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*Research Article*

# Gender differences in perceived effects of climate change and adaptation strategies among arable crop farmers in Iwo Local Government Area of Osun State, Nigeria

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**Abstract:** The study examined differences in perceived effects of climate change (CC) and adaptation strategies (AS) adopted by male and female arable crop farmers in Iwo Local Government. The study utilized a 2-stage sampling procedure to select a total of 120 arable crop farmers (84 males and 36 females) Data were collected using validated interview schedule and analyzed using frequency counts, percentages, independent t-test and Pearson's Product-Moment Correlation. Results showed that 39.3 percent of males and 55.6 percent of female arable crop farmers were between 41 and 50 years of age. Nearly 42.0 percent of males and 31.0 percent females had secondary education. Nearly all male and all female respondents (98.8 percent for males; 100.0 percent for females) perceived decreasing trend of rainfall as the most important effect of CC and perceived rise in temperature as the second most important (male 97.6 percent; female 97.2 percent). The adaptation strategies adopted by the male and female arable crop farmers were mixed cropping and mulching. The main constraints faced by the male and female farmers included inadequate information on weather and credit facilities. There was no significant difference in the perceived effects of CC by male and female farmers ($t=1.41$, $p>0.05$) and change their adaptation strategies ($t=0.38$, $p>0.05$). Correlation between perceived effects of CC and adaptability was significant for males ($r=2.25$, $p<0.05$) but not among females ($r=0.200$, $p>0.05$). In conclusion, male and female farmers are more likely to perceive the effects of CC the same way and more likely to adopt the same AS. Both the male and female farmers should be supported and empowered to mitigate the effects of climate change on their agricultural production activities.

**Keywords:** Vulnerability Contexts, Environmental Factors, Arable Crops, Farmers, Farming Strategies

## 1. INTRODUCTION

Climate change has been on top of the agenda of many researchers in the past decades (Swai, Mbwambo, & Magayane, 2012; Wrigley-Asante, Owusu, Egyir, &Owiyo, 2019). This is because of the attendant effects of climate change on every sector of the economy and in particular, agriculture and food security**.** From the simplest connotation, climate change is understood as the identifiable or quantifiable changes in the mean and/or the variability of climate properties that continues for a prolonged period of time (United Nations Framework Convention on Climate Change, 2011). As such, climate change refers to significant changes in global temperature, precipitation, wind patterns and other measures of climate that occur over several decades or longer (Davis, 2020). Generally, these changes are brought about by natural variability or resulting from the aftermath of human activities. The role of

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human activity is mostly emphasized as a major precursor to climate change, and this has prompted many scholars' submission in defining climate change from the anthropogenic angle. This is evident in the explanation put forward by Rahman (2013) that the change in modern climate is brought about predominantly by human beings. This is because human activities chiefly drive the release of greenhouse gases into the atmosphere, which in turn herald the increase in the earth's temperature. The resulting global warming initiates other changes in the climate properties, such as changes in rainfall patterns, the frequency and distribution of weather events such as droughts, storms, floods and heatwaves, among others (Reidy, 2016; Arora, 2019). Relatedly, climate change is also attributed to underpin the high rate of land degradation causing enhanced desertification and nutrient-deficient soils. (Arora, 2019).

The observed conditions portend overarching effects on ecological and social systems. Scientists have claimed that the effects will be overwhelming for natural and human systems and possibly, pose a significant threat to the existence of human civilization (Reidy, 2016). Adams, Álvarez-Romero, Capon, Crowley, Dale, Kennard and Pressey (2017) while highlighting the fundamental roles of agriculture in human welfare, observed that agricultural productivity is chiefly dependent on climate, which makes the sector highly vulnerable to climate change effects. This was also reported by Aryal, Sapkota, Khurana, Khatri-Chhetri and Jat (2020) in their study on climate change and agriculture in South Asia. Even though the impact of climate change is very comprehensive, its sweeping effects are more visibly felt in agriculture, on which the food production and economy of the developing countries depend (Lykhovyd, 2018; Arora, 2019). In other words, global food security is equally threatened with climatic disorientation of agricultural production. Adequate recognition of this in agricultural developmental plans is important to equip farmers' production system in order to be able to buffer the production system against climate changes (Jat, Sapkota, Singh, Jat, Kumar & Gupta, 2014). As such, preparing and equipping farmers for climate change adaption is sacrosanct for agricultural development.

