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CROP FARMERS' PERCEPTION OF RAINFALL VARIABILITY: A STUDY IN YANDEV, BENUE STATE

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Abstract
Agriculture plays a pivotal role in the livelihoods of many African nations, including Nigeria, where it contributes significantly to the Gross Domestic Product (GDP) and engages a substantial portion of the population. However, climate change and variability pose formidable challenges to the agricultural sector, especially in developing countries. This study examines the intricate relationship between climate change and agriculture in Nigeria, with a focus on its impact on the livelihoods of rural farming communities.
Climate change is a global phenomenon, and its repercussions are acutely felt in the agricultural sector, particularly in regions like sub-Saharan Africa. This vulnerability is exacerbated by the heavy dependence of Nigerian agriculture on climate patterns. Changes in climate variables, such as temperature and rainfall, directly affect agricultural productivity, potentially leading to food insecurity and economic hardship.
In this context, we explore the specific challenges faced by rural farming households and communities in Nigeria due to climate variability. The study highlights the need for adaptive strategies and policies to mitigate the adverse effects of climate change on agriculture and ensure the sustainability of rural livelihoods.

Keywords: Climate change, agriculture, Nigeria, rural livelihoods, adaptation strategies.

1 Introduction

Agriculture is the mainstay of the local livelihoods and national Gross Domestic Product (GDP) in many African countries (Mandelsohn *et al.*, 2008). In Nigeria, an agrarian country, about 70% - 80% of the population engages in agricultural production at a subsistence level (National Report, 2006; Tunde, Usman and Olaweopo, 2011), and the agricultural sector accounts for one-third of the GDP of the country (Muhammad-Lawal and Atte, 2006).

Climate change and variability are now well accepted globally, especially for the past century (Diaz and Bradley, 1997) and their impacts pose a massive threat to socio-economic development especially in poor countries (Adger *et al.*, 2003; Boyd *et al.*, 2009). Climate change and variability are phenomena that have the potential of affecting all natural and human systems and may be a threat to human development (Ayoade, 2003). Climate plays dominant role in agriculture, having direct impact on farmers that depend on agriculture as their only source of food (Smit and Skinner, 2002). Agriculture, forestry, hydrology and fisheries are most likely to be affected by climate variability and change (Mandelsohn *et al.*, 2008). Agriculture is most vulnerable to climate change and variability in the tropics because weather and climate are most important variables in agricultural production (Ayoade, 1988).

Agriculture in Nigeria is entirely dependent on climate, and any changes in climate are bound to affect it. The existence of various climatic zones in the country has enabled the production of a wide variety of food and cash crops. However, food production could not keep pace with population increase due to the negative effects of climate change (Tunde *et al*., 2011). In Nigeria, like other sub-Saharan African countries, there is growing evidence of climate variability and potential impact on farming, particularly those of the poor and vulnerable rural farming households and communities.

Most families in rural communities are highly vulnerable to climate variability due to the native nature of farm activities they engage in, such as crop farming, fishing, and animal rearing which are all climate dependent. Therefore, any change in climate trends will negatively affect rural farming activities (Aliyu, 2002). This in turn, may lead to worsening of the food insecurity situation which is already well pronounced and documented in Nigeria (Babatunde, Omotosho and Sholotan, 2007).

Rainfall is the most variable of all climatic elements and determines the growing season of crops in the tropics (Ayoade, 1988). Compared to other elements, spatial and temporal variation in rainfall variables exerts greater influence on agriculture in Nigeria (Ayoade, 1988), and coupled with lack of adaptive capacities constitute a major limiting factor for rainfed agricultural production in smallholder farming systems across sub-Saharan Africa (Waonga, Laux and Kunstmann, 2015). Changing trend in rainfall characteristics has the potential to influence crop production significantly. Rainfall characteristics influence crop production from site selection to yield in Benue State (Tyubee, 2006). The duration and frequencies of wet and dry spell have been reported to have a tremendous effect on farming planning in the Middle Belt of Nigeria (Tyubee and Iwan, 2019). Studies have shown that the observed effect of variability in rainfall variables on crop yield varies from 17% (sorghum) to 98% (cassava) from 1986 to 2002 in Benue State, Nigeria (Tyubee, 2006). In their study, Adamgbe and Ujoh (2013) documented that variation in rainfall variables account for 67.7% of variation in maize yield from 1980 – 2009 in Yandev district, Gboko LGA, Benue State, Nigeria.

The smallholder farmers, particularly in rural areas and communities, are among the most adversely affected by climate change and variability (Byod *et al*., 2009; Domingo *et al*., 2009. In Nigeria, and in other subSaharan African countries, rural population comprises about 70% of the national population (Khan, 2001).The knowledge and perceptions of farmers about climate change and variability would influence the way they respond to climate variations (Dinse, 2011). Local societies already have some knowledge of local climate change and variability as parts of their local ecological knowledge obtained and transferred through generations (Berke *et al*., 2000). The farmers understand climate change and variability primarily based on weather-crop interaction and climate fluctuation events (Traoré *et al*., 2000).

