Environmental Research Journal 6 (2): 68-74, 2012
ISSN: 1994-5396

Impacts of Climate Change and Adaptation in the Agricultural Sector: The Case of Smallholder Farmers in Nigeria

Akwa Labaris
Department of Geography, Nasarawa State University, Keffi, Nigeria

Abstract: This study discusses the findings of research that was carried out in Nigeria among smallholder farmers on their knowledge of climate change and adaptation strategies. The aim was to assess climate change and weather issues of relevance to smallholder farmers' activities, views and knowledge about climate change its impacts and adaptation strategies. These farmers are vulnerable to the effects of climate change due to their marginal location, low levels of technology and lack of other essential farming resources. This study utilizes information from interviews of agricultural extension workers, desk-based research, literature review and questionnaire administered to smallholder farmers in Nasarawa North Senatorial District of Nasarawa state. Majority of farmers indicated that prolonged wet, hot and dry weather conditions affect the efficient use of their resources and investment decisions. Some specific impacts of these conditions include crop damage, death of livestock, soil erosion bush fires, poor plant germination, pest, lower incomes and deterioration of infrastructure. Some farmers professed ignorance about climate change and how it will affect their future farming activities while others pointed out high frequency and severity of drought, excessive precipitation, drying up of rivers, dams and wells and changes in timing and pattern of seasons as evidence of climate change. Suggested adaptation strategies include strengthening and improving indigenous land and water management practices, use of decision support tools such as seasonal weather forecast data, growing drought resistant crops, improving indigenous animal breeds and development of irrigation infrastructure. It is therefore, concluded that there need to conscientise farmers about climate change and design adaptation strategies that take into cognizance existing local level knowledge and practices on land and water management. There is also the need to avail agricultural research results relevant to smallholder farmers and train them on how to use the results to make informed on-farm investment decisions.

Key words: Climate change, impacts, adaptation and smallholders farmers, train, crops, breeds

INTRODUCTION

There is a general consensus among scientists, economists and policy makers that the entire globe facing a real and serious long-term threat from climate (Kinuthia, 1997; Ghazi, 2000; Hansen *et al*., 2007; Okolo, 2010; Speranza, 2010). Projections suggest that by the end of the 21st century, climate change will have substantial impact on agricultural production and hence, on the scope for reducing poverty (Slater *et al*., 2007).

Although, there is relatively little research published on climate change scenarios for Africa, Hulme *et al*. (2001) reviewed and observed past changes (1900-2000) as well as possible future (2000-2100) continent-wide changes in temperature and rainfall for Africa and concluded that the climate was warmer in the year 2000 than it was in 1900. This has occurred at the rate of about 0.5°C/century and the 6 warmest years have occurred since 1987 with 1998 being the warmest year. The 21st century picture remains almost the same with predicted annual warming across Africa of slightly <0.2->0.5°C per decade (Hulme *et al*., 2001). New *et al*. (2006)'s analysis of the daily temperature (maximum and minimum) and precipitation data from 14 South and West African countries over the period 1961-2000 confirms that there is evidence of daily climate extremes over Western and Southern Africa. In these two regions, New *et al*. (2006) discovered that extreme cold days and nights have decreased and hot days and nights have increased. With respect to rainfall, averages dry spell length rainfall intensity and annual i-day maximum rainfall all show statistically significant increase trends.

Additionally, there is an indication of decreasing total precipitation in the two regions showing gradual slide towards drier conditions. This indicates an increased trend in the likelihood of occurrence of weather hazards such as heavy storms leading to floods, high temperatures and both seasonal and mid-rainy season droughts that agriculture and other sectors have to contend with.

Although, there is still a significant uncertainty regarding the climate change scenarios for sub-Saharan Africa with conflicting scenarios about which areas will get wetter and which will get drier (Kinuthia, 1997), there is no doubt that the climate change/variability phenomenon is slowly setting in and the general consensus appears to be that the region will experience hotter and drier climatic conditions in the medium to long term. This will comprise African agricultural production and access to food since, agricultural land will be lost and there will be shorter growing seasons and lower yields. Mendelson estimated that by 2100, Nigeria and other West Africa countries are likely to have agricultural losses of up to 4% of GDP due to climate change. In some countries that experienced soil erosion and operated rain-fed agriculture could have decline in agricultural yield of up to 50% between 2000-2020 to increasing impact of climate change (Oxfam, 2007; IPCC, 2007). Climate change impact studies although, they are still uncertain on the frequency and severity of adverse weather events have shown that effects are significant for low input farming systems such as subsistence farming that are located in marginal areas and due to socio-economic, demographic and policy trends have the least capacity to adapt to changing climate conditions.