More so, Adzawla and Kane (2019) opined that climate adaptation ensures short term and localized benefits from climate shocks to farming households and thereby making it an effective strategy. It is noted that the adaptation strategies to climate change are not universal but largely differentiated, based on the context variability of those concerned. This means that adaptation in agriculture does not arise and function with respect to the climatic stimuli only, rather they are made in light of the joint effects of climatic and non-climatic conditions (Smit & Skinner 2002). The non-climatic determinants include a wide range of economic, political, and socio-cultural conditions, among others. Prominent among the social contexts which shape climate adaptation is the gender construct. The evidence of gender differences in climate vulnerability premised on the existence of gender inequality in access to productive resources; uneven representation has been upheld as primary to climate change adaptation strategies (Adzawla& Kane 2019). Past studies on climate change have focused on the effects of climate change on agricultural production (Karimi, Karami & Keshavarz, 2018; Gupta, Yadav, Gupta, Ranjan, Gupta & Badhai, 2020; Malhi, Kaur & Kaushik, 2021). However, evidence is scarce on the potential gender variability of farmers perception on the effects of climate change as well as the adaptation strategies employed. Arable crop farmers are likely to experience low production, poor yield and consequently, poor income capable of discouraging them from farming activities, thus escalating the burden of food insecurity in the country. With this standpoint, it is thought worthwhile to investigate the possibility of gender differences in farmers' perceived effects of climate change and adaptation strategies.

**Objectives**

The objectives of the study were to

i. describe the socioeconomic characteristics of male and female arable crops farmers;
ii. examine the differences in perceived effects of climate change by male and female arable

crop farmers;

iii. examine the adaptation strategies adopted by male and female arable crop farmers; and

iv. identify the constraints to effective management of climate change effects by male and female farmers.

**Hypotheses of the Study**

The following research hypothesis were tested in the study.

i. There is no significant difference in the perceived effects of climate change by the male and female arable crop farmers.

ii. There is no significant difference in the adaptation strategies adopted to mitigate the effects of climate change by the male and female arable crop farmers.

iii. There is no significant relationship between perceived effects of climate change and the adaptation strategies of male and female arable crop farmers.

## 2. MATERIALS AND METHODS

The study was carried out in Iwo Local Government Area of IwoAgricultural Development Programme (ADP) zone of Osun State, Nigeria. Iwo zone has an area of 245km square and a population of 191,348 (National Population Commission NPC, 2006). The area has a wide expanse of land suitable for agriculture and as such, many of the inhabitants are engaged in agricultural activities and are known for arable crop farming with concentration on maize, yam and cassava.

The population of the study comprise all arable crop farmers in Iwo L.G.A.The study samples were selected by using the ADP structure to access the study population. Using a two-stage selection procedure, a simple random sampling technique was first used to select one-third (three) agricultural development cells (Ile Ogbo, Idiaraba, and Telemu) from the eight agricultural development cells in Iwo L.G.A. At the second stage, simple random sampling was used to select an average of 40 respondents from the arable crop farmers in the three cells. This gave a total of 120 farmers (84 males and 36 females) chosen for the study. The respondents were interviewed using a validated interview schedule. The key variables in the study were perceived effects of climate change; climate change adaptation strategies and constraints to climate change adaptation strategies. The respondents were asked to express the extent to which they perceived the effects of climate change on arable crops using eleven (11) statements in Likert-scale format of (Strongly agree=5; Agree=4; Undecided=3; disagree= 2; and strongly disagree=1). Thus, an overall score (aggregate) of perceived effects of climate change was computed separately for males and females and weighted mean scores (WMS) were derived. The composite score for adaptation strategies was obtained from a total of 11 Likert- scale response statements. Such approaches have been used in previous climate change studies by Kant*et al.*(2015) and Chikezie*et al.*(2016). Data were analyzed using descriptive and inferential statistics such as frequency counts, percentages, independent t-test and Pearson Product-Moment Correlation Analysis.

