FOOD SCIENCE & TECHNOLOGY | RESEARCH ARTICLE

Gender perceptions on the causes of climate variation and its effects on cassava production among farmers in Ghana

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Abstract: This paper seeks to measure farmers’ perceptions on climate variations, and examine the effects of such variations on cassava production in Ghana. Using a three-stage sampling technique involving cluster, stratified, and simple random sampling techniques, structured questionnaires were administered to 252 smallholder cassava farmers in the Awutu Senya District of the Central Region, Ghana. This was supplemented with focus group discussion sessions with male and female cassava farmers for the purpose of triangulating the quantitative and qualitative data. The study showed an overwhelming 98% of respondents, comprising 57% males, and 43% females, acknowledging to have noticed changes in the weather patterns over the last 30 years. While 85% of respondents said rainfall was decreasing, 75% said the rains did not come at the expected time, with 58% of them saying reduced rainy periods were the noticeable changes. Respondents attributed the changes in weather patterns to environmental degradation (72%), natural phenomenon (15%), and punishment by God (1%). Majority of them (97%) said they had suffered from decreasing yields in cassava as a result of seasonal variations in temperature and rainfall. The paper makes a strong case for activities that will bridge the knowledge-and-skill gap between male and female farmers.

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PUBLIC INTEREST STATEMENT

Available research results indicate that the impact of climate variation on the agriculture sector is not gender neutral. Thus, different gender groups may perceive climate variation differently, and may also cope or adapt differently to the impacts of such variations. Over the years, much of the research into agricultural and farming systems in Ghana, especially cassava production, has looked at soil, water and land management strategies, and technologies that make up the portfolio of adaptive agriculture options to the effects of climate variations for improving food crop production. However, not much effort has been made to explore the gender dimensions involved in the perceptions of the causes of climate variations and the perceived effects on cassava production by Ghanaian farmers, which inform the adaptation strategies they adopt to secure their livelihoods. There is therefore the need for more clarity in this area of research to augment previous and current research efforts aimed at improving cassava production in Ghana and beyond.
1. Introduction

It is generally accepted that variation in the elements of the weather and climate (that is, climate variation) especially in rainfall and temperature have major effects on the agricultural industry worldwide. Indeed, it has been predicted that, the overall impacts of climate variation on agriculture will be negative and will threaten food security (G. C. Nelson et al., 2009; G.C. Nelson et al., 2010). The negative effects of climate variation on Africa’s agriculture is not a recent phenomenon. It was much earlier emphasised by the Intergovernmental Panel on Climate Change Fourth Assessment Report (2007), which observed that, the realisation of the African Green Revolution and its contribution to food security and economic growth in sub-Saharan Africa are threatened by climate variation.

Available research results indicate that not only does climate variation effects on agriculture impact differently on males, females, youth and the aged, but also the different gender groups (male, female, youth and aged) perceive and react differently to climate variation, and have different ways of coping and adapting to and mitigating its impacts (Ali et al., 2014). Over the years, much of the research into agricultural and farming systems in Ghana and especially cassava production has looked at soil, water and land management strategies, and technologies that make up the portfolio of adaptive agriculture options to variations in climatic conditions for improving food crop production; but little or no effort has been made to explore the gender dimensions involved in the perception climate variations and its perceived effects on cassava production by farmers, which inform the adaptation strategies they adopt order to secure their livelihoods (FAO, 2011).

It is therefore important to explore the perceptions of male and female farmers on the causes of climate variation and its effects on cassava production to augment previous and current research efforts aimed at improving cassava production in Ghana. It has been noted by earlier studies that an important factor that undermines effective adaptations to climate variation is wrong perceptions (Brody et al., 2008). In addition, the fact that the impact of climate variation is not gender neutral makes it more important to understand how men and women perceive and interpret climatic events so as to devise and advise on effective adaptation strategies that will secure their livelihoods.

1.1. Conceptual framework

This paper is premised on the conceptual framework that suggests that perception is a process by which individuals receive information or stimuli from the environment and transform it into psychological awareness, in order to learn about the environment and respond to what is perceived (Bridgeman & Tseng, 2011). Individuals’ perceived risk, according to this conceptual framework, is influenced, in part, by the type of hazard to which they are exposed and the perceived severity and frequency of that exposure (Slegers, 2008). Perception is important in the dynamics of climate variation because it is one of the elements that influence adaptation process (Yamba et al., 2019 & Yaro, 2013). It is after perceiving the changes in climate that individuals can undertake required measures to adapt to or reduce climate change effects (Maddison, 2007).

