academicJournals

Vol. 10(11), pp. 1288-1294, 12 March, 2015
DOI: 10.5897/AJAR2014.8946
Article Number: 2B7CD5D51450
ISSN 1991-637X

http://www.academicjournals.org/AJAR

African Journal of Agricultural Research

Full Length Research Paper

Farmers' perception on climate change in Sokoto State, Nigeria

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Received 25 June, 2014; Accepted 11 March, 2015

The study examined farmer's perception on changes in climate variables in Sokoto State. Eight local government areas in Sokoto East senatorial district were purposively selected due to their vulnerability to climatic changes. Proportionate sampling was employed to select the eight villages. A total of two hundred and twenty three (223) questionnaires were administered. Descriptive statistics was used to analyze socio-economic characteristics of the farmers. ANOVA was used to test the significant differences between climatic variables in ten years. The results indicated that majority of the respondents (67.9%) agreed that rain normally starts by April-May and that the month of August had the highest amount of rainfall; and 2010 recorded the highest amount of rainfall in ten years from 2000-2010. It was evident from the results that the highest dry spell was recorded in 2011. 56.1% of the respondents perceived that August was the period of lowest temperature (31.97°C) and 20.6% reported that the year 2008 had the highest temperature (36.91°C) in ten years, from 2000-2010. Farmers were aware of the increased change in the climatic indices. It is recommended that farmers need to be sensitized on the importance of afforestation programme to mitigate climate change.

Key words: Perception, climate change, climate variables.

INTRODUCTION

Climate change is a change in the statistical distribution of weather over long periods of time that ranges from decades to millions of years (Cramer et al., 2001). This usually refers to changes in the climatic variables such as temperature, rainfall, wind and humidity. The continuous increase in atmospheric concentration of carbon dioxide due to the release of gasses from the continuous burning of fossil fuel by human activities is predicted to lead to significant change in climate (Cox et al., 2000) more generally known as "global warming". Developed countries are responsible for most of the causes of this phenomenon that affects the developing countries of the world. For example Africa, with about 25% of the world's arable land, contributes only 10% to the global agricultural output (Jayaram et al., 2010). The increased frequency, intensity and magnitude of drought and floods have adversely impacted food and water security, water quality, energy and sustainable livelihoods of rural communities in the study area (AAI, 2006).

People have perceived changes in rainfall and

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temperature patterns over the years on evidences of climate change, the area south of the Sahara are worst hit. Mendelsohn et al. (2006) found that farmers' perception on climate change as affected by an increase in temperature; reduced intensity and distribution of rainfall in many African countries has improved.

Adger et al.(2007) perception on climate change showed that a significant number of farmers believe that temperature has already increased and that rainfall pattern has declined for African countries leading to low yield of agricultural crops, less vegetation for livestock and water for irrigation. Due to the limited water resources agricultural policies play a vital role in agricultural water management. Africa has the most population growth in the world while, the actual yield as percentage of potential yield is 40% for North Africa, and 30% for Sub-Saharan Africa (FAO 2012). Africa needs specific attention; Namara, et al. 2010, mentioned the role of agricultural water management as a panacea to reduce poverty in the world.

Valipour (2012) working in North Africa mentioned the status of irrigation and rain-fed agriculture in the world and summarized the advantages and disadvantages of irrigation system, and attempt to update irrigation information. The result shows that 46% of cultivated areas in the world are not suitable for rain-fed agriculture because of climate changes and other metrological conditions. The value of irrigation equipped areas as share of cultivated areas was 5.8% and value of water management areas as share of cultivated areas was 6.7% for Africa. Burney et al. (2013) argued favorably on the impact of investment in agricultural water management for green revolution in Africa, claiming that poverty was significantly reduced in irrigation equipped area than in rain fed areas. Frank et al. (2008) examined developing capacity for agricultural water management in current practices and future directions, and suggested increased attention to monitoring and evaluation of capacity development and closer link to emerging work on water governance. Wheater and Evans (2009) studies relationship between land use, water management and future flood risk, their study mentioned that apart from irrigation issue, water related implications of climate change for future land use remain relatively unexplored. To conserve usable water resources, land uses which increase evapotranspiration or rapid run off should be discouraged, particularly in the south and east, there is need for continuous efforts to maintain good chemical water gravity in rivers, and ground water resources constrains will limit opportunities to use irrigation as a counter to climate change, which in turn will influence where irrigation production can be located (Weatherhead and Howden 2009).