## 3. RESULTS AND DISCUSSION

### Socioeconomic Characteristics of the Respondents

The results presented in table 1 showed that 26.2% of males and 19.4% of females were in the age group 31-40 years; 39.3% of males and 55.6% of females were between ages 41 and 50 years while 34.5% of males compared with 25 % of females were above 50 years old.There appeared to be no marked difference in the mean age of male (47.5±) and female respondents (47.2±6.28). More males (69.0%) than females (38.8%) had secondary education. Many (47.3%) of the males were Christian while majority (50.0%) of the females were adherents of the Islamic religion. The results indicate that all the respondents had one religious affiliation or the other. The results also show that the mean household size for males was 6.44±2.41 compared to 6.19±2.27 for the females. Three farming characteristics showed variations in types of crops cultivated, contact with extension agents and types of farming system practiced.

For example, more males (76.2%) than females (69.4%) reported contact with extension workers. This result indicates that more than half of the arable crop farmers had contact with the extension workers. More than 7 in 10 male and female farmers reported planting maize, cassava, and yam while more than two-fifth of males (21.4%) and females (22.2%) reported planting of cowpea. This result shows that yam, maize and cassava were mostly planted by the farmers. Mixed cropping was the predominant farming system reported by 92.9% of men and 91.7% of women.

Table1: Distribution of Respondents According to Socio-economic Characteristics n=120

| Variables | Male n=84 (%) | Female n =36 (%) |
|---|---|---|
| **Age** | | |
| 31-40 | 22(26.2) | 19.4 |
| 41-50 | 33(39.3) | 55.6 |
| Above 50 | 29(34.5) | 25.0 |
| | **47.5±9.26** | **47.2±6.28** |
| **Educational Level** | | |
| No formal education | 11(13.1) | 11(30.6) |
| Primary education | 15(17.9) | 11(30.6) |
| Secondary education or higher | 56(69.0) | 14(38.8) |
| **Family size** | | |
| 3-6 | 46(54.8) | 21(58.3) |
| 7-10 | 31(36.9) | 13(36.1) |
| Above 10 | 7(8.3) | 2(5.6) |
| **Mean±sd** | **6.44±2.41** | **6.19±2.27** |
| **Religion** | | |
| Christian | 39(46.4) | 18(50.0) |
| Islam | 40(47.6) | 16(44.4) |
| Others | 5(6.0) | 2(5.6) |
| **Contact with Extension Agent** | | |
| Yes | 64(76.2) | 25(69.4) |
| No | 20(23.8) | 11(30.6) |
| **Crops cultivated*** | | |
| Yam | 59(70.2) | 25(69.4) |
| Cassava | 74(88.1) | 30(83.3) |
| Maize | 66(78.6) | 30(83.3) |
| Cowpea | 18(21.4) | 8(22.2) |
| **Farming system** | | |
| Mono cropping | 3(3.6) | 1(2.8) |

Source: Field Survey, 2020
*Multiple response

**Male and Female Farmers' Perceived Effects of Climate Change on Crops**

The results in Table 2 showed the frequency and percentages of male and female farmers, who agreed to the Likert-Scale statements on perceived effects of climate change on crops as well as their levels of perceived effects of climate change. The results also showed that nearly all the males (98.8%) and female respondents' perceived decreasing trend of rainfall as the most important effect of climate change. Nearly all the males (97.6%) and females (97.2%) perceived rise in temperature as effect of climate change. The male respondents perceived late commencement of rainfall as the third most important effect of climate change, but to the female farmers, the third most perceived effects of climate change was negative impact of wind on crop growth. This shows male and female farmers' awareness of the importance of timely rainfall and optimum temperature for crop growth. Some of the male (15.5%) and female (13.3%) farmers indicated a high level of perceived effects of climate change on crops. This shows a slightly higher indication of the perceived effects of climate change among male farmers than their female counterparts. These findings corroborated those of Swai *et al.,* (2012) on gender and perception of climate change in a Tanzanian study, that male farmers had a higher perceived effects of climate change than their female counterparts.