The perceptions of farmers have the tendency of influencing their coping strategies which ultimately determine the extent to which climate impacts agriculture (Ajadi, Adeniyi and Afolabi, 2011; Mamba, Salam and Peter, 2015). The understanding of rural farmers about climate change and variability is crucial in their ability to manage climate-related hazards (Cutter *et al*., 2008) and in addressing the negative effect of climate change impact on livelihoods (Dube and Phiri, 2013). Information on small scale farmers' perception of climate change and variability is necessary because they are not only beneficiary, client or co-learner in agricultural extension efforts but they are also contributors of cultural, traditional, agricultural and environmental wisdom which could define a more relevant technology and the successful adoption of the technology (Smit and Skinner, 2002).

It is widely believed that most rural crop farmers in Yandev district of Gboko Local Government Area (L.G.A.) of Benue State, like other rural crop farmers in Nigeria and in many sub-Saharan African countries, take decisions on farming operations and activities based on what they think or perceive but not necessarily based on the available scientific evidence or forecasts. In Nigeria, every year the Nigerian Meteorological Agency (NIMET) issues Seasonal Rainfall Prediction (SRP) for the country in

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order to guide farmers and other stakeholders in planning and decision making during the rainy season but it is not certain whether farmers make use of the SRP for planning their farming activities. Assessing farmers' perception on rainfall variability and its impacts and adaptation is fundamental in food security, security of livelihoods and reduction in on-farm losses due to rainfallrelated impacts. Therefore, this study was designed to assess crop farmers' perception and evaluate their adaptation strategies to rainfall variability in Yandev district with a view of recommending towards enhancing crop production and improving the livelihoods of the farmers.

2 Materials and Methods

2.1 Description of the study area

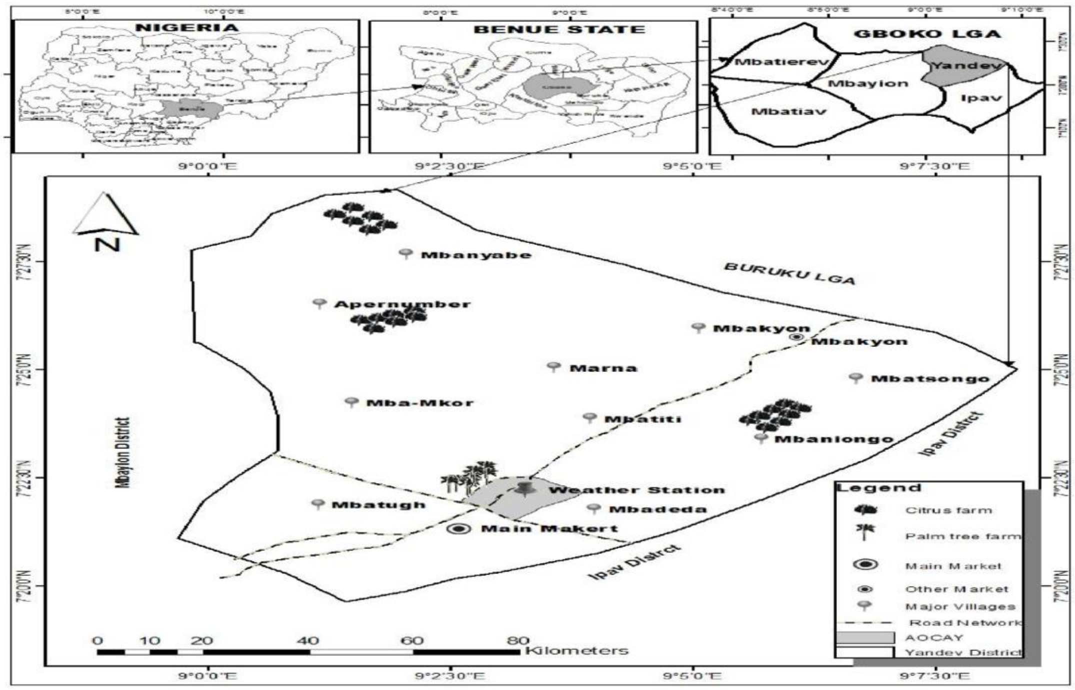
Yandev district is located in the north eastern part of Gboko Local Government Area (L.G.A.) within latitudes $7^{o}\ 05^{'}$ – $7^{o}\ 35^{'}$N and longitudes $8^{o}\ 37^{'}$ – $9^{o}\ 15^{'}$E (Figure 1). Yandev district, which is one of the five districts of Gboko L.G.A., covers an area of 207km^{2} and is bordered to the north by Buruku L.G.A., to south east by Ipav district and in the south west by Mbayion district. The population of Yandev district was 7, 750 people in 2006 (National Population Census data) and it was projected to reach 12, 000 people in 2019 using growth rate of 3.0% per annum.

The relief of the area is undulating with elevation ranging from 88m in the north and north east to 461m in the south, bordering the Mkar hills. The area is drained by rivers Kontien, Ahngwa, Ambor, Ngo and Nguembi. The study area experiences tropical wet and dry climate (Aw type).

The rainy season occurs from April to October with maximal peak in September (237mm), while dry season occurs from November to March (Figure 2a). The monthly rainfall distribution is characterised by a rainfall decline in June, a phenomenon widely refered to as the little dry season in West Africa (Ayoade, 1988). Annual rainfall ranges from 900 – 1600mm with a mean annual rainfall of 1300 mm (1981 – 2017). The mean monthly temperature increases from 27^{o}C, in January, to 30^{o}C in March and April and declines to 27^{o}C during the rainy season which is attributed to decrease in solar energy receipt at the surface due to increase in atmospheric water vapor and cloud cover (Figure 2b).