Ozon and Aisharif (2013) showed home owners irrigated more to meet the water need of their farmlands despite the restrictions imposed by their local government. Characteristics of land tenure and use policy during 30 years of small irrigation system operations in Niger have enhanced beneficiary incentives and project sustainability. Tilman et al. (2012) studied agricultural sustainability and intensive production practices. The use of new incentives and policies for ensuring the sustainability of agriculture and ecosystem services would be crucial to meet the demands of improving yields without compromising environmental integrity. Viata (2008) assessed water management in agriculture successfully using FAO database.

A close look at the historic weather records of Maiduguri (1986-1996) showed that rural people though not literate, have good knowledge of the changes in the climatic variables (Mendelsohn et al., 2005). The mean atmospheric temperature of the area has been on the increase since 1986 with low humidity. They also observed that the little rainfall received has been associated with flooding. Darkoh (1998) also reported climate change and variability in the Sahel region, and on the causes of desertification in the dry land of Africa. Similar observation had been reported by Kandji et al. (2006) on the climate change variability in the Sahel region and on the causes of desertification in dry land of Africa respectively. These observations also corroborate the scientific studies in general (IPCC, 2007). Thus climate change is already visible in the study area. While many factors continue to influence climate, human activities like overgrazing, coupled with bush burning and other forms of degradation of natural vegetation have become dominant forces (Darkoh, 1998.)

MATERIALS AND METHODS

The study purposively considered eight local government areas of Gada, Wurno, Goronyo, Rabah, Illela, Gwadabawa, Isa, and Sabon Birni in Sokoto East. These areas are more prone to the effects of climate change. The number of villages and households in each local government are not the same; therefore thirty percent of the villages in each local Government were proportionately selected. A total of 223 questionnaires were administered.

Primary and Secondary data were collected: the primary data were collected using structured and open ended questionnaires on the socio- economic characteristics of the farmers and the level of farmer's perception on climate change. Secondary data on rainfall, temperature, wind and humidity, were obtained from the Metrological Centre, Sokoto. The data collected were subjected to descriptive statistical analysis (frequency and percentages) to analyze socio- economic characteristics of the farmers. Descriptive statistics was also used to measure the perception and awareness of the farmers. ANOVA was used to test the significant difference between climate variables over 10 years. Statistical package for social science (SPSS) was used for the analysis.

RESULTS AND DISCUSSION

Socio-economic characteristics of the respondents

Table 1 showed that 26.0% were within the age range of 22-32 years, 36.7% of the respondents were within the

Table 1. Socio-economic characteristics of the respondents (223).

Variables	Frequency	Proportion (%)	Variables	Frequency	Proportion (%)
Age (years)			Occupation		
22-32	58	26.0	Crop Production	142	63.6
33-42	82	36.7	Animal Production	2	0.8
43-52	38	17.0	Trading	0	0.0
53-62	33	14.7	Craft	0	0.0
63-72	12	5.3	Both	79	36.1
Total	223	100	Total	223	100
Gender			Cropping Sys. Pattern		
Male	221	99.1	Commercial	11	8.4
Female	2	0.9	Subsistence	212	91.6
Total	223	100	Total	100	100
Marital Status			Farm Size (ha)		
Married	220	98.6	1-4	86	38.5
Single	3	1.4	5-8	78	34.9
Divorce	0	0.0	9-12	49	21.9
Total	223	100	13-16	8	3.5
Family Size			17-20	2	0.8
1-6	103	46.2	Total	223	100
7-12	72	32.3	Seed (kg / hectare)		
13-18	31	13.9	1-40	125	56.9
19-25	17	6.7	41-80	37	17.1
Total	223	100	81-120	28	12.1
Education			122-160	17	7.5
Primary	71	30.8	161-200	8	3.2
Secondary	30	13.4	201-225	6	3.0
Tertiary	17	8.5	Total	223	100
Quranic	88	39.4	Yield (kg / hectare)		
Adult Education	15	7.5	200-4000	138	61.8
Total	223	100	4001-8000	29	13.2
			8001-12000	18	7.5
			12001-16000	25	11.2
			16001-20000	7	2.9
			20001-23000	6	3.4