This study examines smallholder farmers' perspectives on climate change and variability and its impacts on their farming activities. Policy responses to climate change/variability have been mainly driven by debates among scientists whilst insights of poor people living on the frontline have largely neglected (ActionAid International, 2006). This study therefore, tried to put the views of the vulnerable at the centre of the climate change impact and adaptation analysis by assessing views and knowledge about climate change, its impacts and adaptation strategies among smallholder farmers. This helps in the understanding of the complexities of specific real-world smallholder farming systems. Also, a better understanding of farmers' perceptions regarding climate change and variability, current adaptation measures and their determinants will be important to inform policy for future successful adaptation of the agricultural sector (Mutekwa, 2009).

The study also helps to open debates on the impacts and adaptation to a wider range of stakeholders including smallholder and subsistence farmers themselves. This will not only improve knowledge of impacts but aid in building adaptive capacity at all levels including farmers themselves.

Climate change adaptation: De Chavez and Tauli-Corpu (2008) defined climate change as the process by which ecological, social or economic systems adjust to actual or expected stimulus and their effects or impacts. Adaptation is widely recognized as a vital components of any policy response to climate change because it helps farmers achieve their food, income and livelihood security objectives in the face of changing climatic and socio-economic conditions including climate variability, extreme weather such droughts and floods and volatile short-term changes in local and large-scale markets (Kandlikar and Risbey, 2000). Adaptation is also understood include efforts to adjust to ongoing and potential effects to climate change (Mani *et al*., 2008).

Objectives of the study: The overall objectives of the study on Impacts of Climate Change and Adaptation in the Agriculture Sector. The case of smallholder farmers in Nigeria' were to:

- Assess climate change and weather related issues relevance to smallholder farmers' activities
- Determine their knowledge of climate change and adaptation strategies
- Assess the impact of climate change on their farms
- Assess adaptation strategies that the smallholder farmers have adapted
- Determine problems associated with adapting to effects of climate change

MATERIALS AND METHODS

Study area: The study was carried out in Nasarawa North Senatorial district in Nasarawa state. The district has a total of population 262, 559 (NPC, 2006). The area lie between latitude 7°45' and 9°25'N and longitude 70 and 9°37'E of Greenwich meridian. Temperature is generally high in the study area, partly because of its location in the tropical sub-humid climatic belt. The high radiation income in this part of the globe which is also evenly distributed throughout the year also accounts for the high temperature recorded in the state. There is a gradual increase in temperature from January to March. The onset of rains in April ushers in a noticeable decline in temperature. This continues in the cessation periods by October ending when a further decline is made possible in November/December by the coming of the harmattan winds. There is a spatial variation in temperature pattern in the state. Temperatures reached their maximum of 39°C in March. Mean monthly temperatures range from 26.8°C in the Southern part of the state to 27.9°C in the Northern areas. Relative humidity is highest in July (88%) and steady rain commences in April. The entire sate enjoys a maximum rainfall of 328 m by August. Generally sunshine hours are high for the state averaging about 9 h in the dry season but a little lower for the wet season (Fig. 1).

