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AN ASSESSMENT OF RURAL FARMERS' PERCEPTION AND ADAPTATION STRATEGIES TO CLIMATE CHANGE IN NIGER STATE, NIGERIA

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Abstract

Agriculture is inherently sensitive to climate conditions and is among the most vulnerable sectors to risks and impacts of climate change. The applicability of adaptation strategies depends on the farmers' perception and level of awareness to climate change issues and its impacts. The aim of this paper is to assess the rural farmers' perception of and adaptation strategies to climate change in Katcha Local Government Area, Niger State, Nigeria. Purposeful sampling technique was used in the selection of 400 rural farmer respondents. Farmers' perception and adaptation strategies to climate change were obtained by means of structured questionnaire administered to the sampled rural farmers. The results were summarized by means of frequencies and percentages and presented in tabular forms and charts. The study revealed that the rural farmers in the study area know much about climate change. Personal observation is the main source of information on climate change as shown on late onset of rains; agricultural drought and incidence of flood after rain. Common adaptation strategies in the study area include the use of crop varieties that are well acclimatised, planting of pest and disease resistant crop and use of irrigation system. The study concludes that the climatic characteristics of the study area affect crop production while adaptation strategies have significant contribution on crop production in the area. The study recommended that the research institutes should produce better adapted earlier maturing varieties of crops and other grains while the government subsidizes the seeds to the farmers. Furthermore, there should be adequate provision for irrigation, weather forecasting and other agricultural technological infrastructure, modern knowledge on climate change adaptation and strengthening of the extension services.

Keywords: Adaptation strategies; Assessment; Climate Change; Rural farmers; Niger State

Introduction

Climate change is a global environmental problem that has transcended the boundaries of science and environmentalism to become a mainstream political, economic and social concern. Climate change refers to some observable variations in the climate system that are attributable to human (anthropogenic) activities, especially those that alter the atmospheric composition of the earth and ultimately lead to global warming (Ozor, 2009). The Inter-governmental Panel on Climate Change (IPCC, 2007) defined climate change as a change in the state of the climate that can be identified (e.g. by using statistical tests) by changes in the mean and/or the variability of its properties, which persists for an extended period typically decades or longer. Climate change involves complex interactions between the climatic environment, economic, political institution, social and technological processes (IPCC, 2001). Climate change, in the most general sense, encompasses all forms of climatic inconstancies (that is, any difference between the "long-term" statistics of the meteorological elements calculated for different periods but relating to the same area), regardless of their statistical nature or physical cause (Maunder, 1994).

The most crucial things about the concept of climate change is not only the time periods involved but also the degree of variability that the change is subjected to as well as the duration and impact of such variability on man and the ecosystem (Ayoade, 2003). The systematic changes in the average

conditions over time are difficult to observe and discern without statistical measurement, and this makes it difficult for the skeptics to believe climate change is happening (Weber 2010). Although climate change may occur in different parts of the world, it will result in heterogeneous effects which may result in the destruction of some ecosystems (Brody et al. 2008; Leiserowitz 2005).

Climate change adaptation is a very broad concept and different authors defined adaptation differently. For instance, Stakhiv (1993) defined adaptation as any adjustment, whether passive, reactive or anticipatory, that is proposed as a means of ameliorating the anticipated adverse consequences associated with climate change. On the other hand, the IPCC (2001) defines adaptation as adjustments in ecological, social or economic systems in response to actual or expected stimuli and their effects or impacts. This term also refers to changes in processes, practices and structures to moderate potential damages or to benefit from opportunities associated with climate change. Depending on its timing, goal and motive of its implementation, adaptation can either be reactive or anticipatory, private or public, planned or autonomous, (Klein and Tol, 1999). Adaptations can also be short or long term, localized or widespread (IPCC, 2001).

Adaptation to climate change requires that farmers using traditional techniques of agricultural production first notice that the climate has altered. Farmers then need to identify potentially useful adaptations and implement them. Doss and Morris (2001) opined that the perspectives of the local people, the way they think and behave in relation to climate, as well as their values and aspirations have a significant role to play in addressing climate change. In spite of this, traditional people are only rarely considered in academic, policy and public discourses on climate change, though the impact of impending changes of climate is greater on them (Adefolalu, 1986). Although most people report being aware of climate change and its causes and show some concern, they cannot explain in detail its causes, consequences and solutions. They believe that climate change is caused by anthropogenic and natural causes but frequently do not understand the details (Lorenzoni et al. 2007). How people perceive climate change, it causes and solution is also influenced by who they interact with.