Source: Field Survey 2011.

age of 33-42 years; 17.3% of the farmers have attained the age range of 43-52, 14.7% of the farmers were 53-62 years of age, while 63-72 years of age range constituted 5.3% of the total respondents. Males formed the majority of the respondents with 99.1% and female the minority with 0.9%. This indicated that males dominate agricultural work force in the study area. It agrees with Adedoyin et al. (2005) who reported that male folks dominated the agricultural workforce in Nigeria. The high proportion of males to females may be because religion and custom play crucial roles in the livelihoods of the study area. For instance, males who are mostly the household heads, have more access to land and participate more in out door activities than females. Majority of the respondents (98.6%) in the area reported that they were married, while (1.4%) were single. This indicated that majority of the respondents have family responsibilities to cater for which affects their farming activities.

The result showed that 46.2% of the respondents had family sizes in the range of 1-6, (46.2%) 7-12 (32.3%) in the range 13-18, (3.9%) and those with 19-25 members per household were 6.7%. On the educational level, it was reported that 30.8% of the respondents in the study area had primary education, 13.4% had secondary education, 8.5% had tertiary education, 39.4% had quranic and 7.5% had adult education. The study showed that 63.6% of the farmers engaged in crop production, animal production 0.8% while other livelihood engagements including crafts, trading and animal rearing was 35.4%. Most of the farmers (91.6%) were engaged in subsistence farming, while only few (8.3%) engaged in commercial agriculture. Farm size varied from 1 to 20 ha, with majority (38.6%) having between 1 and 4 ha, while 35.5% had between 5 and 8 ha. About 56.9% of the farmers planted 1 to 40 kg of seeds, 17.1% of the farmers had planted between 41 to 80 kg per hectare.

Yield obtained by the farmers ranged between 233-230000 kg of seed per ha. About 61.8% of the farmers harvested 200 to 4000 kg, 13.2% harvested 4001 to 8000 kg, 11.2% had 8001 to 12000, while others recorded 20,001 to 23000 kg of seed yield per hectare. Low levels of education, small farm sizes and low income in the selected communities had contributed to their vulnerability to climate change.

Farmers' perception on climatic change

Table 2, showed that 67.9% of the respondents agreed that rainfall starts by May, 32.2% believed that rain starts by June, while 0.8% maintained that rainfall starts by July. This indicated that the farmers are aware of the onset of rainfall. Information from the respondents revealed that drought causes stress to forest trees by affecting their life, most especially young trees, the higher the temperature, the higher the evapotranspiration and the lower the availability of water to the plant which in turn affects young trees, *Mangifera indica,* and *Psidium guajava* experience low production during drought. According to AAI (2006) "from July to August every year, there were heavy rains, the dry season starts in October and last until May. Rainy season starts late, sometimes as late as June; December and January were extremely cold months with frequent fogs. Water collects in rivers and ponds take longer time to dry up. Now they frequently dry up as early as November. "Majority of the respondents (87.0%) in the area reported that August had the highest amount of rainfall, 9.4%observed that September had the highest amount while 3.6% were undecided.

The result showed that 98.2% of the respondents were of the view that 2010 had the highest amount of rainfall in ten years, and 1.8% were undecided. 67.2% of the respondents believed that 2011 was the year of highest dry spell within ten years. 21.6% observed 2008 as the year of highest dry spell. While only 11.2% were undecided, 63.2% of the respondents opined that May-September had the highest duration of rainfall, 35.8% pointed June –Septembet, and 0.9% July-October as the highest duration of rainfall.

