cessation of the rainy season, females considered late onset of the rainy season, early cessation of the rainy season and erratic rain during the rainy season as the three key observed changes. It thus appeared that both male and female farmers had similar notions of what constitute climate change and that both were affected more by drought-related conditions than floods. These findings resonates with Arku's (2013) study which also revealed similar understanding of climate change among men and women farmers in the Eastern region of Ghana.

The emphasis on drier conditions as observed changes is not surprising as about 50% and 32.5% of female farmers in Ashanti and Brong-Ahafo regions, respectively, reported that droughts affected them to large extent. Similarly, 33.2% and 30.3% male farmers in Ashanti and Brong-Ahafo regions, respectively, also reported that droughts affected them to large extent. These conditions are, however, more pronounced in the Brong-Ahafo region than the Ashanti region where crop farmers expressed heightened concerns about erratic rainfall patterns as this increases uncertainty about planting regimes and as Acquah and Onumah (2011) have noted, it may also induce diseases and pests leading to mass crop failures. Such uncertainties about planting regimes were expressed during FGDs as follows:

In the past, one could depend on rain to plant. The rainfall pattern was good but in the past few years, the pattern has changed drastically. You are never sure of when to plant, sometimes we have to wait till May before planting and when you plant during this time, you are not likely to get very good returns because the rains can stop and all your crops can die (Male farmer in Nkonsia in the Brong-Ahafo region).

The rainfall pattern has changed. In the past we could plant 2 times in the year, nowadays it's only once because the rains are unpredictable. Sometimes it just rains for a short time and it stops. The weather then becomes hot and hotter, so once you plant you can lose all your crops. The crops can also easily burn as a result of bush fires. (Female farmer in Akrobi in the Brong-Ahafo region)

These statements imply that changes in rainfall pattern observed as reduced amounts of rainfall during the rainy season, long dry spells and persistent drought subsequently affects agriculture particularly crop production. In all the six study communities, farmers reported of substantial decreases

Table 2. Observed weather changes.

Observed Changes	Ashanti		Brong-Ahafo		Total	
	Male	Female	Male	Female	Male	Female
Late onset of the rainy season	56.6	64.2	89.2	88.0	72.9	76.1
Early cessation of the rainy season	18.9	21.9	45.7	52.8	41.6	37.4
Uncertain onset of the rainy season	43.0	39.8	32.9	33.0	38.0	36.4
Erratic rainfall during the rainy season	29.7	23.2	66.7	65.3	48.2	44.4
Long dry spells during the rainy season	16.5	19.6	42.4	47.4	29.5	33.5
Less rain during the rainy season	58.0	53.3	48.2	47.6	53.1	50.5
More rain during the rainy season	2.2	0.7	–	1.3	1.1	1.0
Persistent drought	39.2	38.3	50.7	49.7	45.0	44.0
Rising day temperature	6.8	10.6	11.5	13.4	9.2	12.0
Rising nighttime temperatures	2.5	2.8	3.6	8.2	3.1	5.5

Note: Male (248) Female (328).

Source: Fieldwork, 2013.

Table 3. Food production in the last 5 years.

Production in last 5 years	Ashanti		Brong-Ahafo	
	Male	Female	Male	Female
Decreased a lot	48.7	56.6	25.7	35.9
Decreased a little	23.1	20.0	51.5	45.8
Remain the same	5.1	3.4	2.4	5.2
Increase a little	8.5	8.0	11.4	9.2
Increase a lot	14.5	12.00	9.0	3.9
Total	100.0	100.0	100.0	100.0

Source: Fieldwork, 2013.

in crop production with more females in both regions reporting that crop production has decreased a lot in the last 5 years as shown in Table 3.

Only few farmers reported that crop production has increased a lot with more males experiencing increases than females. Again, the increases appear to be higher in the Ashanti region than the Brong-Ahafo region. The gender differences in increases in crop production was due to the fact that men had more access to agricultural resources such as improved seedlings, fertilizers that they may have used on their own as adaptation options to address the adverse impacts of the changed climatic conditions. This has been discussed in details in the next section.

