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RURAL FARMERS' PERCEPTION OF CLIMATE VARIABILITIES IN BENUE STATE OF NIGERIA

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ABSTRACT

Climate change and severe weather events such as temperature shocks and declining rainfall often strongly impede sustainable farming development, especially where agriculture is rain fed and when other external shocks such as poverty, poor access to inputs and credit are common. This is the context in which rural farmers carry out their farming and other livelihoods activities. This study compares rural farmers' perception of temperature and rainfall with the result of 30 years (1980-2009) meteorological records of temperature and rainfall, examines the farmers adaptation practices in response to climate change and the constraints to their adaptation. The study found an increasing trend in minimum and maximum temperature as well as rainfall amount. This validates the farmers' perception of temperature and rainfall. Bush burning and Tree cutting were the perceived leading causes of climate change. Farmers mostly engaged in changing planting dates and change in house construction in response to climate change. Efforts that address poverty and provide access to agricultural support services like access to credit; farm inputs and weather forecasting service will help enhance farmers' adaptive capacity to climate change. Farmers' adaptive capacity could be enhanced through agricultural support services such as access to credit, farm inputs and weather forecasting

***Keywords**:* Adaptation, climate change, farmers, rural

INTRODUCTION

Agriculture is one of the sectors highly vulnerable to the impact of climate change, especially in a country like Nigeria where agriculture is rain-fed and practiced at the subsistence level. The nature of the impact of climate change on agricultural activities is complex and still being studied. They include but not limited to uncertainty in the onset of farming season due to changes in rainfall pattern, crop failure, pests and diseases migration, decline in agricultural yield and extreme weather events (Mozny*et al.,* 2009; Lobell *et al*, 2008; Adejuwon, 2006; Washington *et al.* 2006; Wolfe *et al*, 2005; Mendelsohn, *et al*. 2000).

According to Odjugo, (2010), the air temperature pattern in Nigerian since 1901 shows an increasing trend with a sharp rise from the early 1970s till date. The mean air temperature in Nigeria between 1901 and 2005 was 26.6^{o}C while the temperature increase for the 105 years was 1.7^{o}C. This increase in air temperature in Nigeria is higher than the global mean temperature increase of 0.74^{o}C recorded since 1860 when actual scientific temperature measurement started (IPCC, 2007). Should this trend continue unabated, Odjugo, (2010) predicted that Nigeria may experience increase in temperature of about 2.5^{O}C and 4.5^{O}C by the year 2100. High temperature and heat will

have impact on human health and productivity, with heat related diseases such as Cerebrospinal meningitis occurring more frequently and more severely.

Odjugo, (2010) also proved that rainfall trend in Nigeria between 1901 and 2005 shows a general decline. Within the 105 years, the amount of rainfall dropped by 81mm in Nigeria dropped by 81mm. From the early 1970s, the period of rainfall decline coincided with the period of sharp temperature rise. It was observed by Odjugo, (2005, 2007) that rainfall pattern was disproportionate across the country, as coastal areas experience an increase in rainfall while the continental interiors experience a decrease.

Nigeria is plagued with diverse socio-economic and ecological problems, which are directly linked to climate change (Odjugo, 2005; Ayuba *et al*., 2007). Mendelsohn and Dinar, (1999) estimated that by 2100, Nigeria and other West African countries are likely to have agricultural losses of up to 4 % of their Gross Domestic Products (GDP) due to climate change. Farmers' adaptive capacity could be enhanced through agricultural support services such as access to credit, farm inputs and weather forecasting. Decline in Agricultural yield in some ecologically sensitive zones such as the Sahel and Sudan Savannah was predicted to be up to 50% in 2020 (IPCC, 2007).Some documented impacts of climate change includes: Shift in crops cultivated, reduction of arable lands and desert encroachment, pests and diseases migration and crop failure(Odjugo, 2008).According to Apata (2006), some farmers are abandoning farming for non-farming activities as a result of the decline in crop yields and unpredictable weather patterns.

IPCC, (2007) indicated that small scale farmers, pastoralists and artisan fisher folk will suffer complex, localised impacts of climate change due to challenges such as lack of access to production assets and farm inputs, poverty, low literacy level and poor access to agricultural information. This is likely to make them more vulnerable to changes that are beyond their control. It is therefore appropriate to take into account small scale farmers' understanding of climate change. Maddison (2006) points out that adaptation to climate change is a two-step process, which initially requires the perception that climate is changing and then responding to changes through adaptation.