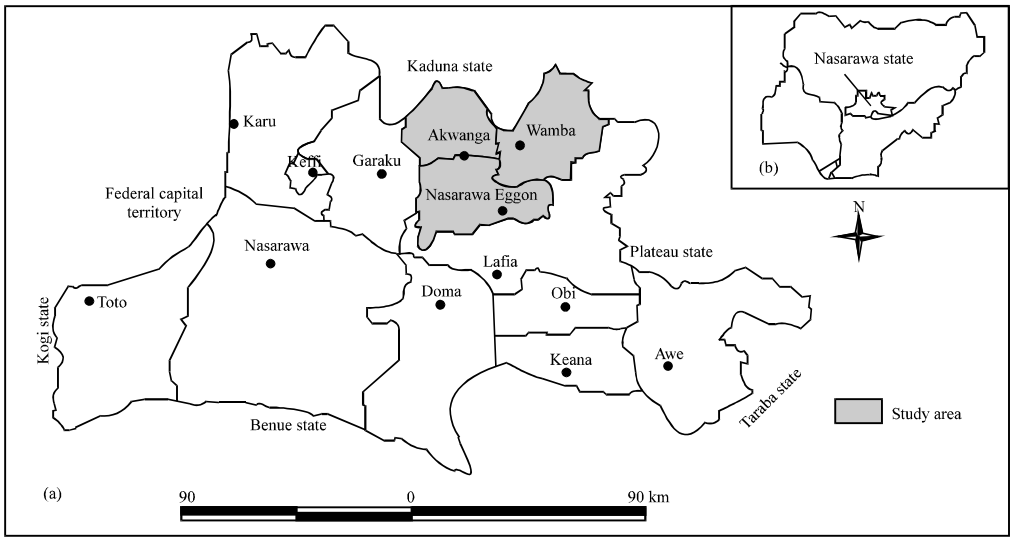

Fig. 1a): Map of Nasarawa state showing the study area; b) map of Nigeria showing Nasarawa state

Data collection: Data was collected mainly through a questionnaire that was administered to 250 randomly selected household heads. The main themes that determined the structure of the questionnaire were:

- Demographic and other socio-economic characteristics of the farmers that have implications on their perceptions, attitudes, knowledge, adoption of adaptation strategies such as gender, age, agriculture resources, main source of household income, education, period of stay in the area and house size
- Knowledge, attitudes and perceptions about climate change, its impact on agricultural activities and productivity
- Present and future adaptation strategies to the vagaries of climate change

Apart from questionnaires, formal and informal interviews were carried out with knowledgeable section of the community such as leaders of agricultural cooperative groups, prominent farmers, traditional rulers and agricultural extension officers.

RESULTS AND DISCUSSION

Demographic and socio-economic characteristics of the respondents: Of the 250 heads of households interviewed, the main age of household heads was 49 years. About >50% of the people interviewed had elementary education (55%) whilst 30% had secondary, 9% had tertiary education and 6% had never been to school. The mean household size was 7.2 and the main source of household income for the majority (48.5%) was farming. Other

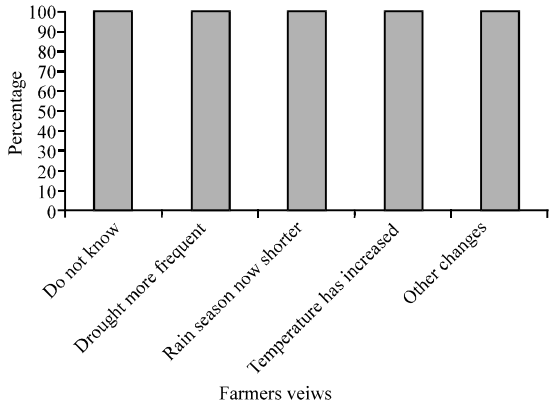

Fig. 2: Smallholder farmers' views and knowledge about current and long-term climate change

sources of that provided sustenance to the households included off-farm formal employment (25.0%), remittances (14.6%) while 11.9% depended on other sources such as crafts and trading grains among others. The size of land holdings in the study area ranges from 4-6 ha per household. Land for farming is acquired through families or lease.

Farmers' views and knowledge about climate change: The findings indicate that farmers' perceptions on climate change/variability are based on assessment of temperature and precipitation events as they experience them within the locality. Figure 2 shows that the majority of the farmers (57%) professed ignorance about climate change and its potential consequences whilst 42% indicated that was some kind of change that they had

observed in recent years. Of those who have noticed some change in climate, 58% of them pointed out that rainfall patterns have become highly unpredictable in the last few years to the effect that they could not predict the time of onset of seasonal rainfall and the prevalence of mid-season dry spells had increased. About 22% have observed that in addition to the unpredictable nature of precipitation, below-normal rainfall years are becoming more frequent exacerbating food insecurity throughout the area.