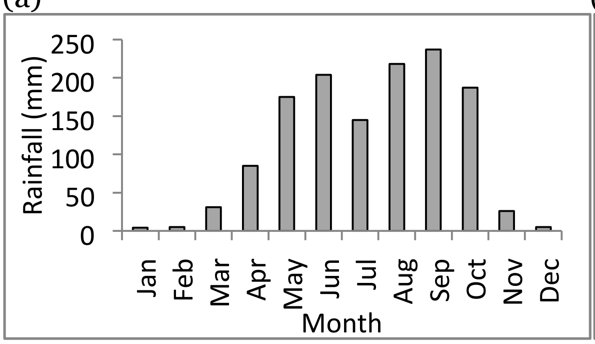
Farmers inYandev district are dominantly indigenous Tiv people of north central Nigeria. They practice subsistence farming and grow a wide range of crops such as *Dioscorea rotundata* (white yam), *Dioscorea alata* (water yam), *Manihot esculenta* (cassava), *Zea mays* (maize), *Glycine max* (Soya bean), *Sesamum indicum* (beniseed or sesame), *Sorghum vulgare* (guinea corn or sorghum), *Panicum miliaceum* (millet), *Arachis hypogaea* (groundnut), *Oryza sativa* (rice), *Solanum lycopersicum* (tomato) and *Capsicum annuum* (chili pepper). Tree crops are also grown by farmers in the study area such as *Citrus sinensi,* (sweet orange), *Mangifera indica* (mango), *Elaeis guineensis* (oil palm) and *Anacardium occidentale* (cashew).

Figure 1.1: Location of the study area.



Source: Modified from the Administrative Map of Gboko LGA, 2016

(a)



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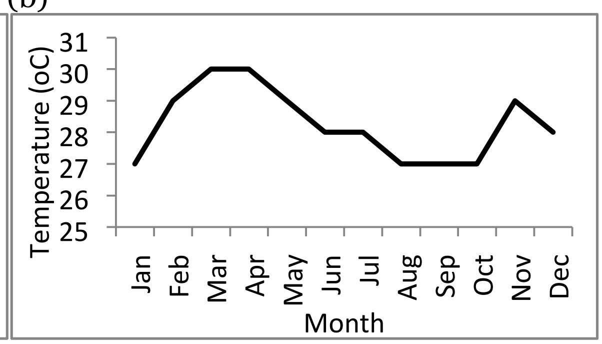

Figure 2: Distribution of mean monthly rainfall (a) (1981 – 2017) and mean monthly temperature (b) (2004 – 2017) in Yadev district.

Farmers in Yandev district have a comparative advantage over other farmers in Gboko L.G.A. due to the location of Akperan Orshi College of Agriculture, Yandev (AOCAY) in the district. The AOCAY institution was established as Farm Training Center by the former Regional Government of Northern Nigeria in 1926 and provides free or subsidised extension services and improved seedlings to farmers in the host community as its corporate social responsibility.

2.2 Data need and sources

Data on crop farmers' perception covered rainfall variables (onset and cessation of the rainy season, and annual rainfall), impact of rainfall variability on crop production and adaptation strategies to rainfall variability. The perception data were acquired from crop farmers in the study area. Rainfall variables of onset and cessation of the rainy season, and annual rainfall were chosen because their direct influence on crop production in the study area (Tyubee, 2006; Adamgbe and Ujoh, 2013).

Rainfall data were obtained from Akperan Orshi College of Agriculture, Yandev (AOCAY) weather station for a period of 37 years (1981 – 2017). Though the weather station was established in the 1950s, regular data collection commenced in 1979. In perception studies on climate change and variability, climate data are used to confirm local farmers' assessment of climate change (and variability) (Traoré *et al*., 2016).

2.3 Study population and sample size of respondents

The study population covered all indigenous arable crop farmers who have lived and carried out farming business for a minimum of 20 years in Yandev district. For the purpose of this study, attention was focused on registered crop farmers who are members of farmers' cooperative societies. This is due to the ease of accessing them compared to the non-registered farmers.

A reconnaissance survey was first conducted in the study area to ascertain the number and membership of existing farmers' cooperative societies. A total of five registered farming cooperative societies were found in the district with a total population of 428 members. Each of the five cooperative societies comprised farmers who cultivate same crop(s). Out of the five societies, four cultivate arable crops as their main crops while one grows arable crops as its secondary crops (Table 1). The membership of the societies ranged from 10 (Mbaiwar crop farmers' cooperative society) to 228 (Kyado pepper and tomato L.t.d.) (Table 1).

A uniform sample size of 25% of the total population of crop farmers for each society was adopted. This is based on the assumption that the crop farmers lived in the same community and participated in similar farming activities, and are thus fairly exposed to similar impacts of rainfall variability. The 25% sample size translated to the number of selected farmers ranging from 3 farmers (Mbaiwar crop farmers' cooperative society) to 57 farmers (Kyado pepper and tomato L.t.d) with a total sample size of 107 farmers (Table 1). A table of random numbers was used to select the number of sampled farmers from the list of registered farmers of each society in order to eliminate bias and to ensure that each farmer had equal chance of being selected. The list of farmers, for each of the five farming societies, was acquired during the reconnaissance survey from Yandev office of farmers' cooperative societies.