Perception is a process by which organisms interpret and organize sensation to produce a meaningful experience of the world. Perception is the process by which we receive information or stimuli from our environment and transform it into psychological awareness (UNEP 1998). Pointedly, the Oxford Dictionary defines perception "as the way in which something is regarded, understood or interpreted". In this study, rural farmers' perceptions will be understood as different understandings, and/or utterances with regards to climate change deliberations. Perceiving climate variability is the first step in the process of adapting agriculture to climate change (Deressa et al., 2011). A better understanding of farmers' concerns and the manner in which they perceive climate change is crucial to design effective policies for supporting successful adaptation of the agricultural sector. Furthermore, it is also important to have precise knowledge about the type and extent of adaptation methods being taken up by farmers and need for further advances in existing adaptation setups. Hence, understanding how farmers perceive changes in climate and what factors shape their adaptive behaviour is useful for adaptation research (Mertz et al., 2009; Weber, 2010). The choice of adaptation methods by farmers depends on various social, economic and environmental factors (Deressa, 2007; Bryan et al. 2013). This knowledge will ultimately enhance the credibility of policies and their strength to tackle the challenges being imposed by climate change on farmers (Deressa et al., 2011). Adaptation will require the participation of multiple players from sectors such as research and policy, those in the agricultural extension services and private welfare organizations, as well as local communities and farmers (Bryan et al., 2013).

Of all human economic activities, agriculture is the most sensitive to climate change related issues. Changes in the world's climate will bring major shifts in food production. In spite of recent technological and scientific development, weather remains a key variable in agricultural production. Weather and climate act both as a resource and a constraint to agricultural production. The resource value of weather has to be optimized while the hazards posed by weather have to be managed (Ayoade, 2002). It is common knowledge that farmers in Sub-Saharan Africa, including Nigeria are struggling to cope with the current climate variability (Chakeredza et al., 2009).

Anselm and Taofeeq (2010) observed that climate change exerts multiple stresses on the biophysical as well as the social and institutional environments that underpin agricultural production.

That is, socio-economic factors, international competition, technological development as well as policy choices will determine the pattern and impact that agro-climatic changes will have on agriculture. In all, Khanal (2009) classified the patterns of impact of climate change on agriculture into biophysical and socio-economic impact. The biophysical impacts include; physiological effects on crop and livestock change in land, soil and water resources, increased weed and pest challenges, shifts in spatial and temporal distribution of impacts. The socio-economic impacts result in decline in yield and production, reduced marginal GDP from agriculture, fluctuation in world market prices, changes in geographical distribution of trade regime, increased number of people at risk of hunger and food insecurity, migration and civil unrest.

Analyzing local adaptation is, therefore, important to inform policy for future successful adaptation of the agricultural sector to the impact of climate change. The overall aim of this study is to access rural farmers' perceptions and adaptation strategies to climate change. To this end, the specific objectives are to:

I. Assess the perception of the local farmers towards climate change; perception is a precondition for adaptation;

ii. Assess climate impacts in the area;

iii. Identify and document local adaptation strategies for climate change adaptation;

Study Area

Niger state is one of the states in the Middle Belt region of Nigeria. The State is one of the largest States in Nigeria and has a land area of about 86,000 sq. Km which represent 9.30% of the total land area of the country. The state is divided into three agricultural zones taking into account the agro climatic features. The State comprises of 25 Local Government Areas (LGA) (Dauda et. al., 2015). Katcha is one of the LGAs in the state located on 9°03'N and 6°09'00E (see Fig. 1). It is bounded in the north by Gbako and Bosso LGAs, in the south by the great river Niger and Mokwa LGA; while to the east and west by Agaie, Bida and Lavun LGAs respectively. According to the 2009 census, Katcha LGA has a population of about 122,176 with a total area of about 1,681 Km².