Rural farmers are not only beneficiary, client or co-learner in agricultural extension efforts; 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). Accordingly, there is the need to gather as much information on small scale farmers' perception of climate change, their adaptation strategies and how their adaptive capacity can be improved.

This study will guide policy makers on ways to promote adaptation within sustainable development programmes. According to Richard and Klein (2004), climate change studies have limited usefulness in providing local-scale guidance on adaptation. The study will brings to the fore small scale farmers' knowledge which can be shared and explored in developing adaptation strategies and action plans.

The study aimed at investigating farmers adaptation strategies to Climate Change. The specific objectives are to:

a. examine farmers' perception of temperature and rainfall variation in the study area,
b. investigate farmers' adaptation practices in response to climate change, and

c. identify farmers' constraints to proper response to climate change adaptation.

METHODOLOGY

The study was carried out in Benue State. The State derives its name from River Benue. It lies within the lower river Benue trough in the middle-belt region of Nigeria. Its elevation is below 300m and its geographic coordinates are longitude 7° 47' and 10° 0' East, Latitude 6° 25' and 8° 8' North. Benue has a population of 4,253, 641 (NPC, 2006), occupies a landmass of 32,518 square kilometres and has twenty-three (23) Local Government Areas. Benue State is the nations acclaimed *food basket* because of its rich agricultural produce. Agriculture is the mainstay of the economy of Benue state. It engages over 75% of the population. Makurdi is the State Capital.

The study was based on a survey of one hundred and ten (110) farm household heads during the 2010/2011 farming season in Benue State. The farm household heads were beneficiaries of the *Strengthening the Livelihoods of Small Scale farmers in Nigeria* (SLISSFAN) agricultural programme co-funded by the European Commission and Oxfam GB. Women in Agriculture Association assisted in data collection. The study samples were collected from the five communities (Agashia in Guma LGA, Tyowanye in Buruku LGA, Utabar in Gboko LGA, Mbaduku and Mbayongo in Vandeikya LGA). These were the communities that participated in the SLISSFAN project.

From the SLISSFAN project baseline data obtained from Oxfam, household heads who were 40 years old and above and who have lived in the community for 30 years and above were purposively selected and used as the sampling frame. This was done to ensure only farmers that were matured enough to recall temperature and rainfall pattern in their communities were sampled. Twenty two household heads were randomly selected from each of the 5 participating communities to make one hundred and ten respondents.

Questionnaire was used to elicit information from household heads selected for the survey. Thirty years (1980 – 2009) meteorological records on temperature and rainfall in the study area were obtained from Nigeria Meteorological Agency (NIMET) for the Makurdi Station.

Trend lines were plotted using Microsoft Excel 2007 software version to analyse the meteorological data and estimate the changes in temperature and rainfall. The pattern of temperature and rainfall were depicted using lines and histogram respectively, while trend lines were used to depict the slopes of the rainfall and temperature. Farmers were asked to respond to questions on patterns of temperature and rainfall over the past twenty (30) years, their adaptation practices and constraints to climate change adaptation. Frequency counts and percentages were used to describe the primary data.

RESULTS AND DISCUSSION

Result on Table 1 shows that 57.3% of respondents perceived an increase in air temperature while 38.2% perceived a decrease in air temperature within the last 30 years. The table further reveal that while 75.5% of respondents perceived an increase in rainfall amount, 16.4% perceived a decrease. About 59 percent of the respondents attributed changes in climate to bush burning, 52.7% linked it to tree cutting, while 29.9 percent claimed that it was caused by industrialization.

Table 1 Distribution of respondents by perception of temperature and rainfall within the last 30 years

Perception	*Frequency*	*Percentage (%)*
Air Temperature		
Increased	63	57.3
Decreased	42	38.2
Stayed Same	2	1.8
Don't know	3	2.7
Rainfall amount		
Increased	83	75.5
Decreased	18	16.4
Stayed Same	4	3.6
Don't know	5	4.5
Total	**110**	**100.0**

Source: Field Survey, 2011

Table 2 reveals that sin against divine beings and evil spirits were perceived as the causes of climate change by 13.6% and 8.2% respectively. Indeed, none of the respondents in the studythought that the change in climate is a normal and natural phenomenon. According to IPCC (2007), the changes in the climate system in recent decades is anthropogenically enhanced, i.e., caused by human activities such as bush burning, tree cutting and industrialization among other things.