Decreases in crop production in the last 5 years have affected food security at the household level. In the Ashanti region, 24% males as against 37.3% females reported that there were months that they experienced food shortages and these were April, May, June and July. Similarly, in the Brong-Ahafo region, April, May, June, July, and August were the months in which both male and female farmers experienced food shortages. Decreases in rainfall also had significant effects on trading activities in the sense that whilst crop production decreased, less agricultural goods were being sold. In all the communities there were gender differences with more females (65.2%) than males (59.4%), reporting of experiencing decreases in trading in agricultural goods. This is not surprising since in Ghana trading in agricultural goods is the domain of women. Indeed, it is noted that 95% of actors in agro-processing and 85% in food distribution in Ghana are women (Opere & Wrigley-Asante, 2008). Decreased rainfall also has significant effect on livestock production. In both regions, more males (26.5%) than females (18.3%) reported to have experienced decreased livestock production in the last 5 years. Again, this result is not surprising as typically, it is the male who own livestock as compared to females.

Also the FGDs further revealed that decreases in rainfall have consequences on other socio-economic and psycho-social aspects of the lives of the respondents such as their inability to cater for their children's education and even attend other social functions as noted:

...yes because the rains are no longer reliable, it creates a lot of challenges for us, both men and women but especially the men, because we can't pay school fees, no money for the home and even attending funeral is a challenge because you can't donate. It creates a lot of thinking for us. (Male farmer in Akrobi in the Brong-Ahafo region)

Similar sentiments were raised in all the communities visited even though some women also insisted that the women, particularly the single mothers and widowed ones, also suffered the most. Nevertheless, the males in particular appeared to be more affected psychologically possibly due to the traditional role of providing for the home. Thus in all the communities there were reports of males going through marriage instabilities and mental stress for their inability to support their families and most importantly their inability to repay their bank loans. For instance, in Sekyedumase in the Ashanti region, it was reported that three men died as a result of their inability to repay loans they took from the bank due to drought and bush fires. These challenges have pushed both males and females to adopt strategies to manage the situation as discussed in the next section.

Table 4. On-farm agronomic practices.

Adaptation strategies	Ashanti		Brong-Ahafo		Total	
	Male	Female	Male	Female	Male	Female
Soil improver (inorganic fertilizer)	87.1	79.0	79.3	59.2	83.2	69.1
Early planting	60.7	55.9	56.1	56.9	58.4	56.4
Early harvesting	46.1	49.4	56.9	54.8	51.5	52.1
Same crop two or more times	71.1	58.7	33.4	42.5	52.2	50.6
Planting on raised ridges	34.8	47.1	62.3	49.9	48.5	48.5
Soil water conservation/mulching	10.4	10.8	77.3	78.1	43.8	44.4
Mixed cropping	25.1	47.3	40.8	56.7	32.9	52.0
Drought resistant varieties	49.3	48.7	38.4	20.8	43.8	34.7
Late planting	47.0	45.8	39.3	31.7	43.1	38.7
Late harvesting	42.2	32.6	39.1	46.8	40.6	39.7
Early maturing varieties	27.1	32.3	42.3	72.7	34.7	52.5
Late maturing varieties	30.0	78.8	48.6	53.2	39.3	66.0
Planting in valleys/wetlands	13.8	6.9	10.9	9.5	12.3	8.2
Irrigation	9.2	7.8	11.5	9.2	10.3	8.5
Soil improver (compost/manure)	2.5	0.8	8.5	7.8	5.5	8.6
Rain water harvesting	2.7	–	1.1	–	1.9	–

Source: Fieldwork, 2014.

Gender and climate change adaptation practices

In this study both male and female farmers reported using similar adaptation strategies which comprised of both off-farm non-agronomic and on-farm agronomic practices (as shown in Table 4). This is not surprising as the majority of both male and female respondents reported that they have received some form of information from both governmental and non-governmental organizations (through their farmer based organizations), to help cope with the climatic shocks such as drought, floods and other disasters. Nevertheless, there were gender differences in the adaptation strategies due to gender inequalities in access to and control over resources, different agricultural activities especially the types of crops grown and differences in off-farm agricultural activities.

The use of chemical fertilizers was a key agronomic adaptation strategy that both male and female farmers used. This practice is to improve yields and it appeared to be very common as many of the traditional crops have given way to maize production, which requires artificial fertilization to improve yield. Thus even though the farmers during FGDs mentioned that improper handling of agrochemicals could lead to detrimental effects to both the environment and human health, it was the best option under the circumstances that they found themselves as it provided a more immediate return on their investments. However, more males (83.3%) than females (69.1%) used chemical fertilizer as an adaptation strategy in both the Ashanti and Brong-Ahafo regions. This was due to the fact that men had the ability to afford to purchase these chemicals as compared to women. It was revealed during the FGDs that men tended to have access to agricultural inputs as compared to women since most often men had a higher control over household financial resources, and also could access possibly access to bank loans to purchase these resources. This confirms other studies that show that many women small-holder farmers have limited access to credit (see for instance Duncan & Brants, 2004; Opere & Wrigley-Asante, 2008). This finding about cost and a higher level of non-adoption among women is also consistent with Ishaya and Abaje (2008) studies in Kaduna State in Nigeria that revealed that lack of access to resources impede adaptation among women farmers.