Table 1: Farming cooperative societies and sample size of crop farmers used in the study

S/n	Names of farming groups	Reg.number	Names of crops	Number of members	Sample size
1	Yandev crops producers' cooperative society	1998/7321	Groundnut and Cassava	49	12
2	Kyado pepper and tomato L.t.d	2000/8974	Pepper and tomatoes	228	57
3	Mbaiwar tree crop farming cooperative society	2001/9290	Yam and maize*	25	6
4	Mbaiwar crop farmers' cooperative society	2009/13660	Rice	10	3
5	Mbaikyon Soya beans farmers' cooperative society	2015/19827	Soya beans	116	29
	Total			428	107

*The society members cultivate yam and maize in their tree crops plantations

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2.4 Study variables

The farmers' perceived rainfall variables used in the study were onset and cessation of rainy season, and annual rainfall. A total of four crop production variables were selected namely time of land preparation and cultivation, time of sowing, time of application of fertilizers and crop yield. The adaptation strategies of farmers to cope with rainfall variability adopted in the study are change in farming system (C.F.S) (e.g. mono to multi cropping), change in farming method (C.F.M) (e.g. subsistence to mechanized), diversification of livelihood sources (D.L.S) (e.g. additional sources of income than farming), change in major crop grown (C.C.G) (e.g. tomato to rice), change in main occupation (C.M.O) (e.g. farming to civil service), and change in farming location (C.F.L) (e.g. lowland to upland). All the farmers'perceived variables, climate and non-climate, were selected based on the existing literature on climate-crop relationship.

The observed rainfall variables, onset and cessation of rainy season, and annual rainfall, were derived from the rainfall data collected.There are several methods of computing onset and cessation (end) of the rainy season using only rainfall data. Walter's (1967) method utilised accumulated monthly rainfall amount (beginning from January of each year), using the threshold of 51mm, to determine the onset and cessation date. Ilesanmi (1972) used percentage of the mean annual rainfall that occurs at each 5-day interval to compute onset and cessation data, while Tarhule and Woo (1998) used dry and wet spell sequences in their computation. Walter's (1967) method was adopted in the study because of its higher predictive reliability among other methods (Bello, 1995). The method is expressed as:

Where DM, is the number of days in the month containing the date of onset/end; A, is the accumulated total rainfall of the previous months; TM, is the total rainfall for the month in which 51mm or more is reached, and 51mm, is the threshold of rainfall for both onset and end month.

The annual rainfall amount (mm) was computed by summing the monthly rainfall amounts of the 12 calendar months for each of the 37 years (1981 – 2017). For computational purpose, dates of onset and cessation (end) of the rainy season were converted to Julian days using a 365-day calender year (i.e. 1st January = 1 day, 1st February = 32 days and 31st December = 365 days).

2.5 Data collection

The perception data from crop farmers were collected using a structured questionnaire. The socioeconomic characteristics of the respondents were covered in section A. The perception of farmers on rainfall variability and impact of rainfall variability on crop production were contained in sections B and C. Section D covered the perceived adaptation strategies to rainfall variability by crop farmers. A total of 107 copies of the questionnaire were produced in English and administered to the respondents. A total of 13 respondents could not read and the questionnaire was interpreted to them in the native Tiv language.

2.6 Data analysis

The data collected on farmers' perception were analysed using frequency distribution (f) and percentage (%), while trend in the observed variability in the three rainfall variables was analysed using correlation analysis.

3 Results and discussion

3.1 Socio-demographic characteristics of respondents

3.1.1 Age distribution

The result of age distribution of respondents showed that majority of the farmers (31%) are within the ages of 45-54 years and 3% of the farmers are within the ages of 75-84 years and no farmer is above 85 years (Figure 3). In addition, the result showed that 78% of the farmers fall within the productive age group (35 - 65 years) and only 22% of the farmers are above 65 years. Age is an important factor in

farming as it affects experience which is also crucial in agricultural productivity. It is beneficial to farming business in the study area that majoity of the farmers are within the productive age group. This is because crop production requires a lot of energy and working hours. However, aged farmers (above 65 years) play important role in agriculture particularly
to the younger farmers by sharing their worth of experience acquired over several decades in farming.

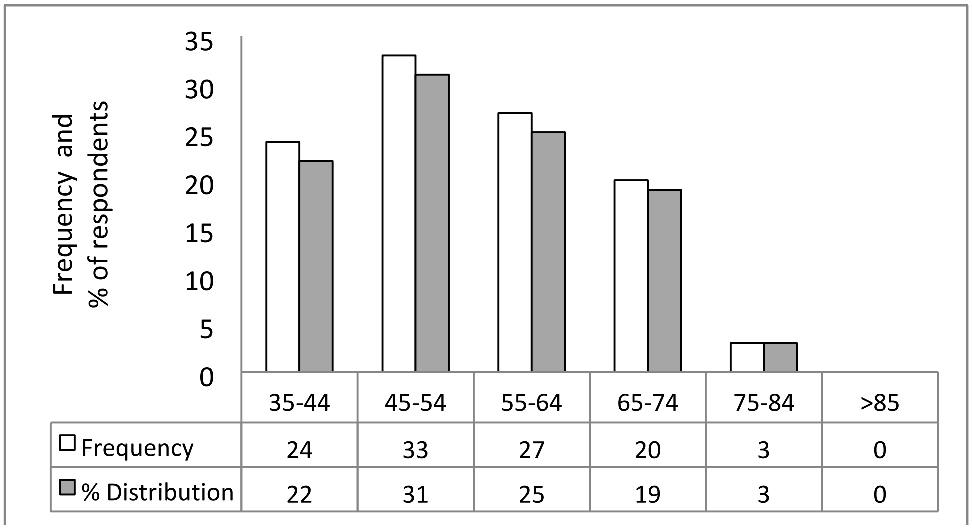

Figure 3: Age distribution of respondents (n=107)