Current climate change-related weather events and their impact on smallholder farming systems: Through interviews carried out during this study, small explained how the current weather patterns were affecting their systems and subsequently their livelihoods. They cited precipitation and temperature-related weather events as the ones that are real cause for concern in relation to their agricultural activities. The high frequency of excessive rainfall and drought since, the 1980s has been the major challenge eroding the farmers' assets, leaving them more vulnerable to the vagaries of these climatic events. The high frequency of these events give farmers no time to recover from previous impacts through either asset accumulation or acquiring the skills and knowledge necessary for adapting to climate changes. Consequently, farmers are subjected to continuous hunger and deeper cycles of poverty and vulnerability (ActionAid International, 2006). The unpredictability of precipitation presented more challenges to the farmers than any other climate change elements.

Impact of prolonged wet weather: Prolonged wet conditions during the growing season may lead to flooding, waterloging, erosion and excessive leaching-all of which lead to crop failure, depending on the intensity of the condition. Weeding, fertilizer, pests, diseases and chemical application become difficult. Farming costs increase as more fertilizers and other chemicals are required, leading to losses to pests and diseases of field crops as well as those that are stored on the farm. If these conditions are experienced during harvesting and post-harvesting periods, heavy crop damage and loss are incurred as crops rot in the fields as well as on open spaces since, most farmers do not have water or moisture proof storage facilities. The impact of prolonged wet weather conditions on crop marketing is quite devastating for the farmers. The water-damaged crops will be of poor quality and therefore, fetch low prices on the market. Sometimes the prolonged wet weather leads deterioration of already poor rural roads and bridges making the roads that traverse the area impassable. This affects the timely transportation of both agricultural inputs and outputs to and from the markets further affecting agricultural productivity and household incomes in subsequent years.

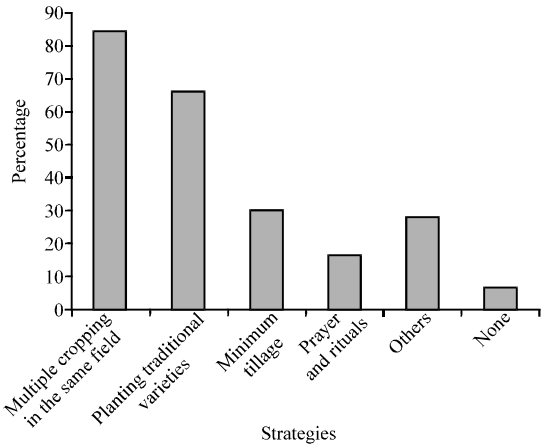

Fig. 3: Traditional adaptation strategies

Some of the road infrastructure remains in state of disrepair for years leading to deepening poverty among farmers whose household income mainly comes from farming. The farmers were however, quick to point out that prolonged wet conditions that damage crops were uncommon but when they occur, they will be quite intensive and devastating.

Farm level adaptation strategies and their sustainability: Smallholder systems, especially those located in marginal environments are often characterized by livelihood strategies that have been evolved to reduce overall vulnerability to climate shocks (adaptive strategies) and to manage their impacts ex-post (coping strategies). The distinction between these two categories is very blurred since, what starts as a copy strategy in exceptional years can become adaptations for households or whole community (Morton, 2007).

Farmers in the study area have adopted several adaptation strategies for these climate conditions, different strategies are shown in Fig. 3. These traditional coping methods were based on experience accumulated over the years and transmitted from generation to generation.

Climate change is eroding these coping mechanisms by causing climatic extremes with a frequency and intensity that local people had never seen before. This has alerted the farmers on need to re-examine land use, management practices and farm infrastructure leading to the adoption of additional coping strategies shown in Fig. 4.

As can be seen in the results, every farmer including those that claimed had no knowledge about climate change have adopted at least one strategy to cope with the current trends. The most popular adaptation strategies in the study area included short season varieties, crop diversification and varying planting dates. The main