Table 2: Gender Disaggregated Perceived Effects of Climate Change on Arable Crops Production

| Statements on Perceived Effects of Climate Change by Male and Female Farmers | Gender | Strongly Disagree n (%) | Disagree n (%) | Undecided n (%) | Agree n (%) | Strongly Agree n (%) | Weighted Mean | Rank |
|---|---|---|---|---|---|---|---|---|
| The decreasing trend of rainfall availability has had any negative impact on crop yield over the years. | M | 0 | 0 | 1(1.2) | 58(69.1) | 25(29.7) | 4.52 | 1 |
| | F | 0 | 0 | 0 | 30(83.3) | 6(16.7) | 4.17 | 1 |
| The rise in temperature has had a negative impact on crop yield. | M | 0 | 1(1.2) | 1(1.2) | 59(70.2) | 23(27.4) | 4.24 | 2 |
| | F | 0 | 0 | 1(2.8) | 31(86.1) | 4(11.1) | 4.08 | 2 |
| Late commencement of rainfall will have an adverse effect on crops in terms of germination and growth | M | 0 | 3(3.6) | 4(4.8) | 61(72.6) | 16(19.0) | 4.07 | 3 |
| | F | 0 | 1(2.8) | 2(5.6) | 28(77.8) | 5(13.9) | 4.02 | 4 |
| Rain cessation earlier than usual reduces the yield of crops. | M | 1(1.2) | 2(2.4) | 7(8.3) | 63(75.0) | 11(13.1) | 3.96 | 6 |
| | F | 0 | 3(8.3) | 1(2.8) | 28(77.8) | 4(11.1) | 3.92 | 6 |
| Unpredictable weather changes favour diseases prevalence, which will affect crop | M | 0 | 1(1.2) | 19(22.6) | 55(65.5) | 9(10.7) | 3.86 | 7 |
| | F | 0 | 3(8.3) | 6(16.7) | 24(66.7) | 3(8.3) | 3.75 | 7 |

Source: Field Survey, 2020

**Climate Change Adaptation Strategies**

The results in Table 3 showed that the five most reported adaptation strategies employed by the male farmers were mixed cropping (WMS=2.63), mulching (WMS=2.58), use of improved varieties (WMS=2.25), crop rotation (WMS=2.21) and adjustment of planting period (WMS=2.20). For the female farmers, the five most reported adaption strategies were mixed cropping (WMS=2.58), mulching (WMS=2.58), diversification to non-farm activities (WMS=2.25), change in crop patterns and the use of improved varieties (WMS=2.22). These findings indicate that male and female farmers in the study area might have experienced the effects of climate change on their crops over time and as such, they were already adopting some strategies to combat those effects. The male arable crop farmers had a higher weighted mean score (WMS) of 9 out of the 13 adaptation strategies and as such, they are more likely to adopt more strategies than the female farmers. These may be due to several reasons, such as differences in power and responsibility as remarked by Adzawla *et.al*. (2019), differences in access to agricultural information and resources, where the male has an edge over the female. These findings were also buttressed by Twyman, *et al*. (2014) in a similar study of four sites in Africa on gender differences and perceptions on climate change, climate awareness and adoption of climatic smart agricultural practices. They found that both male and female farmers experienced changes in long-run weather patterns but with some changes in their behavior regarding agricultural practices. This necessitates the need to target women with climate and agricultural information in the event of any agricultural innovations. Specifically, more male farmers than females were more likely to adopt mixed cropping, mulching, use of improved varieties, crop rotation, adjustment of planting period, irrigation, mixed farming, shifting cultivation and mono-cropping. More female farmers than male farmers were more likely to use agroforestry, planting of cover crops, diversification to non-farm work and change in crop patterns. The findings that male farmers adopt more strategies for climate change effect mitigation than female farmers have also been reported in earlier studies by Jin, Wang and Gao (2015) and Wrigley-Asante, Owusu, Egyir and Owiyo (2019).

Table 3: Climate Change Adaptation Strategies of Male and Female Farmers

| | **MALE (n=84)** | | **FEMALE (n=36)** | |
|---|---|---|---|---|
| **ADAPTATION STRATEGIES** | | | | |
| | **WMS** | **RANK** | **WMS** | **RANK** |
| Adjustment of the planting period | 2.20 | 5 | 2.19 | 5 |
| Agroforestry | 1.69 | 13 | 1.78 | 11 |
| Change in crop pattern | 2.19 | 6 | 2.22 | 4 |
| Crop rotation | 2.21 | 4 | 2.05 | 7 |
| Diversification to non-farm activities | 1.98 | 9 | 2.25 | 3 |
| Irrigation | 2.08 | 7 | 2.06 | 6 |
| Mixed cropping | 2.63 | 1 | 2.58 | 1 |
| Mixed farming | 2.01 | 8 | 1.81 | 10 |
| Mono cropping | 1.96 | 11 | 1.86 | 9 |
| Mulching | 2.58 | 2 | 2.50 | 2 |
| Planting of cover crops | 1.87 | 12 | 1.97 | 8 |
| Shifting cultivation | 1.97 | 10 | 1.78 | 11 |
| Use of improved varieties | 2.25 | 3 | 2.22 | 4 |