Again, slightly more male (58.4%) than female (56.4%) farmers mentioned doing early planting (a management technique well-known by both male and female farmers) as a favored adaptation strategy. However, a few more female (56.9%) than male (56.1%) farmers in the Brong-Ahafo region reported using early planting as a favored adaptation strategy. This perhaps has been associated with consistent reports of increases in rainfall variability and early cessation of rainfall in the Transition Zone, particularly in the Brong-Ahafo region (Owusu & Waylen, 2013).

When we consider early harvesting, slightly more female (52.1%) as compared to male (51.5%) farmers mentioned early harvesting as a favored adaptation strategy. Indeed, more females in the Ashanti region as compared to their male counterparts used this as a preferred adaptation strategy. It was explained during FGDs that this management practice was a well-known one which farmers use to avoid attack by pests as well as bush fires that occurred during the dry season (following the minor cropping season). Most importantly, early harvesting was done so that cash-strapped farmers could gain income from early sales. This possibly explains why more females favored this strategy as they claimed they needed the financial resources to support or supplement their household budgets.

Similarly, planting same crop two or more times was a preferred adaptation practice, with more females in Brong-Ahafo region (42.5%) doing that as compared to their male counterparts (33.4%). This is a practice where farmers planted the same crop at different intervals within and across cropping seasons to hedge against crop failure and at the same time protect them against dry spells at critical stages of the crop development. It is therefore not surprising that female farmers in the Brong-Ahafo region preferred that since the region experience increases in rainfall variability and early cessation of rainfall (Owusu & Waylen, 2013).

Mixed cropping, also a well-known practice was more prevalent among female farmers (52.0%) than male farmers (32.9%) and has been intensified. For instance, in Nkonsia in the Brong-Ahafo region, men resorted to dry season farming of vegetables, such as okro and cabbage, but on a small scale (usually one acre). They also planted different crop varieties such as maize, tomatoes, pepper, yam and plantain. On the other hand, women used wetlands to grow exotic vegetables. Similarly, in the Ashanti region, whilst men in Babasso grew maize, cassava, and cowpea, women grew pepper, garden eggs, groundnut, beans, yam and cassava. Similar practices existed in all the communities visited. The intensification of this practice was to ensure that food availability is not compromised. It is therefore not surprising to find more women adopting this practice in both regions as it is mostly women's responsibility to ensure food security at the household level (World Bank, 2009).

The use of new varieties of existing crop types are important adaptation strategies as observed by Acquah and Onumah (2011). In this study, both male and female farmers reported using new varieties of existing crops in the sense that when the rains are more reliable and last for over three months, farmers manage to cultivate late maturing varieties that may yield more. On the other hand, they use early maturing varieties during the minor rainy season as a result of the short duration and erratic nature of the rainfall. However, more females (66.0%) than males (39.3%) reported using late maturing varieties as well as early maturing varieties as reported by 52.5 and 34.7% of females and males, respectively. The higher percentage of females using these existing crop varieties is due to the differences in adaptation preferences, in relation to the types of crops grown by men and women as well as the off-farm strategies. All of these were often defined by the gender norms and practices as well. For instance, in Akrobi in the Brong-Ahafo region, men mostly engaged in the planting of maize, cowpeas, tomatoes and new crops mostly watermelon and cashew. On the other hand, women were engaged more in the planting of traditional vegetables such as tomatoes, green pepper and garden eggs. This was because women preferred the traditional crops as they were not so sure of the benefits of new crops such as watermelon. This reinforces the view that women were not likely to take risks as household food security is a priority to them (Opere & Wrigley-Asante, 2008; World Bank, 2009).