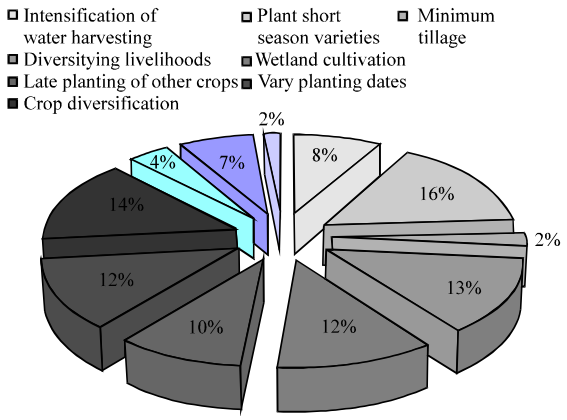

Fig. 4: Traditional adaptation strategies

thrust of these strategies is increased diversification and escaping sensitive growth stages through crop management practices that ensure that critical crop growth stages do not coincide with harsh climatic conditions in the season (Okolo, 2010). Crop diversification improves household food security since, different crops are affected differently by the same climatic conditions. Also, given the high frequency of shortening of the rain season, farmers grow short season drought-resistant crop varieties such as sorghum, ground nut and sweet potato. For a staple crop such as maize, instead planting local varieties have opted for hybrid maize that take a shorter period to mature and yield more than traditional varieties in good years. This appears quite logical and sustainable if seed producers continue to improve on these varieties. However, indigenous land races that were more adapted to the conditions in the area are being lost as farmers prefer high yielding hybrid varieties.

Livelihood diversification has increasingly become an important adaptation strategy in the study area. It was reported that there are more climate change related migrations to other urban centres in the state and the federal capital Abuja. Some young who have been employed in the urban sometimes remit to supplement agricultural incomes.

Soil and water conservation strategies such as water harvesting activities which are currently practiced by about 38% of the smallholder farmers are being intensified as agricultural extension workers, Federal Ministry of Water Resources and NGOs are now out to promote the activities. These institutions are enthusiastic about promoting these practices because they are building on the knowledge, skills and experience acquired over the years as farmers were battling to survive the harsh climatic conditions that prevail in the area. If these practices are properly promoted and adopted by the farmers, they promise to address some of climate change challenges among smallholder farmers considering their poor resources and marginal location which makes conventional irrigation impossible.

Other adaptation strategies include growing of legumes such as beans potatoes towards the end of the rain season when cereals fail, mainly due excessive rainfall and adaptation of more fertilizers when nutrients are heavily leached from the soils. Legumes mature fast and provide nutritious relish. Application of more fertilizers as an adaptation strategy has its own challenges. Chemical fertilizers are scarce and exorbitantly priced in Nigeria and most smallholder farmers cannot afford them.

Factors that hinder farmers' adaptive capacity to climate change: The study revealed that farmers' adaptive capacity to climate change is hindered by several factors which ranges from limited knowledge of the nature and consequences of climate change, farm members' health status (particularly in relation to HIV/AIDS), unemployment that is supposed to both complement and supplement agricultural incomes and poor rural infrastructure.

Limited knowledge about the nature and magnitude of climate change starts with researchers and academics. For instance in relation to Nigeria there are several climate change issues that have not been established with certainty that are important for agriculture such as time of onset of rain and prevalence dry spells within the raining season. This affects the information that has to be relayed to the farmers and specific strategies to be devised, promoted and adopted.

Soil and conservation strategies despite their potential effectiveness in addressing some of the challenges of climate change, require much labour and appropriate training of farmers. Conservation tillage for instance is useful option for improving the storage of rainwater in the soil and can help mitigate agricultural drought. However, it requires adequate draught power, appropriate machines and good training of farmers to be effective. These conditions rarely exist amongst majority of smallholder farmers. It is those farmers who are endowed with livelihood assets that mainly adopt conservation tillage as compared to those with limited assets. External support from governmental institutions and development agencies is therefore, needed to implement most soil and water conservation projects.

CONCLUSION

Although, the nature and impacts of climate change are still debatable, there is consensus that it is inevitable and the smallholder farmers in Nasarawa North Senatorial district have already started though unknowingly for the majority to learn to live with its reality and adapting as they can to its impacts. But these impacts are predicted to get worse with time necessitating more serious measures to be taken by the farmers themselves, the government, NGOs and other private sector organizations that may assist farmers with knowledge and resources to enhance their adaptive capacity.