3.1.2 Sex distribution

The result of sex distribution of respondents has revealed that 60 farmers, representing 56%, are male, while 47 of the farmers, representing 44% are female (Table 2). However, the male-female farmer ratio varies among the societies and crops. The sampled farmers in Mbaiwar crop cooperative society are all males. The female farmers are majority (58%) over male farmers (42%) in pepper and tomato farming. The result implied that farming of more labour-demanding crops such as cassava, yam, soya beans and maize is dominated by male farmers, while females are dominant in the farming of less labour-intensive crops like tomato and pepper.

Table 2: Sex distribution of respondents

S/n	Names of farming groups	Male		Female		Total	
		F	%	F	%	F	%
1	Yandev crops producers' cooperative society.	8	67	4	33	12	100
2	Kyado pepper and tomato L.t.d	24	42	33	58	57	100
3	Mbaiwar tree crop farming cooperative society	5	83	1	17	6	100
4	Mbaiwar crop farmers' cooperative society	3	100	0	0	3	100
5	Mbaikyon Soya beans farmers' cooperative society	20	69	9	31	29	100
	Total	60	56	47	44	107	100

F=frequency; %=percentage

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3.1.3 Distribution by marital status

The result of the distribution of respondents by marital status indicates that majority of the respondents (93%) are married whereas 1%, 2% and 4% are single, divorced and widows respectively (Figure 4). The result has implication on crop production in the study area. Married and widowed farmers are more likely to pay more attention on any rainfall variability because they have families to feed and cater for, and their primary source of livelihood comes from farming activities. In addition, variation in rainfall has a direct impact on farm production which in turn may have impact on their families' wellbeing.

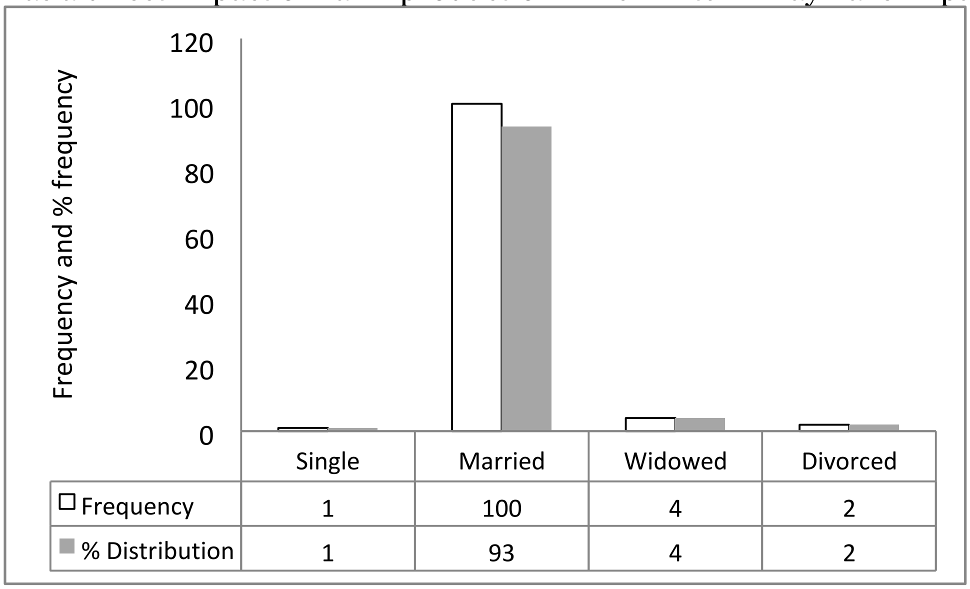

Figure 4: Distribution of respondents by marital status (n=107)

3.1.4 Distribution by level of education

The result showed that majority of farmers (44%) have acquired secondaryeducation and only 5% have acquired tertiary education. Similarly, 39% and 12% of the farmers have primary and non-formal education (Table 3). Generally, 88% of the farmers have acquired formal education and 12% of the farmers did not acquire formal education. The level of education is vital because literacy, which is obtained through education, has been noted as one of the factors that enable farmers to obtain as well as process applicable information (Manyatsi *et al*., 2012). It is also anticipated that the level of education does play a crucial role in influencing the adoption level of new innovations by farmers as well as decision making process. The farmers who are educated may likely be able to communicate and also to adopt new farming techniques. According to Kurukulasuriya *et al*. (2006), education and experience of farmers are critical in perceiving and responding to variation of climate.

Table 3: Distribution of respondents by level of education

S/n	Educational level	Frequency	Percentage
1.	Non-Formal/Adult	13	12%
2.	Primary	42	39%
3.	Secondary	47	44%
4.	Tertiary	5	5%
	Total	107	100

3.2 Rainfall variability

3.2.1 Farmers' perceived rainfall variability

The result of farmers' perception on rainfall variability in the study area is presented in Table 4. The result indicates that 82 farmers (77%) were of the opinion that onset of rainfall is becoming late; 7 farmers (6%) perceived that onset of the rainy season is becoming early, and 18 farmers (17%) said that changes in onset of rains are negligible. For the cessation of rainy season, 88 farmers (82%) opined that there is a declining trend (early cessation), whereas 16 and 3 farmers, representing 15% and 3% respectively perceived an increasing trend in cessation of rainy season (late cessation) in the study area. Moreover, majority of farmers (37%) in the study area observed that change in annual rainfall is negligible, whereas 38 farmers (36%) and 29 farmers (27%) are of the opinion that annual rainfall is declining (i.e. it is becoming drier) and increasing (i.e. it is becoming wetter) respectively (Table 4).