WMS= Weighted Mean Score
Source: Field Survey, 2020

**Constraints to Effective Management of Climate Change**

The results in Table 4 showed that males ranked inadequate credit facilities (WMS=2.42) as the most severe constraints to effective management of climate change. Inadequate information about weather and climate (WMS=2.38) was rated the second most severe constraints. For the females, inadequate information about weather and climate (WMS=2.47), and inadequate credit facilities (WMS=2.39) were ranked as the first and the second most severe constraints to effective management of climate change effects. Other studies on constraints to climate change adapation segregated by gender have reported significant differences between men and women exists (Ampaireet. al.,2017). Similar findings were reported in Ghana by Assan*et al.* (2020) in a study on climate change perceptions and challenges to adaptation among smallholder farmers. Ndamani and Watanabe, (2016) in their study on determinants of farmers' adaptation to climate change in Ghana, identified unpredictable weather, high cost of farm input, poor knowledge of weather information and lack of access to water resources, as the most important constraints to use of adaptation strategies.

Table 4: Constraints to Effective Management of Climate Change

| **Constraints** | **Male (n=84)** | | **Female (n=36)** | |
|---|---|---|---|---|
| | **WMS** | **RANK** | **WMS** | **RANK** |
| Low knowledge of climate effects | 1.66 | 5 | 2.19 | 5 |
| Inadequate extension services and advice | 1.99 | 4 | 2.14 | 4 |
| Inadequate credit facilities | 2.42 | 1 | 2.39 | 2 |
| Inadequacy of appropriate tools and equipment | 2.35 | 3 | 2.36 | 3 |
| Inadequate information about weather and climate | 2.38 | 2 | 2.47 | 1 |

Source: Field Survey, 2020

**Mean Difference in Perceived Effects of Climate Change and Adaption Strategies of Male and Female Farmers**

Table 5 show the results of the mean difference in the perceived effects of climate change between male and female farmers. The mean score for the perceived effects of climate change for males was 42.3 compared to the mean score for females (41.2). Although the mean score for the perceived effects of climate change for male farmers was slightly higher than the mean score for the females, the difference was however not significant ($t=1.41$, $p>0.05$). Thus, the hypothesis that the male and female farmers do not differ in the way they perceived the effects of climate change was upheld. Similarly, the mean score for adaptation strategies for male farmers (27.7) was slightly higher than that of female farmers (27.3), further statistical analysis showed that the difference was not statistically significant ($t=0.38$, $p>0.05$). Thus, the hypothesis that male and female farmers do not differ in their adaptation strategies to manage the effects of climate change was also upheld. This implies that male and female farmers perceived the effects of climate change the same way and adopted similar adaptation strategies to effectively manage climate change.This analyses of gender differences in the perceived effects of climate change will drive policy and programmes aimed at mitigating the effects of climate change and adaptation strategies.This is in line with Bedeke*et. al*. (2019) in their study on the adoption of climate change adaptation strategies by maize-dependent smallholders in Ethiopia

**Table 5: Mean Difference in Perceived Effects of Climate Change and Adaption Strategies of Male and Female Farmers**

| Perceived Effects of Climate Change Score | N | Mean | Std. dev | 95 % CI | t (p-value) |
|---|---|---|---|---|---|
| Female | 36 | 41.22 | 3.05 | 40.19 - 42.26 | -1.41 |
| Male | 84 | 42.29 | 4.12 | 41.40 - 43.19 | (0.162) |
| Total | 120 | 41.98 | 3.86 | 41.28 - 42.67 | |
| **Adaptation Strategies score** | **N** | **Mean** | **Std. dev.** | **95% CI** | **t (p-value)** |
| Female | 36 | 27.36 | 4.12 | 25.97 - 28.76 | 0.384 |
| Male | 84 | 27.71 | 4.81 | 26.67 - 28.76 | (0.702) |
| Total | 120 | 27.60 | 4.60 | 26.78 - 28.44 | |