1.2. Objective of the study

Knowing the importance of perception, climate change perception studies have been conducted in developed countries mainly to explore mitigation options (Hansen et al., 2012; Mertz et al., 2009). In developing countries, studies on perception have been conducted in relation to adaptation options (Dhaka et al., 2010; Gbetibouo, 2009; Nzeadibe et al., 2011). However, Dankelman (2010)
notes that although climate variation affects everybody, it is not gender neutral. As stated by Goh (2012), differences in cognitive abilities and normative factors may also mean that men and women would interpret (perception) and respond to climate variation impacts differently. In the light of these facts, this paper seeks to assess gender perceptions on the causes of climate variation and its effects on cassava production among farmers in the Awutu Senya District of the Central Region of Ghana. First of all, the study measures farmers’ perceptions on climate variations and secondly, it examines the effects of such variations in climate on cassava production.

2. Materials and methods

2.1. The study area
The research was conducted in four settlements in the Awutu-Senya District of the Central Region of Ghana. The towns were Awutu Breku (the district capital), Senya Beraku, Bawjiase, and Bontase. Awutu-Senya District is located on the eastern coast of the Central Region of Ghana. The District is a hub for agriculture and its related activities. Besides, the District is noted as one of the cassava-producing areas in Ghana, where both males and females are actively involved.

2.2. Research design, target population, sampling procedure and sample selection
The research design employed was the mixed method used to collect both quantitative and qualitative data. With regard to the research procedure, a survey was conducted to gain in-depth understanding regarding perceptions of male and female farmers to the variations in climate in the District. Data were collected using structured and semi-structured questionnaires and interview guides. Data were processed and analysed using the International Business Machines Statistical Package for Social Science (IBM SPSS) Version 22 and Microsoft Excel 2013. The statistical tools were used to produce sample statistics such as means, and proportions of the various samples. Other outputs from the software such as frequency tables and diagrams such as, bar graphs, charts and trends were used to express the results of the data analysed.

A three-stage sampling technique, involving the clustering sampling, the stratified sampling, the simple random sampling techniques combined with focus group discussion method was used to select the desired sample for the study. With regard to the multistage sampling, the first stage involved the clustering of the 18 communities in the Awutu Senya District into 11 cassava-growing communities. At the second stage, four communities were randomly selected from the 11 using the lottery method. The third stage involved the selection of samples from the four selected communities. Here, the simple random sampling technique was adopted. The randomisation ensured that each and every unit had an equal chance of being selected. Focus group discussions were held with cassava farmers divided into two groups based on gender (male and female).

The sample included two hundred and fifty (250) cassava farmers and two (2) key informants from a population of seventy-four thousand (74,000) cassava farmers and opinion leaders in the four communities. The sample size was determined within a 95% confidence interval, using the following expression: 

\[ n = \frac{X^2 NP \times (1 - P)(ME^2(N - 1)) + (X^2 P(1 - P))}{\text{where}} \]

\[ n = \text{sample size}; X^2 = \text{Chi-Square for the specified confidence interval at 1 degree of freedom}; \]
\[ N = \text{population size}; P = \text{population proportion and} \]
\[ ME^2 = \text{desired margin of error (Krejcie & Morgan, 1970).} \]

3. Results and discussions

3.1. Farming experiences of respondents from a gender perspective
Previous studies have shown that farmers’ perceptions are determined by factors such as education, farming experience, gender and access to extension services (Deroess et al., 2009; Gbetiboou, 2011; Goh, 2012).
To find out farmers' experiences about climate variation, the respondents were asked to indicate how long they had been farming and how often their climate varied in the communities they lived. The results (Figure 1) indicated that 75 respondents (30%) had farmed within the study area for some 6 to 10 years. Another 55% had been farming for over 10 years. Six to 10 years of farming experience in the study area was considered significant enough for a farmer to experience climate variation.

The results showed that 30% of the 147 male respondents and 30% of the 107 female respondents had been farming in their communities for 6 to 10 years. The results also revealed that 87% of the male and 72% of the female respondents had been farming in their communities for more than 5 years (Figure 1).

### 3.2. Farmers' perceptions on climate variation

Farmers were first asked to state the yield trend of key crops such as cassava, yam, vegetables and maize they had been cultivating. They were supposed to indicate whether yields were increasing, stable, fluctuating or decreasing as a result of the variation in the climatic elements. The results indicate variation over the years as shown in (Figure 2).