Table 2 Distribution of Respondents by Perception of Causes of Climate Change

*Perceived Causes**	*Frequency*	*Percent*
Bush Burning	64	58.2
Tree Cutting	58	52.7
Industrialization	23	20.9
Sin	15	13.6
Evil Spirits	9	8.2

Source: Field Survey, 2011

*Multiple Responses

The implication of this finding is that rural farmers need more enlightenment on the scientific meaning, causes and impact of climate change.

Rural farmers practice a wide array of adaptation options in response to changes in climatic conditions. The leading climate change adaptation practices as shown in Table 3 are change in planting date (86.4%), changes in house construction (83.6%), tree planting (62.7%), changes in farming type, e.g. from crop to livestock or vice versa (60.0%) insect management (56.4%), crop diversification (51.8%) and use of improved crop/livestock species (50.9%).

Table 3 Distribution of Respondents by Adaptation Practices in Response to Climate Change

*Farm Adaptation Options**	*Frequency*	*Percentage (%)*
Change Planting Date	95	86.4
Changes in Construction	92	83.6
Tree Planting	69	62.7
Change in Farming Type	66	60.0
Insect pest management	62	56.4
Crop Diversification	57	51.8
Improved Crop/Livestock	56	50.9
Irrigation	54	49.1
Non-farm Activities	47	42.7
Prayers/Spiritual Exercise	40	36.4
Soil/Water Conservation	40	36.4
Livestock Management	40	36.4

Source: Field Survey, 2011

*Multiple Responses

Change in planting date is cost effective but require good technical knowledge and current information on when it is best to plant. Tree planting could be a response to encroaching desert conditions spreading to the guinea savannah from the Sudan/Sahel savannah and the associated wind storm (Yaqub, 2007; Ogjugo and Ikhuoria, 2003). Trees also serve as shades, carbon sink and eventually as source of fuel wood in rural communities. However, the benefits tree planting as an adaptation option will take several years to begin to accrue. Furthermore, the use of improved crop/livestock species and crop diversification in response to climate change will require some measure of scientific input, technical knowledge and access to information by the farmers.

In order to respond to the impacts of climate change on different aspects of their livelihoods, farmers also engaged in a variety of non-farm adaptation practices. Changes in house construction by the respondents involved making adjustments in old building and innovative architecture in new ones that provide ventilation and use less heat conducting materials. Insect pest management in the study area include the burning of dry leaves that

produce a unique smell that dispel mosquitoes. Non-farm adaptation activities in response to climate change in the study area includes petty trading, daily movement to nearby towns to work as car wash men, drivers and bus conductors. Prayers and spiritual exercises such as offering sacrifices is practiced by farmers as a way to appease divine beings who they believe are able to either influence the climate and make it favourable to them. It also helps to give closure or psychological stability to farmers who suffer from losses due to climate change in these rural communities.

Table 4 Distribution of Respondents by Constraints in Adjusting Farm Practices to Changes in Climatic Conditions

*Constraint**	*Frequency*	*Percentage (%)*
Inadequate Financial Resource	68	61.8
Inadequate information on weather	35	31.8
Inadequate Knowledge of Adaptation Options	29	26.4
Inadequate access to Farm Inputs	18	16.4
Shortage of labour	18	16.4
Inadequate Irrigation Water	16	14.5
Shortage of Farm Land	11	10.0

Source: Field Survey, 2011

*Multiple Responses

Data in table 4 shows that 61.8% of the respondents indicated inadequate financial resources as a constraint to Climate change. Other common constraints were inadequate information on weather (31.8%) and inadequate knowledge of adaptation options (26.4%). The implication of this finding is that for climate change adaptation strategies for small scale farmers to be effective, it should not impose heavy financial burden on the farmers. Weather forecasting services, awareness and capacity building on climate change adaptation options should also be incorporated into adaptation strategies for small scale farmers.