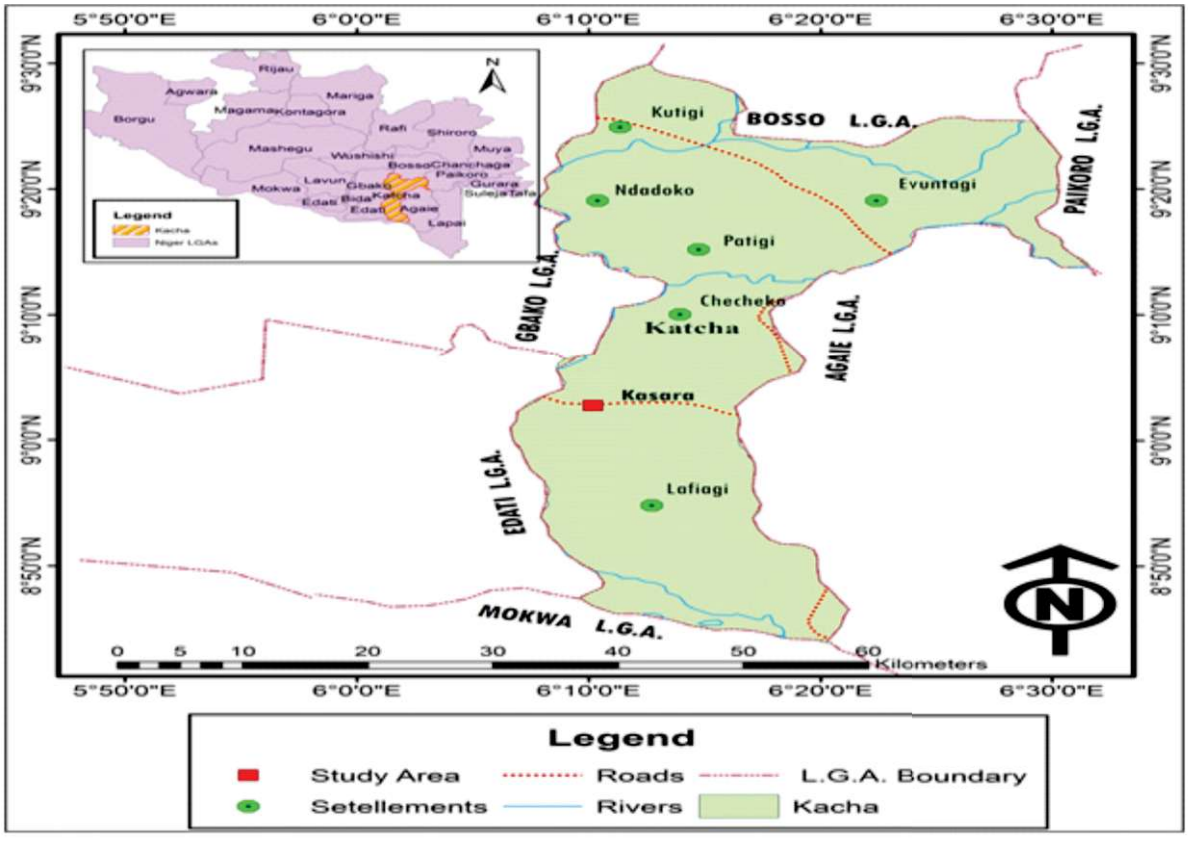

Figure 1: Map of the study Area

Source: G.I.S. Lab, Geography Department A.B.U. Zaria.

Sample Size and Sampling Technique

Multistage sampling technique was used to purposively select two villages, Kasara 1 and Nwogi to form the respondents of the study in the LGA. The farmers' perception and adaptation strategies to climate change were obtained by means of structured questionnaire. The questionnaire and oral interview were administered to the sampled rural farmers by trained enumerators who understand the local language. The number of questionnaire used was based on Krejcie and Morgan's (1970) technique where a population range of between 75,000 to 1,000,000 the sample size could be 384 at 95% confidence level and 0.05% margin of error. Since the population of the study area is 122,176 which fall between these range, the sample size of 384 is in order. However, 400 respondents were used to reach out to more rural farmers.

Purposeful sampling, according to Bernard (2002) "is the deliberate choice of an informant due to the quality the informant possesses." For the purpose of administering the questionnaire, rural farmers above thirty (30) years of age and who must have lived at least twenty (20) years within the study area were identified through the "Sarkin Noma" (Head of the Farmers) and the village Heads. This was done by asking the farmers of their age and how long they have lived in the area. Thereafter the questionnaire was issued. The reason for this decision was that those within the age bracket have the information needed about climate change. To present the various agricultural adaptive strategies used by the farmers to cope with climate change, percentage analysis was used. The data was summarized and presented in tables, charts, percentages.