Respondents were asked to indicate if they had noticed any change in the weather pattern during the 30-year period. If changes were noticed, respondents were to indicate the interval and type of change. Approximately 98% of the respondents acknowledged noticing some changes in the weather patterns. Of these 57% were males and 43% were females (Figure 3).
With regard to the frequency of change, 131 (52%) respondents said they had noticed some changes in the weather pattern every other year. This comprised 56% of the males and 47% of the females (Figure 4).

Some of the changes noticed included decreasing amount of rainfall, rains not occurring at the expected time, reduced rainfall periods, longer dry seasons, and high temperatures. Other observations were increasing severe droughts, increasing floods and low temperatures. Eighty-five percent (85%) of the respondents said rainfall was decreasing during the 30-year period. Seventy-five percent (75%) said the rains did not come at the expected time, while 58% said reduced rainy periods were the noticeable changes. Some, 8%, however, said they had noticed some increasing amounts of rainfall during the 30-year duration (Figure 5).

In terms of gender disaggregation, 63% of the males said they had noticed reduced rainy seasons, while 51% of the females also said rainy seasons had reduced. Seventy-seven percent (77%) males compared with 73% females said the rains did not fall at the expected times. Some 29% males and 17% females noticed increasing drought periods, while 52% males and 50% females said they had noticed rising temperatures. For those who noticed reduced dry seasons, 5% were males and 8% were females. (Figure 5).

Analysis of respondents’ perceptions of how climate variation was affecting seasonal rainfall weather patterns according to age group (Table 1) revealed that majority of those who were of the opinion that the rains were decreasing as the seasons went by, were the older farmers (40 years...
There were also the majority who said rainfall was erratic and temperatures were increasing. These perceptions were consistent with the climatic data of the study area.

Respondents said the observed changes in the weather pattern were caused by the following: environmental degradation, climate, natural phenomenon and punishment by God. Seventy two percent (72%) attributed the causes of variations in climate to environmental degradation, while 15% linked the changes to natural phenomenon. A few (1%), linked the changes to God’s punishment to humankind (Figure 6).

There were differences in opinions between male and female respondents with regard to the possible causes of the seasonal variations (Figure 7). For example, 67% of those who linked causes

| Table 1. Farmer perceptions of the effects of climate variation on rainfall and weather patterns by age |
|---------------------------------------------------------------|
| **Observed Changes**                                      | **Age Group** |
|                                                           | 20–29 | 30–39 | 40–49 | 50–59 | 60 and above |
| Decreasing Amount of Rainfall                             | 70%   | 72%   | 94%   | 85%   | 95%          |
| High temperatures                                          | 50%   | 45%   | 59%   | 44%   | 65%          |
| Reduced dry seasons                                        | 5%    | 5%    | 6%    | 7%    | 5%           |
| Rains do not fall at expected time or erratic rainfall pattern | 40%   | 66%   | 83%   | 81%   | 90%          |
| Increasing floods                                          | 5%    | 5%    | 6%    | 3%    | 5%           |
| Increasing drought                                         | 15%   | 28%   | 29%   | 19%   | 20%          |

Source: Survey data (2018)  
Multiple Responses
of the variations in the climatic elements to environmental degradation were males. On the other hand, majority of those who said that the causes were the result of natural phenomenon or punishment by God were females. More males than females had no idea about the causes of seasonal variations.

To find out if respondents (delete apostrophe) actually noticed changes in the weather pattern, they were asked to indicate the onset of the rainy and the dry seasons every year over the past three decades. The results were then cross checked with the climatic data of the study area obtained from the Ghana Meteorological Agency (GMet). The results indicated mixed responses as shown in (Table 2). The majority (66%) indicated that the rainy season usually started from March every year, while 15.5% indicated February as the start of the rainy season. On the other hand, 14.6% said it was in April and 2.4% said it started from May. Of those who said the rainy season started from March, 69% were males and 31% were female, while 67% of those who indicated the month of May as the beginning of the raining season were females and 33% were males. With regard to the onset of the dry season, the majority (53.4%) said the dry season started
Table 2. Respondents’ opinions about the onset of the rainy and the dry seasons

| Beginning of the raining season | April | February | March | May | N/R | Total |
|--------------------------------|-------|----------|-------|-----|-----|-------|
| **Sex**                        |       |          |       |     |     |       |
| Male                           | 17    | 27       | 98    | 2   | 1   | 145   |
| Female                         | 20    | 12       | 69    | 4   | 2   | 107   |
| **Total**                      | 37    | 39       | 167   | 6   | 3   | 252   |
| **Sex**                        |       |          |       |     |     |       |
| Male                           | 81    | 2        | 2     | 57  | 3   | 145   |
| Female                         | 51    | 3        | 2     | 49  | 2   | 107   |
| **Total**                      | 132   | 5        | 4     | 106 | 5   | 252   |