Similarly more males (43.8%) as compared to females (34.7%) reported to have resorted to the use of drought resistant crops implying that more men than women may have access to agricultural resources such as drought resistant varieties. This supports Swai, Mbwambo, and Magayane (2012) argument that men led in the use of improved seeds of short-maturity and drought-tolerant crops. For instance in Awisa in the Brong-Ahafo region, male farmers had diversified into lucrative business of cashew production (a drought resistant crop). Women, however, engaged mostly in short-term traditional crops such as garden eggs and okro. They also worked as factory hands in a cashew processing factory rather than producers because cashew production requires large acres of land for which many women did not have access, limiting their entry into this lucrative venture. This situation also confirms studies that show that traditionally women's access to and ownership to land is often limited

affecting their economic opportunities (Benneh, Kasanga, & Amoyaw, 1995; Duncan & Brants, 2004; Wrigley-Asante, 2008).

When we compare the two regions, the use of drought-resistant crop varieties was higher among farmers in the Ashanti region than in the Brong-Ahafo region. This could possibly be the establishment of the Crop Research Station at Ejura (the municipal town) in the Ashanti region that could be contributing to the better sensitization of farmers and hence their adoption. Ejura also has a long history of mechanized commercial production of crops especially maize. In other words, there is a stronger institutional support in the Ashanti region as compared to the Brong-Ahafo region. Moreover, both male and female farmers generally reported that they received institutional support including support from NGOs to assist them resolve problems caused by changes and uncertainties in climate. But it appears more males in both Ashanti and Brong-Ahafo regions had received more support than females.

Interestingly, few farmers had adopted irrigation, rain water harvesting, and planting in valleys and wetlands as well as the use of compost and manure. The limited use of irrigation in particular is not strange as agriculture in Ghana is almost entirely rain-fed with less than one percent of arable land irrigated (Ministry of Food & Agriculture, [MOFA], 2003). In cases where irrigation facilities are available possibly through the construction of small dams, it may be expensive and it is likely that women may have limited access to irrigation facilities (Opore & Wrigley-Asante, 2008). This came up clearly in our study where less than 10.0% of farmers with the majority being males (10.3%) than females (8.5%) relied on irrigation. Most of these farmers were from Akrobi in the Brong-Ahafo region, who explained that they depended on a government supported small dam irrigation project but complained that the pipes were not enough and so only a few farmers benefitted from that project.

With regards to the off-farm adaptation strategies, men, particularly the younger ones migrated to more urban areas and beyond. This came up strongly in the Brong-Ahafo region, particularly Akrobi where it was reported that young men often went to Libya as a major strategy. On the other hand, women often resorted to more diversified activities particularly petty trading in both household durables and consumables. This is a major adaptation strategy for women that conform with many similar studies such as Arku's (2013) and Dzah's (2011) studies in the Eastern and Central regions of Ghana, respectively, which also highlighted petty trading as a key coping strategy for women.

It was explained that it is culturally wrong for men to trade (in food stuffs) and therefore trading was the preserve of women as noted in other studies (see for instance Arku, 2013). The engagement of women in this activity provided them with some form of 'comfort' to adapt to climatic changes and its associated low food crop production as this enabled them to maintain and support their homes. Subsequently, it provided some gains for women in terms of decision-making at the household level and these have been discussed in the next section.

Other emerging strategies employed by both males and females included the intensification of livestock rearing (especially goats, sheep and pigs) and the introduction of new livestock such as rearing of snails, grass-cutters and poultry-raising. A few farmers also mentioned fish farming and this was done mainly by the male farmers. There was also the use of ecosystem services such as collecting wildnuts, mushrooms and spices, mainly for home consumption and surplus for sale which was a strategy mostly used by the females. This strategy was however, at a very minimal level, as the high levels of environmental degradation have reduced the provision of ecosystem products especially mushrooms in supporting adaptation. Rain water harvesting emerged as the least adaptation strategy used because it is mainly required for post-harvest activities (such as washing of foodstuffs) and therefore not considered a priority by the farmers.

Gender, adaptation and household dynamics

One of the key objectives of this study was to examine how the decision-making role of particularly females at the household level has been influenced by the adaptation strategies. It is well noted that women are often excluded and underrepresented in decision-making at the household level (Ardayio-Schandorf, 1994; Wrigley-Asante, 2008) and especially issues pertaining to climate change (World

Bank, 2009). Our findings revealed that women's engagement in off-farm adaptation strategy particularly with regards to petty trading appeared to have positively influenced their socioeconomic status and in turn influenced their decision-making role at the household level. This confirms other studies conducted in Ghana that shows that women's ability to support the home financially improves their decision-making role (Brown, 1994; Opong, 2005; Wrigley-Asante, 2008).