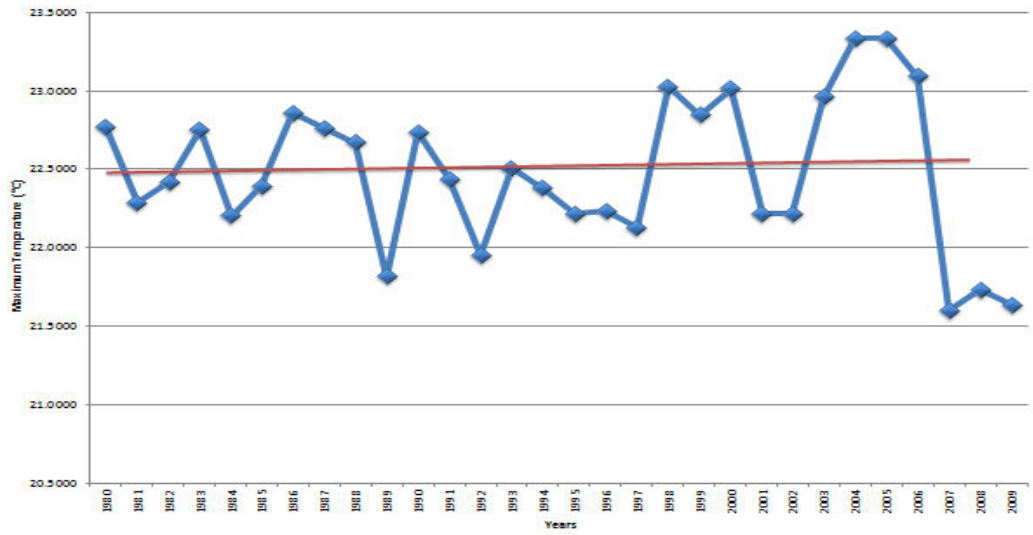

Figure 1 Trend of Minimum Temperature for Makurdi from 1980 – 2009

Figure 1 shows an increasing trend in minimum temperature for the study area. During the 30 years period, the minimum temperature has risen by 0.1°C (y^0 = 22.4 + 0.003x) fluctuating

between the lowest of 21.6^{0}C in 2007 and the highest of 23.4^{0}C in 2004 and 2005, with mean of 22.4^{0}C and standard deviation of 0.35. The last 12 years has accounted for the high minimum temperature.

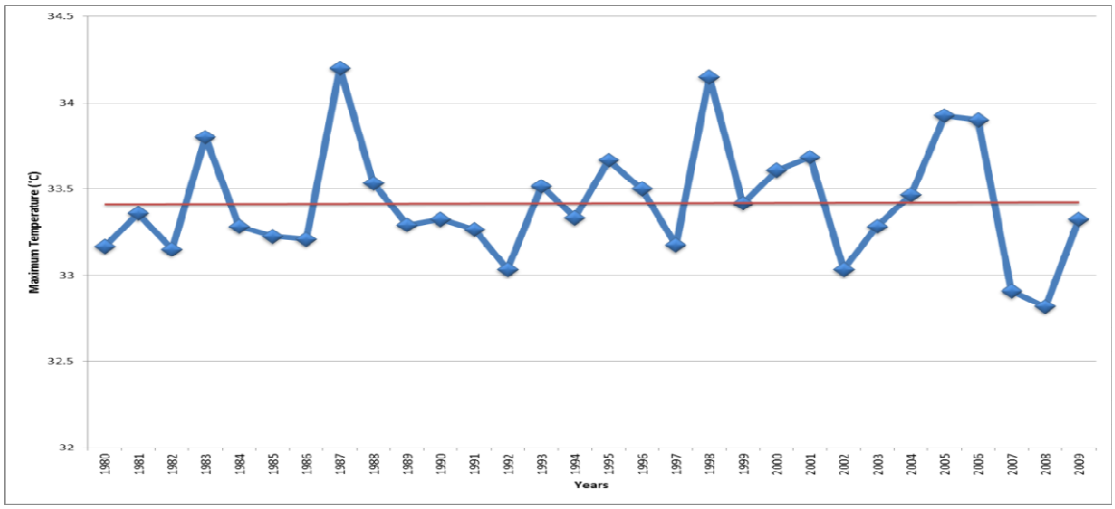

Figure 2 Trend of Maximum Temperature for Makurdi from 1980 – 2009

Figure 2 shows an increasing trend in maximum temperature trend for the study area. During the 30 years period, the maximum temperature rose by 0.49^{o}C (y^0 = 33.43 + 0.016x), with the lowest in 2007 (32.7^{0}C) and highest in 1998 (34.2^{0}C), with a mean and standard deviation of 33.4^{0}C and 0.33 respectively. Given that 57.3% of the respondents perceived an increase in air temperature, it can be inferred that the farmers' perception of temperature in the study area appears to fall in line with meteorological records in the area.Thus, the climate is not just changing, but farmers are noticing the changes and its impact on their production. Temperature thresholds differ for each crop and its impact varies depending on the stages of the crop's development.