Source: Survey data (2018).

from December, with 61% of them being males and 39% being females; 42.1% of respondents indicated the month of November. Approximately 2% (each) named the months of January and October. Of those who said the month of January marked the onset of the dry season, 60% of them were females, while 40% were males. Comparing the responses with the data from the GMet, the majority, mostly the male responses exactly matched with those of the GMet’s data. According to the GMet’s data the rainy season usually starts from March and ends in November.

The above results showed that almost all the respondents interviewed had noticed changes in the rainfall and temperature patterns during the past 30 years. Almost all the farmers knew that some changes in the temperature and rainfall pattern had taken place, which eventually affected yield trends of key crops. Farmers identified decreasing rainfall, increasing drought, erratic rainfall pattern and increasing temperatures as the most frequent occurrences. These observations were consistent with the results obtained from the analysis of the climatic data. The observations were also corroborated by the findings of and McSweeney et al. (2010) which indicated that, Ghana was already experiencing a monthly rainfall decrease of about 2.4% (change percent to % for consistency) per decade and an increase in the mean annual temperature of 1°C per decade since 1960, (Government of Ghana, 2011; McSweeney et al., 2010). It was also noticed that factors such as age of respondent, period of stay in the study area, educational level of respondent and social group affiliation played significant roles in the formation of respondents’ perceptions. The majority of respondents who perceived decreasing trend in the rainfall, increasing trend in temperatures, reduced rainfall period, and erratic rainfall patterns as emerging climatic trends in the study area were within the age group of 40 years and above.

According to the findings, a greater proportion of the older respondents had been farming in the area for at least 10 years; 63% who had stayed in the study area for more than 10 years were above 40 years. The implication therefore is that, the older farmers have lived and farmed in the study area long enough to have observed some climate variations in the study area. Similar findings have been reported by Mamba (2016) whose findings indicated that, the age of farmers helped them to perceive more accurately compared to younger farmers due to their many years of farming experience and to the indigenous knowledge that help them perceive correctly climate variables such as rainfall in the beginning of each farming season.

Social group affiliation shaped the farmers’ perceptions of climate variation in the study area as indicated by Oremo (2013) and as cited in Ayuma (2016). Discussions with respondents revealed that several farmers came together to form some kind of association with the aim of working as groups. These groups usually shared information about improved farming practices, the weather and the right planting times in view of the changing weather conditions. The groups were given support in the area of climate-smart agricultural practices to withstand (replace stand with withstand) the challenges posed by climate variation by Community-based Organisation (CBOs), Agricultural Extension Officers, and some government agencies (MoFA). The findings corroborated
the findings of the study conducted by Gbetibouo (2009), which stated that farmers with access to extension services were more likely to perceive changes in the climate, because extension services provided information about climate and weather. Hence information sharing among group-members helped to shape the individual cassava farmers’ perceptions or opinions about climate variation. This finding is also supported by that of Tazeze et al. (2012) in eastern Ethiopia that said that access to information on climate change through farmer-to-farmer extension was a significant factor that explained farmers’ perceptions of climate change.

According to Mohammad (2016), valid perceptions are important for developing, or adopting successful adaptation strategies. Perception of risk is essential for motivating farmers in their decision to adapt; this explains why the majority of the males were more likely to take steps that would mitigate the effects of any climatic variations on their livelihoods. They were more prepared to accept adaptation measures or improved practices that would help alleviate the effects of the variations in the climate on their livelihoods. Those who had the perception that the causes of climate variation were an act of God, and hence nothing could be done about it, would most likely not try to find any solution for combating the adverse effects of climate variation on their livelihoods. They would rather accept the extreme climatic event as coming from God. Furthermore, those who were not even aware of the possible causes of climate variation, the majority of whom were females, were also likely to be overtaken by events. Being aware of the possible causes of a phenomenon helps to take the appropriate actions that will remedy the situation (Mohammad, 2016).

A major reason why more of females had wrong perceptions about climate variation and its causes could be explained by the fact that there were more illiterate female farmers than the males as demonstrated in the gender analysis of respondents’ educational background. Even in situations where some of the female respondents had formal education, most of them stopped at the basic level. These findings are in consonance with the findings from the study by Rakgase and Norris (2015), where education, literacy level, and gender were important predictors of how farmers perceive climate change and drought phenomena.