Source: Field Survey, 2020

**Relationship between Perceived Effects of Climate Change and Adaptation Strategies of Male and Female Farmers**

The results in Table 6 showed that there was a significant correlation between perceived effects of climate change and the adaptation strategies ($r=0.229$, $p<0.05$) among male farmers. However, for the female farmers, there was no significant correlation between the perceived effects of climate change and the adaptation strategies ($r=0.200$, $p>0.05$). The implication of the above results suggest that how male arable crop farmers perceived climate change may significantly influence their choice of adaptation strategies. However, the female arable crop farmers perceived that the effects of climate change may not necessarily determine their choice of adaptation strategies. Thus, in mitigating the effect of climate change, what the male and female farmers perceived as effects of climate should be considered for any successful intervention

Table 6: Relationship between Perceived Effects of Climate Change and Adaptation Strategies of Male and Female Farmers

| | Coeff | N | p-value |
|---|---|---|---|
| Male | 0.2287 | 84 | 0.0120* |
| Female | 0.2001 | 36 | 0.2419 |
| Total | 0.2336 | 120 | 0.0325* |

* Significant

## 4. CONCLUSION AND RECOMMENDATION

The male and female farmers shared more or less the same view about the climate change effects in terms of rainfall and temperature fluctuations in relation to agricultural production. As such, male and female farmers hardly differ in the deployment of climate change adaptation strategies which include mulching of planted crops, irrigation of plots as well as mixed cropping among others. While the relationship between perceived effects of climate change and adaptation strategies is significant for the male gender, this is not so for the female gender. The most important constraint for effective management of climate change adaptation strategies identified by the male and female farmers were inadequate weather information and measurement facilities, as well as inadequate credit facilities. The male and female respondents identified decreasing trend of rainfall and its attendant effect on crop yields, as the most perceived effect of climate change. More male farmers than females were found to adopt mixed cropping, mulching, use of improved varieties, crop rotation, adjustment of planting period and irrigation as their adaptation strategies. In conclusion, male and female farmers were more likely to perceive the effects of CC the same way and are more likely to adopt the same AS. Higher proportion of people live in rural communities in developing countries are disproportionately vulnerable to climate change and in dare need of strategies for climate adaptation. This poses a great threat to food security and the realization of global sustainable development goals. Consequently, both male and female farmers should be supported through climate smart extension services to empower them in mitigating the effects of climate change on their agricultural production activities. Also, constraints faced in adopting the identified strategies should be taken into consideration for the success of any climate change gendered policy.

## REFERENCES


Adams, V. M., Álvarez-Romero, J. G., Capon, S. J., Crowley, G. M., Dale, A. P., Kennard, M. J., & Pressey, R. L. (2017). Making time for space: The critical role of spatial planning in adapting natural resource management to climate change. *Environmental Science & Policy,* 74, 57-67.

Adzawla, W., Azumah, S. B., Anani, P. Y., &Donkoh, S. A. (2019). Gender perspectives of climate change adaptation in two selected districts of Ghana. Heliyon, 5(11), e02854.

Adzawla, W., & Kane, A. (2019). Effects of climate shocks and climate adaptation through livelihood diversification on gendered welfare gaps in northern Ghana. *Int. J. Environ. Clim. Chang,* 9(2), 104-119.

Ampaire, E. L., Jassogne, L., Providence, H., Acosta, M., Twyman, J., Winowiecki, L., & Van Asten, P. (2017). Institutional challenges to climate change adaptation: A case study on policy action gaps in Uganda. *Environmental Science & Policy, 75*, 81-90.

Arora, N. K. (2019). Impact of climate change on agriculture production and its sustainable solutions. *Environmental Sustainability*, 2, 95–96. https://doi.org/10.1007/s42398-019-00078-w

Aryal, J. P., Sapkota, T. B., Khurana, R., Khatri-Chhetri, A., & Jat, M. (2020). Climate change and agriculture in South Asia: adaptation options in smallholder production systems. *Environment, Development and Sustainability*, 22:5045–5075 https://doi.org/10.1007/s10668-019-00414-413

Assan, E., Suvedi, M., Olabisi, L. S., &Bansah, K. J. (2020). Climate change perceptions and challenges to adaptation among smallholder farmers in semi-arid Ghana: A gender analysis. *Journal of Arid Environments,* 182, 104247.