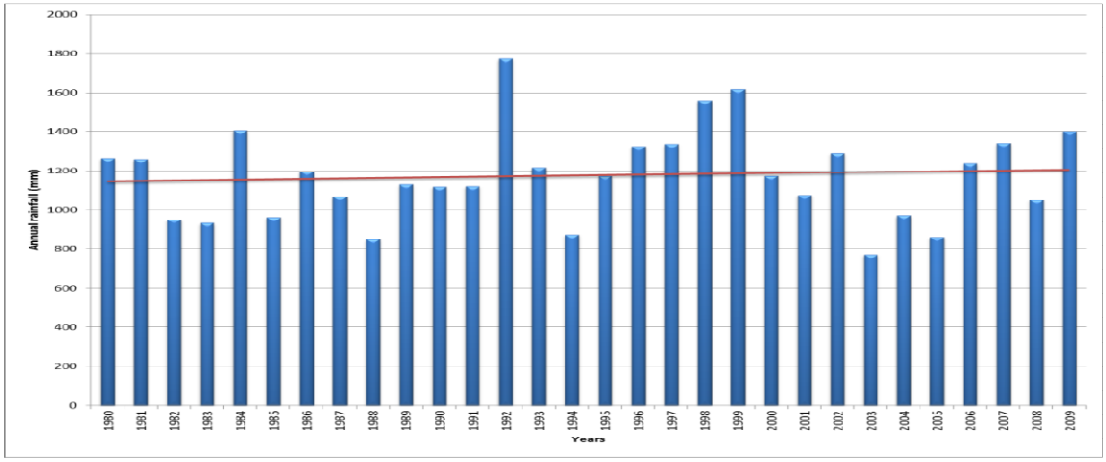

Figure 3 Trend of Rainfall Amount for Makurdi from 1980 – 2009

Figure 3 shows the total annual rainfall amount trend for the study area for the period 1980 to 2009 and presents an increasing trend. Total annual rainfall trends for Makurdi from 1980 to 2009, total annual rainfall amount has increased by 46.2mm.The mean total yearly rainfall amount is 1177.2mm, with lowest rainfall of 770.4mm (2003) and highest of 1772.4mm (1992). Given that the

highest proportion of the respondents (75.5%) perceived that rainfall amount is increasing, the farmers' perception is in agreement with meteorological records in the area.

The study further investigated West season average rainfall amount in 5 years period for the study area from 1980 – 2009. The result showed a consistent drop in rainfall amount in the month of July (-473.0mm/30years). Also, between 1980 and 1984, average rainfall was highest in July and by 2005-2009 it was lowest. Similarly, there has been an increasing trend in average rainfall amount in August (8.33mm/30years). September also had a decreasing trend (-2.32mm/30years). This underscores the unpredictability of rainfall as it is contrary to previous climatic records in Nigeria which shows double rainfall maxima in June and September with a break in August (FME, 2003). It also supports the findings of Odjugo (2005) and Odjugo (2007) that the short dry period during the raining season commonly known as the *August break* is shifting to July. This makes it difficult for farmers to time their farming operation.

CONCLUSION AND RECOMMENDATION

This study demonstrates that the climate is changing and farmers are able to correctly perceive the changes in the climate trend. Furthermore, the study reveals that farmers engage in a variety of farm and non-farm practices to adapt to the changing climate, but they face constraints such as inadequate financial resources and poor access to required weather information to plan their farming activities. These constraints will limit their ability to respond to current and future climate changes. It is recommended that policy makers and development partners collaborate with rural farmers in terms of information exchange in developing appropriate policies and programmes that will build the farmers' adaptive capacity. Development efforts in rural agrarian communities should also incorporate climate change information initiatives and weather forecasting services.

REFERENCES

Adejuwon, J.O. (2006).Food Security, Climate Variability and Climate Change in Sub-saharan West Africa. Assessments of Impacts and Adaptations to Climate Change (AIACC), Project No. AF 23, A Final Report, AIACC Project Office, Washington, DC.