Gender diversity in perceptions about occurrence of climate variation and causes could also be based on cognitive and normative difference in the capacity to recognise the risks posed by climate variation. Again, differences in the perceptions of male and female farmers could have taken root from social or cultural norms of the study area. For example, during an interview session with the male opinion leader from Awutu-Breku, he said that:

“Parents usually prefer to use their limited financial resources in educating the boy/male within a family than the girl/female to the highest level because it is their belief that the males are usually brighter and it is they who will eventually become heads of families with greater responsibilities. He further indicated that: “as for females, they will one day marry and become a man’s responsibility.”

This type of response was consistent with majority of the respondents and also reflective in the educational background of the respondents. The observations agree with those by Ostrom (1990); and Maddison (2007).

3.3. Effects of variations in climate on cassava production
Climate variations affect crop cultivation in a number of ways, such as through changes in average temperatures, rainfall and climate extremes with an important impact on soil erosion (that is, floods, drought), changes in pests and diseases, proliferation of weeds and changes in growing season (World Bank, 2008). According to Ministry of Food and Agriculture (2016), farming in Ghana is still highly dependent on rainfall, making the production of crops rely entirely on the weather. Abubakari and Abubakari (2015) confirm that climate variation is a threat to agriculture and food security, because of the loss of crops through variation in rainfall and temperatures.
As indicated earlier, Awutu Senya district is experiencing variation in climatic elements with variation in the rainfall pattern and increases in temperatures over a 30-year period from 1984 to 2014. To find out the extent to which climate variation has affected cassava production in the study area, personal observations of respondents with regard to the effects of the variations in the wet and dry seasons on crop yields, labour cost, outbreak of pest and diseases, and delay in sowing and harvesting times were discussed/solicited from the farmers. Others included crop losses, debt increase and financial burdens. Observations of respondents indicated that variations in temperature and rainfall patterns (close up letters) affected cassava production.

Results (Figure 8) were that, the majority (97%) of the respondents said they suffered from decreasing yields in cassava over the years as a result of seasonal variations in temperature and rainfall. This is consistent with the observations of Stutley (2010) which states that extreme temperatures and erratic rainfall in Ghana are a source of low yields in the crop production.

Next in rank was delayed harvesting, where 80% of the respondents said they had to delay harvesting of their crops for the ideal climatic conditions to set in. Seventy percent (70%) indicated that they suffered crop losses as a result of variations in the climatic elements. Only 6% of the respondents indicated that they had to delay the sowing of crops due to the late onset of the rainy season; (semi colon) an action, which respondents claimed affected the harvesting time and the quantity of the harvested tubers. Although other adverse effects such as increased incidence of cassava tuber-rots, delayed planting and difficulty in harvesting affected farmers (Figure 8), these adverse effects from the seasonal variations were not as common among respondents as the first three (decreasing yields, delayed harvesting and crop loss).

Concerning the yields realised, respondents were asked to state the yield of cassava per acre under favourable and unfavourable climatic conditions. Yields were scored based on the following criteria; “high” represented “above normal yield”, “moderately high” referred to “just above normal yield”, “moderate” meant “normal yield”, “moderately low” represented “just below normal yield” and “low” referred to “far below normal yield” on the Likert scale. Normal yield according to MoFA (2014) was 17 t/ha which was about 204 maxi bags/ha.

Responses (Figure 9) showed that, under favourable weather conditions, 14% obtained high yields per hectare averaging above 270 maxi bags/ha, while 1% obtained high yield under unfavourable weather conditions; 40% obtained moderately high yields per hectare averaging between 270–230 maxi bags/ha under favourable weather conditions. There were no responses on unfavourable conditions. However, 27% said they obtained normal yield (17 t/ha) or 204 maxi bags/ha.
of cassava per every hectare cultivated under favourable weather conditions, while 29% said they obtained normal yield under unfavourable conditions. Some 17% recorded moderately low yields per every hectare, that is below 150 maxi bags to about 80 maxi bags under favourable climatic conditions, but under unfavourable climatic conditions 69% recorded moderately low yield.

On the effects regarding finance (Figure 10), 40% of the respondents indicated that they earned incomes from GHc100 to GHc1,900/ha under favourable conditions, while 76% of the respondents indicated they earned incomes within the same range under unfavourable condition. When it came to the earning of higher income under favourable and unfavourable weather conditions, majority said that they earned higher incomes (GHc2,000 and above)/ha under favourable weather conditions (Figure 10).