Findings and Discussion

Age plays an important role in the farming activities as it determines the effectiveness and competence of labour availability in crop production. Table 1 shows the distribution of respondents by their socio-economic characteristics. Majority of the respondents (54%) were within the age group of 41 to 50 years; 31% are between 31 to 40 years while 15% of the respondents are between 51 years and above. The result in Table 1 further revealed that 86% of the respondents are male, while 14% are female. All the farmers are literate in one way or the other. This could lead to increase in awareness and adoption of climate change adaptation strategies and better standard of living of the rural farmers because literate individual accept new technique easily and manage better than illiterate. 15% have primary school education as their highest educational experience, 47% have SSCE/GII, 1% tertiary and 37% have Koranic education.

Table 1: Frequency Distribution of Respondents by their Socio-economic Characteristics

Parameters	Options	No. of Respondents	Percentages (%)
Age (years)	31 – 40	123	31
	41 – 50	218	54
	51 and above	59	15
	Total	**191**	**100**
Gender	Male	343	86
	Female	57	14
	Total	**400**	**100**
	Primary	61	15
	SSCE/GII	187	47
Level of education	Tertiary	04	1
	Koranic	148	37
	Total	**400**	**100**

Source: Field Survey, 2016

Table 2: Farmers' years of Residency and Farming Experience in the study Area

Years of Residency in the Study Area			
S/N	**Years**	**Respondents**	**Percentage (%)**
1	20 – 30	248	62
2	31 – 41	114	28
3	41 and above	38	10
	Total	**400**	**100**
Years of farming experience			
S/N	**Years**	**Respondents**	**Percentage (%)**
1	1 – 5	20	5
2	6 – 10	100	25
3	11 – 15	120	30
4	16 – 20	80	20
5	20 and above	80	20
	Total	**400**	**100**

Source: Field Survey, 2016

Table 2 shows that majority of the sampled farmers (62%) have lived in the study area for about 20 – 30 years; 28% have lived for about 31 to 40 years and 10% have lived for 41 years and above. From the above, the sampled farmers have lived in the area for at least 20 years. This gives them the advantage to understand the climate of the study area. This study researched into the respondents' years of cultivating grains. Table 2 indicated that 5% have been cultivating grains for about 1 to 5 years, 25% for 6 to 10 years, 30% for 11 to 15 years, 20% for 16 to 20 years and 20% for over 20 years.

Table 3: Ranking of Crops Produced

S/N	Popular crop	1990 - 1999 (%)	Ranking	2000 - 2015 (%)	Ranking
1	Mixed cropping - maize, millet and sorghum	28	**1**	30	**1**
2	Sorghum	22	**2**	24	**3**
3	Maize	20	**3**	16	**4**
4	Millet	16	**4**	28	**2**
5	Other crops	14	**5**	2	**5**

Source: Field Survey, 2016

The grain farmers ranked their favorite grains produced in the 1990 to 1999 and 2000 to 2015. Table 3 indicated that mixed cropping (of maize, millet and sorghum) was ranked number one (28%) followed by sorghum (22%), maize was ranked 3rd (20%), millet was 4th (16%) and other crops 5th. There was a slight shift in the crops cultivated by the farmers in the 2000's. Sorghum that was ranked 2nd in the 1990s now ranked 3rd, while millet now ranked 2nd after mixed cropping system. The study revealed that the percentage of farmers practicing mixed cropping increased from 28% in the 1990s to 30% in the 2000s.