Ajayi, S. (2009).Impact of Climate Change on Food Security in Nigeria. Agricultural Show Seminar, Tudun Wada, Karu LGA, Nasarawa State.

Apata, T.G. (2006) Income and Livelihood Diversification Strategies in Oil Producing Areas of Ondo State, Nigeria. Unpublished Ph.D. Thesis in the Department of Agricultural Economics, University of Ibadan, Ibadan, Nigeria pp: 201

Ayuba, H.K., Maryah, U.M. &Gwary, D.M. (2007).Climate Change Impacts on Plant Species Composition in Six Semi-arid Rangelands of Northern Nigeria. *Nigerian Geographical Journal*. 5(1): 35-42.

Federal Ministry of Environment. (2003)Nigeria's First National Communication under the United Nations Framework Convention on Climate Change. Federal Ministry of Environment, Abuja, Nigeria.

Intergovernmental Panel on Climate Change. (2007) Climate Change 2007: Impacts, Adaptation and Vulnerability: Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge

Lobell, D.B., Burke, M.B., Tebaldi, C., Mastrandrea, M.D., Falcon, W.P. & Naylor, R.L. (2008) Prioritizing Climate Change Adaptation Needs for Food Security in 2030. *Science*, 319(5863):607–610

Maddison, D. (2006) The Perception of and Adaptation to Climate Change in Africa. *CEEPA Discussion Paper* No. 10. Centre for Environmental Economics and Policy in Africa. Pretoria, South Africa: University of Pretoria.

Mendelsohn, R., Morrison, W., Schlesinger, M., &Andronova, N. (2000) *Country Specific Impacts of Climate Change*. The World Bank Group.

Mendelsohn, R. & Dinar, A. (1999) Climate Change, Agriculture and Developing Countries: Does Adaptation Matter? *The World Bank Research Observer,* 14:277-293.

Mozny, M., Tolasz, R., Nekovar, J., Sparks, T., Trnka, M. & Zalud, Z. (2009) The Impact of Climate Change on the Yield and Quality of *Saaz hops* in the Czech Republic. *Agricultural and Forest Meteorology*, 149:913-919

Odjugo, P.A.O. (2010) General Overview of Climate Change Impacts in Nigeria. *Journal of Human Ecology*, 29(1):47-55.

Odjugo, P.A.O. (2008) Quantifying the Cost of Climate Change Impact in Nigeria: Emphasis on Wind and Rainstorm. *Journal of Human Ecology*, 28(2):93- 101.

Odjugo, P.A.O. (2007) The Impact of Climate Change on Water Resources: Global and Regional Analysis. *The Indonesian Journal of Geography*, 39:23-41.

Odjugo, P.A.O. (2005) An Analysis of Rainfall Pattern in Nigeria. *Global Journal of Environmental Science*, 4(2):139-145.

Odjugo, P.A.O. &Ikhuoria, A.I. (2003) The Impact of Climate Change and Anthropogenic Factors on Desertification in the Semi-arid Region of Nigeria. *Global Journal of Environmental Science*, 2(2):118-126.

Richard, J.T. & Klein, O. (2004) Approaches, Methods and Tools for Climate Change Impact, Vulnerability and Adaptation Assessment. Keynote Lecture to the In-Session Workshop on Impacts of, and Vulnerability and Adaptation to, Climate Change, Twenty-First Session of the UNFCCC Subsidiary Body for Scientific and Technical Advice, Buenos Aires, Argentina, 8 December 2004.

Smit, B. & Skinner, M. (2002) Adaptation Options in Agriculture to Climate Change: A Typology. *Mitigation and Adaptation Strategies for Global Change*, 7: 85-114.

Washington, R., Harrison, M., Conway, D., Black, E., Challinor, A., Grimes, D., Jones, R., Morse, A., Kay, G. & Todd, M. (2006) African Climate Change: Taking the Shorter Route. *Bulletin of the American Meteorological Society*, 87:1355–1366.

Wolfe, D.W., Schwartz, M.D., Lakso, A.N., Otsuki, Y., Pool, R.M. &Shaulis, N.J. (2005) Climate Change and Shifts in Spring Phenology of Three Horticultural Woody Perennials in North-Eastern USA. *Journal of Biometeorology*, 49:303-309.

Yaqub, C.N. (2007) Desert Encroachment in Africa: Extent, Causes and Impacts. *Journal of Arid Environment*, 4(1):14-20.