It can thus be seen from the finding that; declining precipitation and temperature increases present serious challenges to the cassava farmers since they depend entirely on rainfall for crop production and other rural livelihoods. High temperatures increase evapo-transpiration that leads to reduction in soil moisture content. Even though temperature is important for crop production, rainfall is a critical element for crop production in the tropics (Sivakumar et al., 2005). Perhaps, this could be attributed to the fact that the lack of, or excess of rainfall over a long period, leads to either drought or flooding that can reduce crop production, and hence to food shortage and income reduction (Haile, 2005).

Adverse effects of climate variability on cassava production are manifested in yield decreases, delayed harvesting of crops, and frequent crop losses. These results are backed by the facts that high temperatures, decreasing or erratic rainfall, and reduced rainy periods, or longer dry seasons

Figure 9. Effects of favorable and unfavorable weather conditions on cassava yield.

Source: Survey data (2018)

Figure 10. Seasonal climate variations and earnings from cassava production per hectare.

Source: Survey data (2018) N/R = Non-ResponseThe exchange rate of the Ghana Cedi to the US Dollar, as of 2018 during the field work, was GHc4.52 to US $1.00
and extended drought periods were some of the frequent seasonal climate events observed by respondents in the Awutu-Senya District. Almost every farmer experienced decreasing yields over the years because of erratic rainfall, extended drought periods, unusually high temperatures and intermittent floods caused by occasional heavy down-pours. Available evidence also suggests that these adverse climatic events negatively affect cassava production. For example, too much water or flooding, promotes cassava root-rot and the proliferation of pests. All these combine to affect yields as Moses, Asafu-Agyei and Ayueboteng, (2005) have observed.

Respondents indicated that they had to delay the harvesting of their crops by staggering the sowing time of their crops. Seven out of every 10 respondents endured some crop loss as a consequence of severe droughts and high temperatures. These findings are supported by Cock (1985) who claimed that temperatures above or below certain thresholds have considerable effects on cassava growth, as it affects sprouting and ultimately, tuber yield. Incomes of farmers from cassava production were also partly affected by seasonal variations. Most of the respondents said incomes from the sale of cassava continued to reduce due to poor yields caused by drought and erratic rainfall. Some of the respondents said that they incurred debts and were unable to repay the loans they took to invest in their farms because of poor harvest or crop failure. The impact of climate variation on farmers’ income is influenced by changes in actual yields (Reidsmoe et al., 2009).

4. Conclusions and policy implications
The study showed variations in climate over the last 30 years with its implications on crop yields and livelihoods of farmers. Approximately 98% of respondents acknowledged noticing some changes in the weather patterns with 57% of them being males and 43% being females. It was evidently clear that declining precipitation and temperature increases presented serious challenges to the cassava farmers as they depended entirely on rainfall for production and other rural livelihoods. Adverse effects of climate variability on cassava production were manifested in yield decreases, delayed harvesting of crops and frequent crop losses. Besides, overwhelming majority (97%) of respondents said they had suffered from declining yields of cassava over the years as a result of seasonal variations in temperature and rainfall. On the other hand, incomes of farmers from cassava production, were partly affected by seasonal variations. These findings have possible policy implications. First of all, education and experience emerged as the important determinants of perception. It will therefore be very useful if development practitioners, policy makers, government agencies, donors and researchers pay much attention to bridging the knowledge and education gap between male and female farmers. This can be achieved through intensive training and sensitisation of farmers. Secondly, Government should put in place policies that will deliberately target the education of the less educated, inexperienced and vulnerable farmers on climate change and variation, its causes and the best climate-smart agricultural practices. Thirdly, to reduce crop losses and decreasing crop yields associated with climate variation, MoFA and other allied institutions should endeavour to make farmers aware of existing technologies and innovations that are capable of over-coming climate variation.

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References
Abubakari, F., & Abubakari, F. (2013). Effects of Climate Changing on FoodCrop Production System in Ghana. Journal of Agricultural Science and Research, Vol. 3(4), 76–79. doi: 10.14662/ARJASR2015.007
Ali, A. D., Deininger, K., & Markus, G. (2014). Environmental and gender impacts of land tenure regularization in Africa: Pilot evidence from Rwanda. Policy Research Working Paper Series 7565.

Ayumah, R. (2016). Climate variability and food crop production in the Bawku municipality. Unpublished doctoral thesis. Kwame Nkrumah University of Science and Technology, Kumasi, College of Humanities and Social Sciences, Department of Geography and Rural Development.