Bedeke, S., Vanhove, W., Gezahegn, M., Natarajan, K., & Van Damme, P. (2019). Adoption of climate change adaptation strategies by maize-dependent smallholders in Ethiopia. NJAS-Wageningen Journal of Life Sciences, 88, 96-104.

Chikezie, C., Ibekwe, U. C., Ohajianya, D. O., Orebiyi, J. S., Henri-Ukoha, A., Ukoha, I. I., ... & Anthony, G. (2016). Climate change and perceived climate hazards: A trend analysis in Southeast Nigeria. *International Journal of Weather, Climate Change and Conservation Research, 2*(1), 1-10.

Davis, U. C. (2020). Climate Change Terms and Definitions. University of California, Davis, One Shields Avenue, Davis, CA 95616 | 530-752-1011. Retrieved from https://climatechange.ucdavis.edu/science/climate-change-definitions/#:~:text=Climate%20change%20refers%20to%20significant,Ocean%20acidification%20is%20increasing.

Gupta, A., Yadav, D., Gupta, P., Ranjan, S., Gupta, V., &Badhai, S. (2020). Effects of climate change

on Agriculture. *Food and Agriculture Spectrum Journal,* 1(02), 103-107.

Jat, R. K., Sapkota, T. B., Singh, R. G., Jat, M. L., Kumar, M., & Gupta, R. K. (2014). Seven years of conservation agriculture in a rice–wheat rotation of Eastern Gangetic Plains of South Asia: yield trends and economic profitability. *Field Crops Research*, 164, 199-210.

Jin, J., Wang, X., & Gao, Y. (2015). Gender differences in farmers' responses to climate change adaptation in Yongqiao District, China. *Science of the Total Environment*, 538, 942-948

Kant, K., Sankhala, G., & Prasad, K. (2015). Constraints perceived by the dairy farmers in adapting to changing climate in Western Dry Region of India. *Indian J. Dairy Sci*, *68*(4), 399-407.

Karimi, V., Karami, E., & Keshavarz, M. (2018). Climate change and agriculture: Impacts and adaptive responses in Iran. *Journal of Integrative Agriculture,* 17(1), 1-15.

Lykhovyd, P. V. (2018). Global warming inputs in local climate changes of the Kherson region: current state and forecast of the air temperature. *Ukrainian Journal of Ecology*, 8(2), 39-41.

Malhi, G. S., Kaur, M., & Kaushik, P. (2021). Impact of climate change on agriculture and its mitigation strategies: A review. *Sustainability*, 13(3), 1318.

National Population Commission (NPC). 2006. Analysis of Nigerian 2006 Census Results

Ndamani, F. & Watanabe, T (2016). Determinants of farmers' adaptation to climate change: A micro level analysis in Ghana. *Scientia Agricola,* 73(3), 201-208 https://doi.org/10.1590/0103-9016-2015-0163

Rahman, M. I. U. (2013). Climate change: A theoretical review. *Interdisciplinary Description of Complex Systems: INDECS*, *11*(1), 1-13.

Riedy, C. 2016. Climate Change. The Blackwell Encyclopedia of Sociology. Wiley online library. https://doi.org/10.1002/9781405165518.wbeos0737

Smit, B., & Skinner, M. W. (2002). Adaptation options in agriculture to climate change: a typology. *Mitigation and adaptation strategies for global change, 7*(1), 85-114.

Swai, O. W., Mbwambo, J. S., &Magayane, F. T. (2012). Gender and perception on climate change in Bahi and Kondoa Districts, Dodoma Region, Tanzania. *Journal of African Studies and Development*, *4*(9), 218.

Twyman, J., Green, M., Bernier, Q., Kristjanson, P. M., Russo, S., Tall, A., ... & Badiane Ndour, N. Y. (2014). Adaptation actions in Africa: evidence that gender matters. CCAFS Working Paper.

United Nations Framework Convention on Climate Change (2011) : Fact sheet: Climate change science - the status of climate change science today https://unfccc.int/files/press/backgrounders/application/pdf/press_factsh_science.pdf

Wrigley-Asante, C., Owusu, K., Egyir, I. S., &Owiyo, T. M. (2019). Gender dimensions of climate change adaptation practices: the experiences of smallholder crop farmers in the transition zone of Ghana. *African Geographical Review*, *38*(2), 126-139