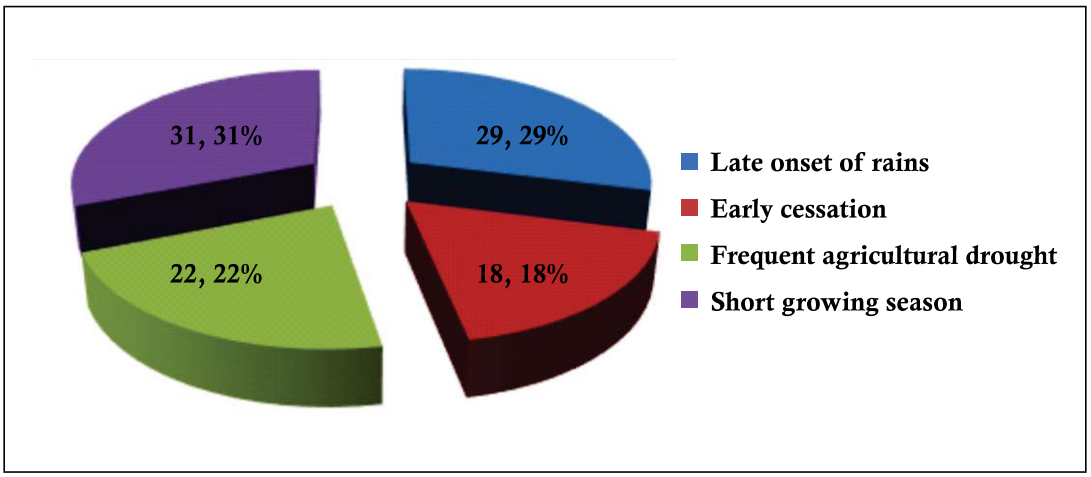

Fig. 2: Farmers Reasons for the Shift in Crop Production in the Study Area
Source: Field work, 2016

Shift in Crop Production

Grain farmers gave reasons why they shifted in crops they produced as shown in Fig.2, 29% shifted from other crops to grains, precisely millet because of late onset of rains. 18% stated early cessation, 22% indicated that the frequent agricultural drought was responsible, while 31% noted the short growing season was responsible. The findings of this research is in line with a similar study conducted by Ikpe et al., (2016), that millet is the most cultivated grain crop in Goronyo, Sokoto State because of its drought resistant nature; it requires little effort and maintenance to cultivate; it has high economic and domestic value over sorghum and maize and it yield very well when compared to sorghum and maize.

On farmers' awareness of climate change in the study area as shown in Table 4, majority of the farmers (93%) are aware of climate change, only 7% are not aware of climate change.

Table 4: Farmers' Perception of Climate Change

S/N	Response	Respondents	Percentage (%)
1	Yes	372	93
2	No	28	7
Total		**400**	**100**

Source: Field Survey, 2015

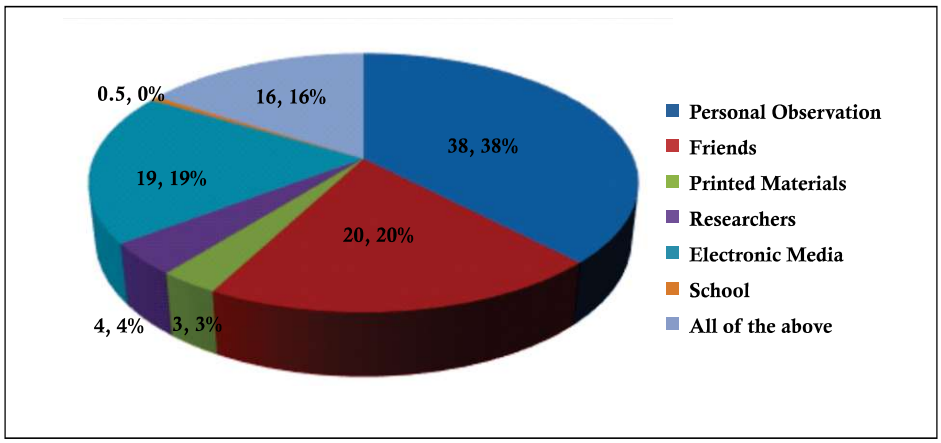

Fig. 3: Sources of Information on Climate Change

Source: Field Work, 2015

Information on Climate Change

Availability and accessibility of information on climate change is a key determinant of level of awareness, understanding and knowledge of climate change. Fig. 3 shows that 38% received information on climate change by personal observation, 20% by interacting with friends, 3% from printed materials (e.g. newspaper, magazines, bulletins etc.), 19% from electronic media (radio, television etc.), 4% from researchers, 0.5% from schools and 16% from all the sources. The implication of the above is that personal observation remains the largest source of information to the rural farmers. The result also implies that the school played little role in informing the farmers on the climate change. This could be in part, due to the farmers' education level. Again, the rural conditions of the study area may explain why responses to printed materials were low (3%).