Bridgeman, B., & Tseng, P. (2013). Embodied cognition and the perception-action link. Physics of Life Reviews, pages. 8(8 issue 1), 73–85. March 2011. https://doi.org/10.1016/j.plrev.2011.01.002

Brody, A., Demetriades, J., & Esplein, E. (2008). Gender and climate change: Mapping the linkages: A scoping study on knowledge and gaps. United Kingdom Department for International Development.

Cock, J. H. (1985). Cassava: New potential for a neglected crop (pp. 48–57). Westview Press, Boulder, CO.

Dankelman, I. (2010). Gender and climate change: An introduction (Vol. 2012). UK.

Deressa, T. T., Hassan, R. M., Ringler, C., Alemu, T., & Yefrem, M. (2009). Analyzing the determinants of farmers’ choice of adaptation methods to climate change in the Nile Basin of Ethiopia. Global Environmental Change, 19(2), 248–255. https://doi.org/10.1016/j.gloenvcha.2009.01.002

Dhakal, B., Poonia, M. K., & Chayol, K. (2010). Analysis of farmers’ perception and adaptation strategies to climate change. Libyan Agricultural Resource Central Journal International, 1(6), 388–390. IDOSI Publications. http://dx.doi.org/10.4236/ajcc.2017.61009

Food and Agriculture Organisation. (2011). The state of food and agriculture. Women in agriculture: Closing the gender gap for development.

Gbetibouo, G. (2009). Understanding farmers’ perceptions and adaptations to climate change and variability, the case of the Limpopo Basin, South Africa: IFPRI discussion paper 00849. In S. Sani & C. Tamiru (Eds.), Farmers’ perception, impact and adaptation strategies to climate change among smallholder farmers in Sub-Saharan Africa: A systematic review, 36. Assosa University.

Goh, A. H. X. (2012). A literature review of the Gender-Differentiated impacts of climate change on women’s and men’s assets and Well-Being in developing countries. CAPRI Working Paper No. 106. Washington, D.C.: International Food Policy Research Institute.

Government of Ghana. (2011). Ghana’s second national communication report to the UNFCCC. UNDP. http:// unfcc.int/resourcedocs/nata/ghana_second_nationalcommunication_final_version.pdf.

Hoile, M. Weather patterns, food security and human nutrition response in sub-Saharan Africa. (2005). Philosophical Transactions of the Royal Society B: Biological Sciences, 360(1463), 2169. In: Antwi-Agyei, P. (Ed). Vulnerability and adaptation of Ghana’s food production systems and rural livelihoods to climate variability. Doctoral Thesis. The University of Leeds. https://dx.doi.org/10.1098/rstb.2005.1746

Hansen, J., Sato, M., & Ruedy, R. (2012). Perception of climate change. Proceedings of the National Academy of Sciences, 109(37), 14726–14727, E2415-E2423. https://doi.org/10.1073/pnas.1205276109

Intergovernmental Panel on Climate Change. (2007). Climate change 2007: Impacts, adaptation and vulnerability. Contribution of working group II to the fourth assessment report of the intergovernmental panel on climate change. Eds. M. L. Parry, O. F. Canziani, J. P. Palutikof, P. Van Der Linden, & C. E. Hanson (pp. 976). Cambridge University Press.

Krejcie, R., & Morgan, D.W. (1970). Determining sample size for research activities. Educational and psychological measurement, 30(1970), 607–610.https://doi.org/10.1177/001316447003000308

Maddison, D. (2007). The perception of and adaptation to climate change in Africa. CEEPA. discussion paper no. 10. Centre for economics and policy in Africa. Pretoria, South Africa: University of Pretoria.

Mambo, S. F. (2016). Factors influencing perception of climate variability and change among smallholder farmers in Swaziland. Indian Journal of Nutrition, 3 (2), 2016. www.opensciencepublications.com

McSweeney, C., New, M., Lizzano, G., & Lu, X. The UNDP climate change country profiles. (2010). American Meteorological Society, 91(2), 157-166. In: Alessandro D, Ulac, Aikke, Jawoo and Marian (2012). Climate Change, Agriculture, and Food crop Production in Ghana. IFPRI, Washington, DC., USA. https://doi.org/10.1175/2009BAMS2826.1

Mertz, O., Halsnaes, K., Olesen, J. E., & Rasmussen, K. Adaptation to climate change in developing countries. (2009). Climate Change 2007: Mitigation. Contribution of working group III to the fourth assessment report of the intergovernmental panel on climate change. Eds. M. L. Parry, O. F. Canziani, J. P. Palutikof, P. Van Der Linden, & C. E. Hanson (pp. 976). Cambridge University Press.