In this study wives were increasingly taking decisions at the household level but often in consultation with their husbands in both the Ashanti and Brong-Ahafo regions. According to the male respondents, wives did participate in decisions on household livelihood activities as well as on household needs. Thus joint decision by husbands and wives came up as a common phenomenon. Women contributed in decisions concerning children's education, healthcare and daily meals. Indeed, the FDGs further revealed that women were increasingly taking part in decision-making as result of the increasing contribution to household budget as reported as follows:

... these days the men listen to the women because they've realized women give good advice and also because they trade, they are sometimes financially better off and can support the man to take care of the home. Also women have a lot of information on what is going on with agricultural goods because they trade and that even informs us on which types of crops are in high demand. (Male farmer at Akrobi in the Brong-Ahafo region)

This situation was attributed to the increasing economic contributions of women, and the structural transformation of the Ghanaian society that has changed the status quo as highlighted in other studies such as Opong (2005) and Wrigley-Asante (2012). Moreover, the wider education on economic empowerment of women also came up strongly as a factor influencing the increasing participation of women in household decision-making. As noted by Kabeer's (1998) earning an independent income can lead to an increase in women's ability to exercise 'voice' in the household decision-making process. This situation creates more freedom for women to take decisions and assume more responsibilities in the affairs of the household as explained:

... these days the women also have a say particularly in our homes because the men can no longer support their wives as it used to be. The wives support themselves and even some of the husbands and so the husbands listen to the women. Also women now know their rights, they talk about these things on radio and at community durbars and so increasingly the men understand that women must take part in issues concerning the welfare of the home. (Male farmer in Anyinasu in the Ashanti region)

Other members of the family, such as adult children and adult family members also contributed to decisions on household livelihood activities. A few women respondents in both regions reported taking decisions on household livelihood activities alone. These are most often the divorced, separated, widowed or single women and they are most likely to be household heads. This confirms other studies such as Wrigley-Asante (2012) study in Ghana and Kabeer (1998) study in Bangladesh, that show that such category of women often take major decisions on their own.

However, the study found out that decisions concerning the use of land at the household level was within the domain of husbands and other male adults (such as uncles and male children) in the household. This is consistent with other studies that show that, traditionally, land has been recognized as the primary source of wealth, social status and power and therefore men tend to control and take decisions over such assets (Duncan & Brants, 2004; Opare & Wrigley-Asante, 2008).

Concluding discussions

This paper sought to highlight the gender differences in climate change adaptation among small-holder farmers' and its implication for women's inclusion in decision-making. The major findings were that both male and female farmers knew and could describe the nature of changing environmental conditions such as observed increased temperatures, reduction in rainfall, and variations in the rainfall regime. In general, it appears both male and female farmers are affected more by drought-related conditions than floods. The emphasis on drier conditions as observed changes was very important to them as it resulted in decreased food crop production and its resultant adaptation choices.

To address the negative impacts of climate change, farmers have adopted both off-farm non-agronomic and on-farm yield enhancing agronomic strategies to address the challenges. The on-farm strategies included the use of chemical fertilizer as a key adaptation strategy with more males than females resorting to it. More males than females were also found to have more access to and used drought resistant crops. Mixed cropping was more prevalent among female farmers than male farmers and with females resorting to traditional crops. This was to ensure that food availability at the household level is not compromised.

Female farmers also resorted to petty trading in agricultural and consumable goods, a key off-farm strategy as this fit more into their traditional gender role. The income and often crop market information gained has in turn increased the resilience of women in adapting to climatic hazards and empowered them in the sense that it has subsequently improved their decision-making role at the household level.

Our findings show that there are some differences between female and male farmers' adaptation strategies. Whilst men are more into on-farm agronomic practices, women are interested and utilize more off-farm adaptation strategies especially petty trading, in addition to the on-farm agronomic practices. Petty trading which is linked to the traditional roles of women, therefore provide some form of resilience to climate change as well as empowering women. We therefore argue that institutions that support climate change adaptation initiatives at the local level must take gender differences into consideration in the discussions of climate change. Whilst mainstreaming gender is important in these discussions, women must be targeted to consolidate their empowerment in particular. Men must also not be left out as it appears crop failures affect their psychological well-being. The situation of both male and females small-holder farmers could therefore be improved through access to micro finance programs as part of the adaptation support. However, this should be supported with wider capacity building on entrepreneurship skills as well as continuous sensitization and educational programs on women's empowerment issues at the community level. This should also be supported with counseling services targeting possibly men at the community level so as to assist them withstand the challenges associated with climate variability and change.

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