The study showed that 17.9% of the respondents said that 2010 had prolong harmattan, while 82.1% were undecided. 43.9% of the respondents viewed January as the period of low temperature, while 56.1% observed low temperature between December to January. 34.6% of the respondents opined that April was the period of highest temperature, while 64.4% observed highest temperature in April-May. 20.6% of the respondents agreed that 2008 had the highest temperature, 7.6% pointed to 2006, while 71.8% were undecided. The climate record of Sokoto state from April- May 2000-2010 indicated highest temperatures of 35.15-36.91°C, August 2000-2010 has the lowest rainfall of 42.88-95.55 mm. This implies that an increase in the average global temperature is very likely to cause death of livestock, agricultural and forest products. It can also lead to changes in precipitation and atmospheric moisture because of changes in atmospheric circulation and increases in evaporation. According to AAI (2006) rainfall and climate are affected by the mountain forest, and also partly by the Chiperoni Mountain in adjacent Mozambique. The climate is warm, hot and humid throughout most of the year, with annual temperature averaging 21-23°C and maximum temperatures around 32-35°C in the months of November and December.

During the dry season (June to mid-August), as a result of wind coming from the Chiperoni mountains, the phalombe plains, south of the Mulanje experience cooler weather. During this period , temperature on mount Mulanje occasionally drops to freezing point. Tea estates located within several kilometres of the southern foot of mount Mulanje experience dry season, rainfall and occasional mists and fogs. At the Mimoso Tea Research station (5 km from the mountain and 650 m above the sea level), the average annual rainfall is 1,626 mm, with 16% falling during the dry season (that is May to October). 41.1% of the respondents believed that changes in weather condition most especially temperature affects people's health as evidenced by widespread diseases such as malaria and high blood pressure,as well as stress to trees. 52.5% of the respondents agreed that November- February had the highest dust storms, 37.2% mentioned December-February, only 10.3% pointed to November –December, as the highest dust storm period.

From the perspective of dust, many people experience eye problems and asthmatic attacks as one of the serious effect of dust storms. 55.2% of the respondents showed that November-January had the highest deposition of sand dune, 23.8% observed November-Febuary 2008 as the year with highest deposition of sand dunes, while only 21.0% believed it to be the period between December- Febuary. 53.4% of the respondents agreed that October had the lowest amount of wind, 35.9% agrued for August, 8.0% indicated May as the period of lowest wind speed, while 3.6% were undecided. 65.9% of the respondents agreed that May had the highest amount of wind, 22.9% argued for June, while only 11.2% argued for July. Wind affect trees during flowering period and also destroy tree branches. 80.3% of the respondents agreed that August had the highest humidity, 8.5% believed it to be July, 5.8% argued for June, and only 5.4% proved to be undecided. According to some respondents (59.2%) the lowest humidity was

Table 2. Farmers' perception on climate change.

Variables	Frequency	Proportion%	Variables	Frequency	Proportion %
Onset of Rainfall			Persistent Dust Storms		
May	149	67.9	Nov –Dec	22	10.3
June	72	32.2	Dec- Feb	83	37.2
July	2	0.8	Nov-Feb	117	52.5
Highest Amount of Rain			Deposition of Sand Dune		
Aug	196	87.0	Nov- Feb	53	23.8
Sept	21	9.4	Dec-Feb	47	21.0
Undecided	8	3.6	Nov-Jan	123	55.2
Years with Highest Rainfal in 10 years			Period of Low Wind		
210	219	98.2	Oct	119	53.4
Undecided	4	1.8	Aug	80	35.9
When was the highest Dry spell in 10 years			May	18	8.0
2011	150	67.2	Undecided	8	3.6
2008	48	21.6	Period of Highest Wind		
Undecided	25	11.2	May	147	65.9
Duration of Rainfall in a year			June	51	22.9
May-Sept	141	63.2	July	25	11.2
June- Sept	80	35.8	Period of Highest Humidity		
July –Oct	2	0.9	Aug	179	80.3
Prolong Harmattan within 10 years			July	19	8.3
2010	40	17.9	Sept	12	5.4
Undecided	183	82.1	June	13	5.8
Period of low Temperature			Period of Low Humidity		
Dec- Feb	98	43.9	Feb	75	33.7
AUG	125	56.1	March	132	59.2
Period of Highest Temperature			April	10	4.4
April	77	34.6	May	6	2.7
April-May	146	64.4			
Years of Highest Temperature					
2008	46	20.6			
2006	17	7.6			
Undecided	160	71.8			

Source: Field Survey 2011.