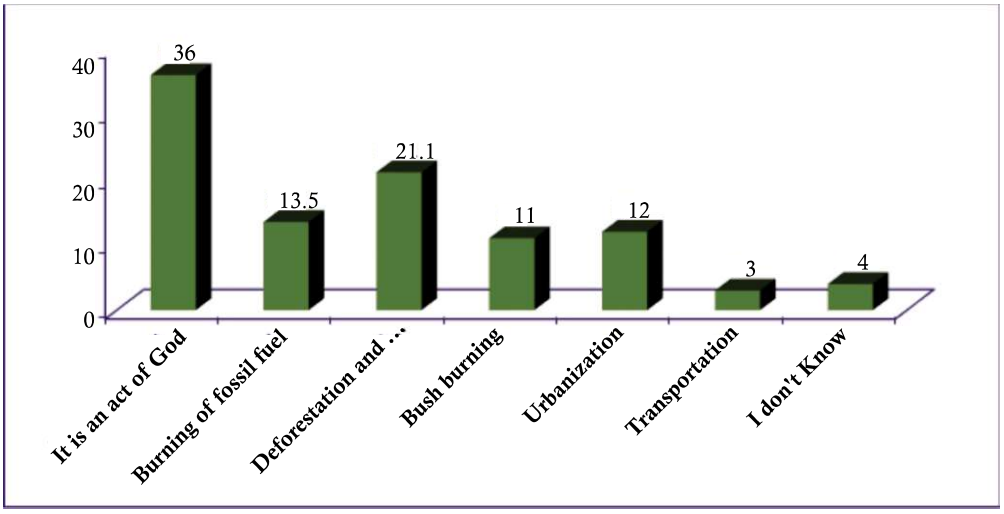

Fig. 4: Causes of Climate Change

Source: Field Work, 2016

Causes of Climate Change

Fig. 4 shows the rural farmers' perceived causes of climate change. 36% farmers ascribed climate change as an act of God; 13.5% ascribed it to the burning of fossil fuel and gas flaring; 21.5% stated deforestation and over grazing; 11% mentioned bush burning; 12% urbanization; 3% transportation and only 4% stated that they don't know the cause of climate .

On measures to reduce climate change as shown in Table 5, 33% respondents suggested public enlightenment in climate change; 22% suggested that deforestation should be reduced; 2.5% encouraged mechanized agriculture; 18% noted that bush burning should be stopped; 18% stated that firewood should be discouraged for cooking and 6.5% said solar, wind and hydro should be used to generate electricity instead of burning fossil fuels which contribute to greenhouse gases.

Table 5: Measures to Reduce Climate Change

S/N	Measures	Respondents	Percentage (%)
1	Public enlightenment	132	33
2	Reduced deforestation	88	22
3	Mechanized agriculture	10	2.5
4	Stop bush burning	73	18
5	Reduce use of wood for cooking etc.	71	18
6	Increase use of solar, wind and hydro electricity	26	6.5
	Total	**400**	**100**

Source: Field Work, 2016

Table 6: Impacts of Climate Change on grain Production

S/N	Impacts	Respondents	Percentage (%)
1	Short growing season	69	17
2	Drying up of surface drainage	64	16
3	Crop infestation	91	23
4	Continuous poor yield	70	18
5	Flooding after rain	61	15
6	Desertification	45	11
	Total	**400**	**100**

Source: Field Work, 2016

The 400 sampled farmers affirmed that climate change has severe impacts on grain production in the study area. These impacts are viewed from different perspective. 17% stated that climate change shortens the growing season of grains in the study area; 16% noted the drying up of surface drainage, 23% crop infestation; 18% continuous poor yield; 15% flood after rain and 11% stated desertification as the impact of climate change on grain production.

Table 7: Possibility of adaptation strategies in climate change

S/N	Response	Respondents	Percentage (%)
1	Yes	319	80
2	No	81	20
Total		**400**	**100**

Source: Field Work, 2016

The farmers were precise in responding "yes" or "no" to the question on whether it is possible to adapt to climate change (Table 7). 80% respondents stated that climate change adaptation is possible, while 20% stated it is not possible, that it is an act of God.

Figure 5 shows 10 indigenous and emerging strategies for climate change adaptation used by rural farmers in Kasara 1 and Nwogi village, Katcha LGA of Niger State. The farmers were asked to rank and classify the adaptation options as "always used", "rarely use" and "not at all". The results shows that more than 50% of the farmers always use mixed cropping, improved seed varieties, mulching with crop residue, chemical fertilizer, Changing the extent of land put into grain production, early planting and early weeding to reduce weed competition, while irrigation and loans/savings were rarely used. The inadequate access to water for irrigation and drainage may be responsible for the low use of irrigation to complement rainfall.