Table 4: Farmers perception of rainfall variability

S/n	Rainfall Variable	Declining F	%	Increasing F	%	Negligible F	%	F	%
1	Onset of rainy season	7	6	82	77	18	17	107	100
2	Cessation of rainy season	88	82	16	15	3	3	107	100
3	Annual rainfall	38	36	29	27	40	30	107	100

F=Frequency; % = percentage

In general, the majority of farmers in the study area have perceived an increasing trend in onset of the rainy season (delay or late onset), decreasing trend in cessation of rainfall (early cessation) and a negligible change in annual rainfall in the study area. The result indicated that farmers in the study area have perceived delayed onset and early cessation of the rainy season suggesting that the duration of the growing season of crops is becoming shorter (Table 4). The result on onset and cessation of the rainy season is in line with farmers' perception in Dire Dawa Administration (Eastern Ethiopia) and Swaziland where late onset and early cessation of the season were also reported by Kidanu *et al.* (2016) and Mamba *et al.* (2015) respectively. Moreover, though the farmers with contrary opinion on variation in the three rainfall variables are a minority, their perceptions are important to consider as they give the idea that different farmers perceive climate change/variability differently as supported by Dhaka *et al.* (2010) and Mamba *et al.* (2015). This also highlights the need for all farmers to be exposed to climate information, particularly rainfall prediction to enable them make informed decisions on farming investment and adaptation strategies.

3.2.2 Observed rainfall variability

The observed variability in onset and cessation of the rainy season, and annual rainfall are presented in Figures 5 – 7. The result showed that earliest and latest onset of rainy season occurred on 25th January 2013 and 19th May 2016, while the mean onset date for the study area is April 15th. The onset dates were generally above the mean date (April 15th) for most of the years particularly from 1991 – 2000 (Figure 5). The trend in onset of the rainy season is increasing (r = 0.017) indicating a delay or late onset of the rainy season in the study area.

The earliest and latest cessation of rainy season in the study area occurred on September 24th (1983) and November 24th (2014 and 2016) while the mean cessation date is October 24th. Like onset of the rainy season, the 1990s experienced higher than average cessation dates (Figure 6). Also, the trend in the cessation of the rainy season is positive and increasing (r= 0.285) suggesting that cessation of the rains is becoming late (i.e. delay in the cessation of the rainy season) which is good for crop production (Figure 6).

The highest and lowest annual rainfall of 1894mm and 904mm were recorded in 1997 and 1983 respectively, and the last decade (2001 – 2010) recorded higher than normal rainfall (Figure 7). Moreover, there is an increasing trend in annual rainfall series (r= 0.144) which indicates that the annual rainfall in the study areas is becoming higher than normal. Unlike onset and cessation of the rainy season, annual rainfall variation showed above average values from 2004 to 2013 (Figure 7).

The results of observed variability in the three rainfall variables (Figures 5 – 7) have shown that onset of the rainy season is becoming late while cessation is becoming late in Yandev district. This implies that there is a gradual shift in the duration of the rainy season from mid April to mid October to late April to late October respectively. The result has mixed implication for crop farmers; whereas late or delay onset of the rainy season is disadvantageous to farmers, late or delay cessation or end of the rainy is a blessing to them.

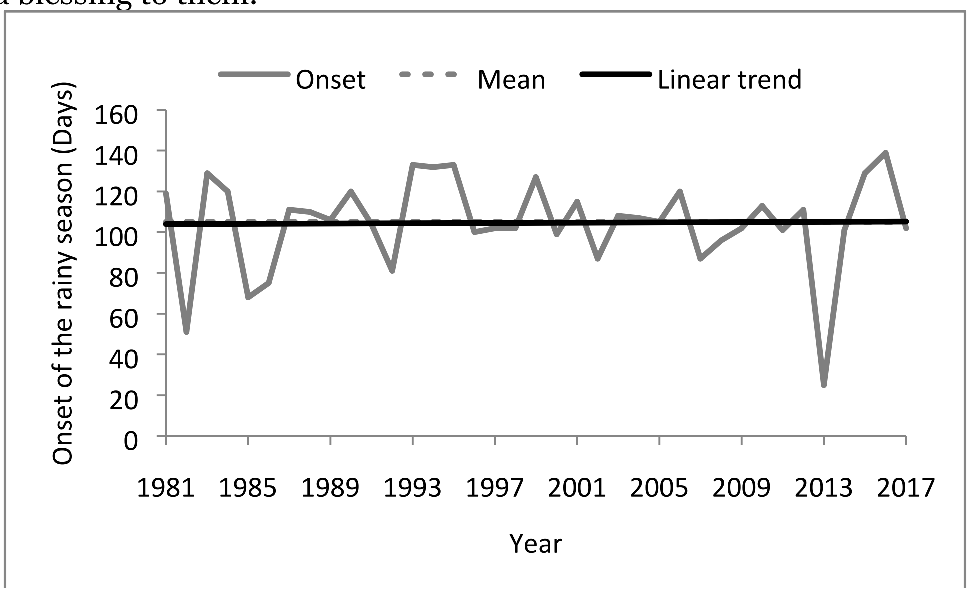

Figure 5: Fluctuation and trend in onset of the rainy season in Yandev district (1981 – 2017)