The fact that the majority of smallholder farmers are still ignorance about climate change means that climate change awareness campaigns are needed to sensitize them about the challenge and its implications in order to facilitate the promotion and adoption of adaptation strategies. These farmers already operate in the marginal areas and most had already adopted some coping strategies to the harsh climatic conditions that have prevailed over the years. These can serve as useful entry points for intervention. Therefore, the old and new strategies need to be intensified through participatory approaches such as farmer field days and trips. Agricultural Extension Workers also need to explain and train farmers on the importance of seasonal climate forecast information and how they can use it to make efficient use of their limited resources through informed investment decisions.

Since, there is no universal way to adapt to any challenges, let alone climate change, adaptation strategies need to be context-specific. This necessitates quantification of various thresholds such as labour, household agricultural assets, knowledge, money and skills that determine the smallholder farmers' adaptive capacity to climate change.

IMPLEMENTATION

Specific programmes and projects can then be implemented to address them so as to enhance the farmers' adaptive capacity to the current and future climate changes. The sustainability of adaptation strategies has to be priotized. The adaptation strategies should therefore, be considered in terms of farmers' location, livelihood systems and ecological setting so as to make them socially, economically and ecologically sustainable. There is need to increase smallholder farmers' productive capacity now so that they can improve their asset base which will place them on a strong footing to take advantage of climate change and variability when it becomes more serious. This will improve national and household food security, incomes and reduce poverty and environmental degradation.

REFERENCES

ActionAid International, 2006. Climate change and smallholder farmers in Malawi: Understanding poor people's experiences in climate change adaptation. A Report by ActionAid International, London, October 2006.

De Chavez, R. and V. Tauli-Corpu, 2008. Guide to Climate Change and Indigenous Peoples. Tebtebba Foundation, Philippines, ISBN: 9789719356639, Pages: 96.

Ghazi, D.P.A., 2000. Forward in Downing. In: Climate Change, Climate Variability and Agriculture in Europe: An Integrated Assessment, Downing, T.E., P.A. Harisson, R.E. Butterfield and K.G. Lonsdale (Eds.). Environmental Change Institute, University of Oxford, Oxford, UK.

Hansen, J.W., W. Baethgen, D. Osgood, P. Ceccato and R.K. Ngugi, 2007. Innovations in climate risk management: Protecting and building rural livelihoods in a variable and changing climate. J. SAT Agric. Res., 4: 38-38.

Hulme, M., R. Doherty, T. Ngara, M. New and D. Lister, 2001. African climate change: 1900-2100. Clim. Res., 17: 145-168.

IPCC, 2007. Intergovernmental Panel on Climate Change. Cambridge University Press, Geneva, Switzerland.

Kandlikar M. and J. Risbey, 2000. Agricultural impacts of climate change: If adaptation the answer, what is the question? Clim. Change, 45: 529-539.

Kinuthia, J.H., 1997. Global warming climate impacts in Southern Africa: How might things change. Int. J. Afr. Stud., 1: 13-13.

Mani, M., A. Markandya and V. Ipe, 2008. Climate Change: Adaptation and Mitigation in Development Programmes: A Practical Guide. World Bank, Washington, DC., USA.

Morton, J.F., 2007. The impact of climate change on smallholder and subsistence agriculture. Proc. Natl. Acad. Sci., 104: 19680-19685.

Mutekwa, V.T., 2009. Climate change impacts and adaptation in the agriculture sector: The case of smallholder farmers in Zimbabwe. J. Sustainable Dev. Afr., 11: 237-256.

NPC, 2006. Nigeria National Population Commission. Census Report. http://www.population.gov.ng/.

New, M., B. Hewitson, D.B. Stephenson, A. Tsiga and E. Mbambalala *et al*., 2006. Evidence of trends in daily climate extremes over Southern and West Africa. J. Geophys. Res., 111: 1-11.

Okolo, 2010. Global Climate Change: Cause, Effect, Impact, Mitigation-A Theoretical and Practical Perspective. Alphabet Nigeria Publishers, Owerri, Nigeria.

Oxfam, 2007. Adapting to climate change: What's needed in poor countries and who should pay. Oxfam Briefing Paper No. 104.

Slater, R., L. Peskett, E. Ludi and D. Brown, 2007. Climate change, agricultural policy and poverty reduction-how much do we know. Natural Resource Perspectives No. 109. http://www.fanrpan.org/documents/d00417/.

Speranza, C.I., 2010. Resilient and Adaptation to Climate Change in Africa Agriculture. Germany Development Institute, Bonn, Germany.