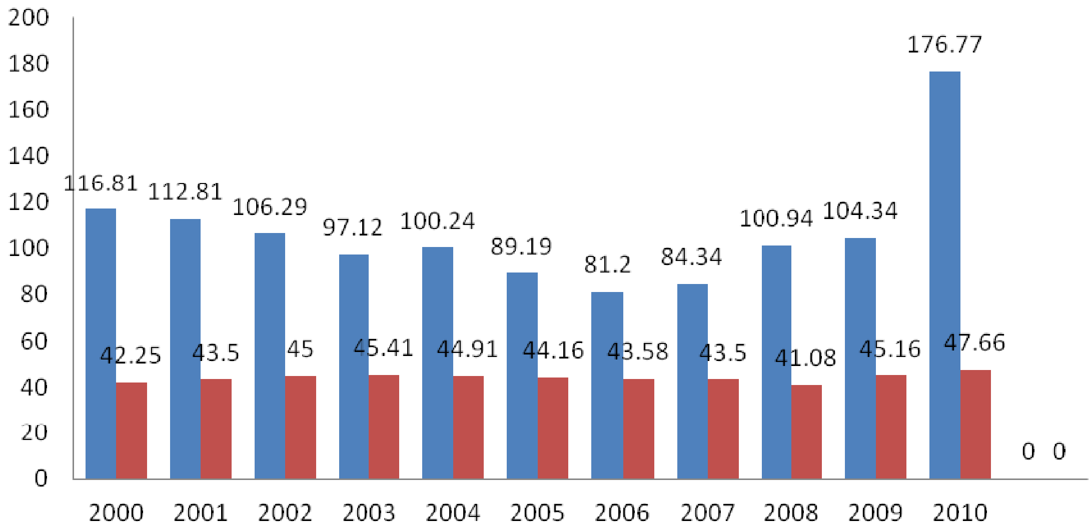

Figure 1. Distribution of wind and humidity over ten years. Source: Metrological Station, 2011 Sokoto.

recorded in March 33.7%, in February, 4.4% in April and only 2.7% discovered May as the period of lowest humidity. This indicated that there were significant differences between climatic indices and perception of farmers in Sokoto state.

The data of the mean annual rainfall and temperature for the period of 10 years (Figure 1) revealed that August 2001 and 2010 had the highest amount of rainfall within ten years. 2010 had highest rainfall within a ten- year period. That climatic record of Sokoto state showed that 2010 had the highest amount of rainfall within eleven years. 2011 had the highest dry spell within ten years, majority of the farmers were aware of the year with prolong harrmattan. From the perspective of temperature majority of the farmers believed that December-January had the lowest from 2001-2010, and April-May had the highest temperature.

The data of the mean annual wind and humidity for the period of 10 years (Table 3) reveal that August had the highest humidity while March had the lowest humidity. October had the lowest wind speed while May had the highest wind. This indicates that the higher the velocity of wind the higher its impact on livelihood (UNFCC, 2007). The wind speed are particularly critical to the success of agricultural resources, which most negatively affects sustainbility. These results showed that both the perception of farmers and the climate records are in agreement.

According to AAI (2006) temperature data from the Mimosa Tea Research Foundation showed a steady increase in maximum and minimum temperatures over the past twenty years. From 1963-1986, the average maximum temperature howered around 28.5°C. The period between 1986 and 2006 saw an increase of over 1°C, with an average maximum temperature of 30.0°C. The minimum temperatures have shifted to a similar degree over the same period.

Conclusion

The results indicated that farmers were aware that the area is getting warmer and drier with change in the time of rains. The implication is that farmers need to adjust their management practices to ensure that they make efficient use of the limited rainfall and water resources for food production and other needs.

Conflict of Interest

The authors have not declared any conflict of interest.

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