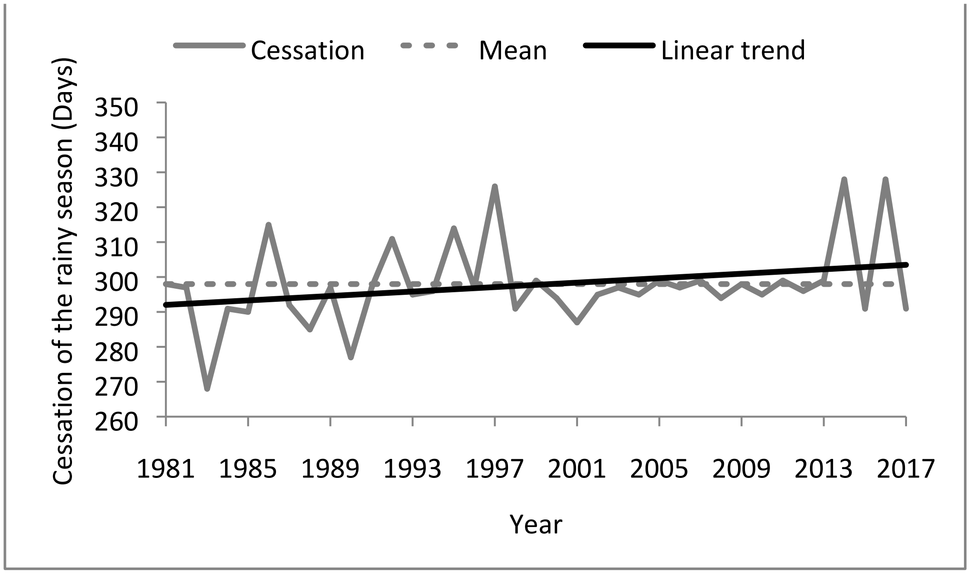

Figure 6: Fluctuation and trend in cessation of the rainy season in Yandev district (1981 – 2017)

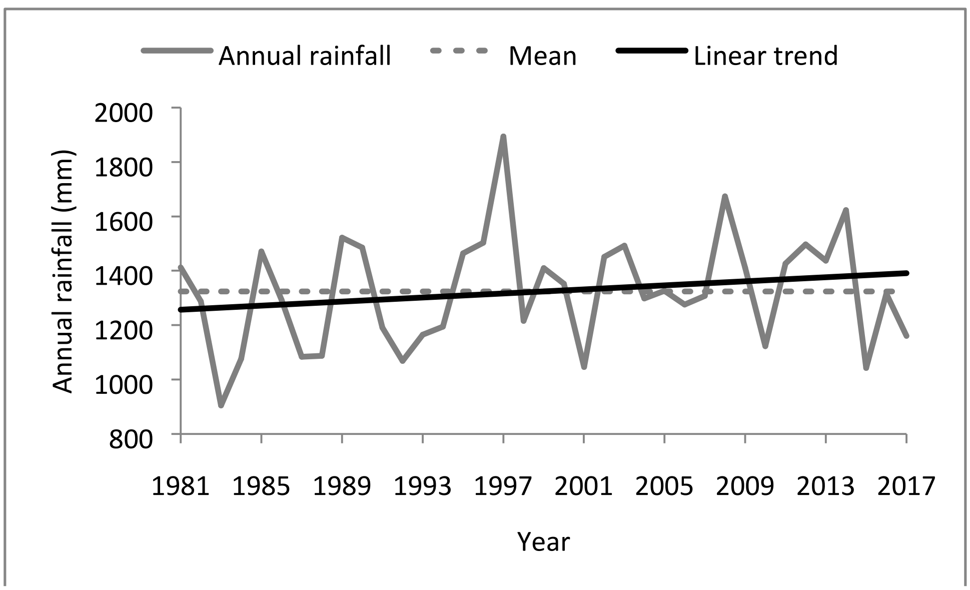

Figure 7: Fluctuation and trend in annual rainfall in Yandev district (1981 – 2017)

Comparing the result of perceived and observed data, there is agreement between farmers' perception and observed variability for onset of the rainy season than for cessation or end of the rainy season, and annual rainfall. This is because farmers are often more affected by onset of the rains which influences cropping activities such as land preparation, cultivation sowing and planting. Most farmers use the first few rain events for land preparation and cultivation whereas sowing and planting take place after several rain events when the soil has acquired adaquate moisture to quarantee sowing and the survival of seedlings. Some farmers mulch their crops to reduce evapotranspiration and prevent wilting of seedlings.

The variance between farmers' perceived and the observed trend in cessation of the rainy season is attributable to the fact that some crops such as pepper and tomatoes are grown and harvested within

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the rainy season and may not encounter abrupt changes at the end of the rainy season. Thus, farmers whose crops have longer duration or are cultivated later in the rainy season are more likely to experience yearly changes in cessation of the rainy season. Thus the farmers that are more likely to experience increasing trend in cessation dates in the study area may be those that cultivate crops with longer growing cycles such as yams and guinea corn or those that cultivate benniseed and dry season millet towards the end of the rainy season.