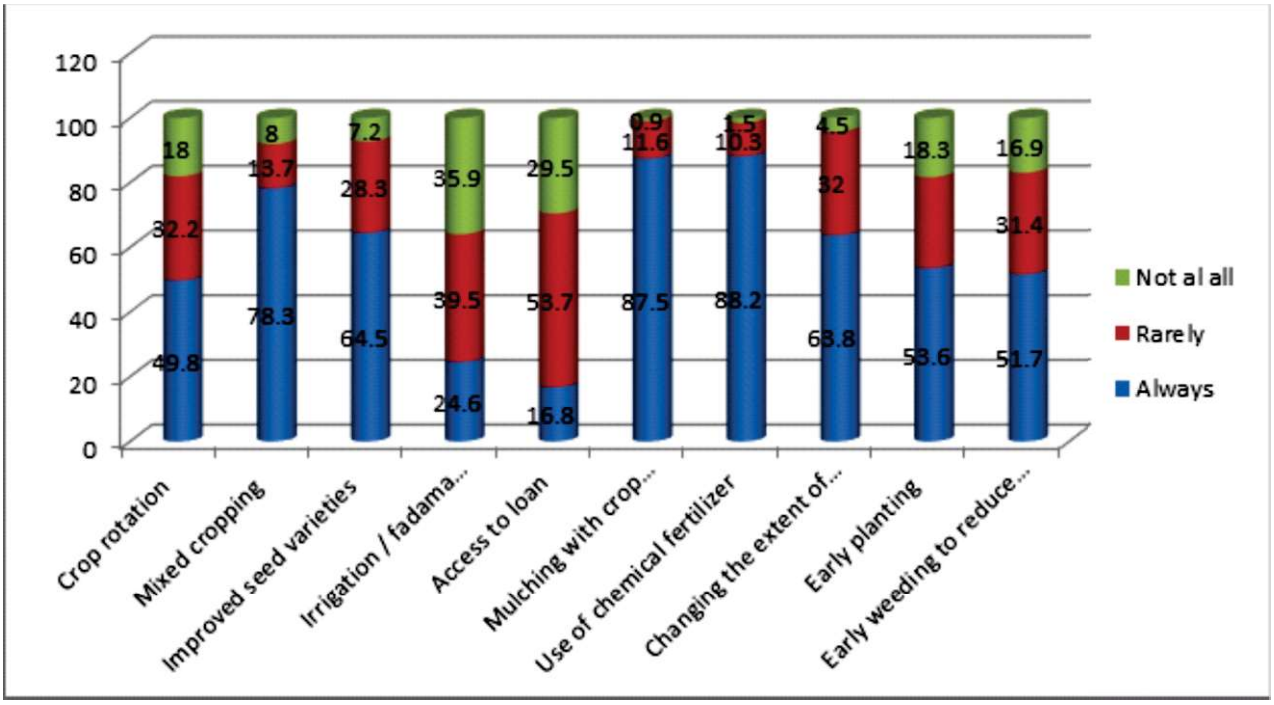

Fig 5: Indigenous Adaptation Strategies by the Rural Farmers
Source: computed from field survey, 2016

Conclusion

The study was conducted to assess the rural farmers' perception and adaptation strategies to climate change in Katcha LGA, Niger state. The study specifically revealed that 93% of the respondents are aware of climate change issues and that climate change has significant impacts on crop production. The study further revealed that mixed cropping is widely practiced in the study area as an adaptive option to climate change. The farmers shift in the crop they produced majorly due to the frequent agricultural drought, short growing season as a result of the late onsets of rains and early cessation. Personal observation is the major source of climate change information. Major indigenous and emerging strategies for climate change adaptation used by the farmers are crop rotation, improve seed varieties, chemical fertilizer etc.

Recommendation

Based on the findings of this study, the following recommendations are made;

1. Farmers in the study area should be enlightened and trained on agricultural technological infrastructure, weather forecasting, modern knowledge on climate change adaptation and agricultural extension services should be strengthened.

2. Research institutes should produce better adapted maturing varieties of crops and other grains and should be subsidized for farmers

3. Grain farmers should adopt viable adaptation strategies such as: improved seed varieties, Irrigation farming (since the study area is close to the Goronyo dam), credit loan, mixed cropping, crop rotation, shifting cultivation e.t.c

4. Government policies should therefore ensure that farmers have access to improved seed varieties, chemical fertilizer, water for irrigation and affordable credit as these increases the resilience of farmers to climate variability.

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