Ministry of Food and Agriculture. (2016). Agriculture in Ghana. Facts and figures. SRID of the MoFA.

Mohammad, B. (2016). Effects of precipitation and temperature on crop production variability in northeast Iran. International Journal of Biometeorology, 55 (3), 387-401. doi: 10.1007/s00484-010-0348-7

Moses, E., Asafu-Adjaye, J.N., Auyeboteng, F., (2005). Identification and control of root rot diseases of cassava: Disease guide. First year report of International Society for Plant Pathology (ISPP) Congress Challenge on the development of appropriate strategies to control cassava diseases in Ghana. [accessed 13 Jan 2011] http://www.isppweb.org/ foodsecurity_cassavaghan.asp.

Nelson, G. C., Rosegrant, M. W., Koo, J., Robertson, R., Sulser, T., Zhu, T., & Lee, D. (2009). Climate change: Impact on agriculture and cost of adaptation. International Food Policy Research Institute.

Nelson, G. C., Rosegrant, M. W., Palazzo, A., Gray, I., Ingersoll, C., Robertson, R., Tokgoz, S., Zhu, T., Sulser, T. B., Ringler, C., Msangi, S., & You, L. (2010). Food Security and Climate Change. Challenges to 2050 and Beyond: IFPRI Issue Brief 66.

Nhemachena, C., & Hassan, R. (2007). In Micro-Level analysis of farmers’ adaptation to climate change in Southern Africa. (IFPRI Discussion Paper, 00714). International Food Policy Research Institute.

Nzeadibe, T. C., Egbug, C. L., Chukwuone, N. A., & Agu, V. O. (2013). Climate change awareness and adoption measures to climate change in Kitui county, Kenya. R. Ayumah, Ed. Climate Variability and Food Crop Production in the Bawku Municipality. 54–55. University of Nairobi. www.epeostory.umbc.dke. (Accessed on 20 April 2014

Ostrom, E. (1990). Governing the commons: the evolution of institutions for collective action. Cambridge, UK: Cambridge University Press.

Rakgase, M. A., & Norris, D. (2013). Determinants of live-stock farmers’ perceptions of future droughts and adoption of mitigating plans. International Journal of Climate Change Strategies and Management, 7 (2),191–205. 2015 pp .. Emerald Group Publishing
Reidsma, P., Ewert, F., Lonsink, A. O., & Leemans, R. (2009). Vulnerability and adaptation of European farmers: A multi-level analysis of yield and income responses to climate variability. European Journal of Agronomy, 32(2010), 91–102. https://doi.org/10.1016/j.eja.2009.06.003
Sivakumar, M., Das, H., & Brunini, O. (2005). Impacts of present and future climate variability and change on agriculture and forestry in the arid and semi-arid tropics. Climatic Change, 70(1), 31–72. https://doi.org/10.1007/s10584-005-5937-9
Sleegers, M. M. W. (2008). If only it would rain*: Farmers’ perceptions of rainfall and drought in semi-arid central Tanzania. Journal of Arid Environments, 72(11), 2106–2123. November 2008. https://doi.org/10.1016/j.jaridenv.2008.06.011
Stutley, C. (2010). Crop insurance feasibility study.
Innovative Insurance Products for the Adaptation to Climate Change Project Ghana (IIPACC). Ghana.

Tazeze, A., Hoji, J., & Ketema, M. (2012). Climate change adaptation strategies of smallholder farmers: The case of Babiilile district, East Harerghie zone of Oromia regional state of Ethiopia. Journal of Economic Sustainable Development, vol 3(Jan), 2012. https://www.iiste.org/Journals/index.php/JEDS/article/view/3718
World Bank. (2008). World bank data on agricultural value added as a share of GDP. Washington DC: The World Bank. http://video.srepec.org/p/wbk/wwrws/5765.html
Yambo, S., Odarme Appiah, D., Slow, L. P., & Casadevall, S. R. Smallholder farmers’ perceptions and adaptive response to climate variability and climate change in southern rural Ghana. (2019). Cogent Social Sciences, 5(2019), 1. Issue. https://doi.org/10.1080/23311886.2019.1646626
Yaro, J. (2013). Perception of and adaptation to climate variability/Change in Ghana by Small-Scale and commercial farmers. Regional Environmental Change, 13(6), 6. December 2013. https://doi.org/10.1007/s10113-013-0443-5