3.3 Perception on impact of rainfall variability on crop production

The result on perception of impact of rainfall variability on crop farming indicates that 93 farmers (87%), 68 farmers (64%), 90 farmers (84%) and 86 farmers (80%) were of the opinion that rainfall variability affects time of cultivation of crops, time of planting, time of fertilizer/herbicide application and crop yields in the study area (Table 5).

The result suggests that majority of the farmers (64 – 87%) are aware of the potential influence of climate variability on crop production. This could be attributed to the knowledge and experience acquired over the years and those inherited from their forefathers. In addition, farmers in the study area were aware that delayed onset, early cessation and low annual rainfall could pose great danger to crop production by causing crop failures, poor harvest and permanent wilting of seedlings and crops.

Table 5: Perceived impact of climate variability on crop farming

S/n	Description	None		Little		Much		Total	
		F	%	F	%	F	%	F	%
1	Time of cultivation	0	0	14	13	93	87	107	100
2	Time of planting/sowing	2	2	37	34	68	64	107	100
3	Time of application of fertilizer/herbicides	0	0	17	16	90	84	107	100
4	Crop yields	0	0	21	20	86	80	107	100

F=Frequency; %=Percentage.

3.4 Perception on adaptation strategies to rainfall variability

The result of farmers' preference of adaptation strategies to rainfall variability is presented in Figure 8. The result revealed that 11% of the farmers accepted change of farming system (C.F.S) and change in main occupation (C.M.O), 13% agreed on change in major crop grown (C.M.G), 44% preferred change in farming location (C.F.L), 45% chose change in farming method (C.F.M) and 74% agreed that diversification in livelihood sources (D.L.S) is their preferred adaptation strategy (Figure 8).

Most of the farmers practiced subsistence mono cropping, without other sources of livelihood, and rainfall related or induced crop failures and losses are likely to impact negatively on their crop yields and household income. These are most probably the reasons why the farmers are increasingly becoming discontent with their status quo farming practices and are turning towards diversification. According to van den Berg (2010), natural hazards could induce people with relatively remunerative livelihoods (such as farming) to choose more defensive strategies which allow them to survive. Thus, the choice of D.L.S and C.F.M as the best adaptation strategies by crop farmers may be related to several benefits associated with both strategies. Some of these benefits include additional sources and security of income that would adequately cushion the negative effects of seasonal rainfall variability and cater for the growing family needs for good education, health care, transport and housing.

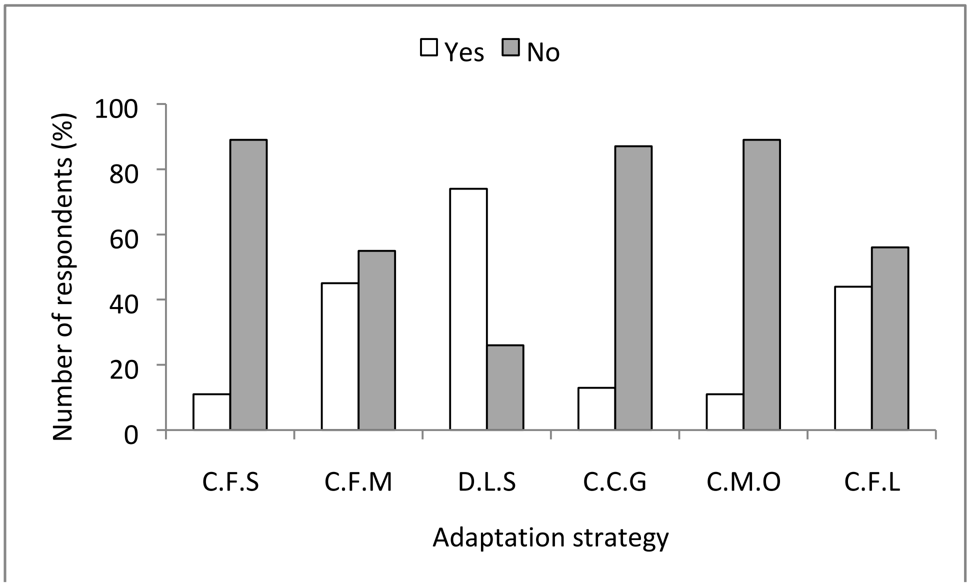

Figure 8: Farmers perception on adaptation strategies to rainfall variability (n=107).

4. Conclusion

The study has revealed that the males have dominated in farming of more labour-demanding crops such as cassava, yam, soya beans ad maize, while females are dominant in the farming of less labour-intensive crops like tomato and pepper. Farmers have perceived delayed onset of the rainy season, early cessation (end) of the rainy season and a negligible change in annual rainfall in the study area.

However, farmers' perceived trend in the three rainfall variables correctly correlates with only the observed trend of onset of the rainy season, and to some extent annual rainfall. Majority of the farmers (64 - 87%) agreed that changes in the rainfall variables have great impact on time of cultivation, planting and application of fertilizers, and crop yields. Moreover, majority of the farmers (74%) have identified diversification in livelihood sources as the major adaptation strategy to rainfall variability. It is recommended that efforts to improve farmers' awareness and application of climate information, especially the seasonal rainfall prediction (SRP) by the Nigerian Meteorological Agency (NIMET) should be increased, and future policies should ensure enhanced access to credit/loan facilities by farmers to enable them implement the appropriate adaptation strategies.

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