



Review and analysis of vulnerability to rainfall variability and policy responses to agricultural water supply in Nigeria

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Abstract

This paper reviewed and analysed vulnerability to climate change-induced rainfall variability and policy responses to agricultural water supply in Nigeria. The review provides evidence for policy feedbacks as well as priority setting for the post-2015 sustainable development agenda. Nigeria's vulnerability to climate change variability is due to a number of factors: its geographical characteristics, limited capacity to adapt, dependence on climate-sensitive resources, teeming population, and concentration of Gross Domestic Product (GDP) generating industries in locations that are highly vulnerable to climate change. The poverty level in the country could further worsen climate change adaptation and mitigation strategies. The policy responses were identified and categorized either as climate change sensitive or climate change specific.

Key words: Climate change, rainfall, vulnerability, policy responses, Nigeria.

Introduction

Climate change is now a global development challenge which raises concerns for adaptation and mitigation for the vulnerable countries and regions of the world ⁷. The United Nations has identified climate change as one of the areas for the sustainable development goals (SDGs). The SDG 13 seeks to *take urgent action to combat climate change and its impacts* ²⁰. Climate change impacts are predicted to result in extreme rainfall events (including, flooding and droughts) in many countries of the world. Sönke and Eckstein ¹⁸ report on the Global Climate Risk Index noted that less developed countries (including, Nigeria) are generally more affected by extreme climate and weather-related events than industrialized countries. Extreme climate-related events would further threaten the future of the countries that have high and extreme vulnerability ratings.

Nigeria is one of those countries expected to be most affected by the impacts of climate change through sea level rise along the coastline, desertification, erosion and flooding disasters, and land degradation with its variety of ecosystems, including mangroves and rainforests on the Atlantic coast in the south to the savannah ¹⁶. The factors accounting for Nigeria's vulnerability to climate change are: its geographical characteristics, limited capacity to adapt, dependence on climate-sensitive resources, teeming population, concentration of Gross Domestic Product (GDP) generating industries in locations that are highly vulnerable to climate change, and high level of poverty ^{7,11,16,19}.

Geographical Characteristics and Vulnerability

The geographical characteristics of Nigeria include coastal area to the south and sudano-savanna to the north. There are two major rivers (Niger and Benue) which ramify the country. The management

of these rivers have implications for siltation, flooding and agricultural production risks. Nigeria lies between 4°N and 14°N, and between 3°E and 15°E and spans six major vegetation zones, reflecting the highly variable climate throughout the country. Its sub-Saharan location is one of the 'hot spots' of climate change likely to experience the most severe impacts due to the delicate nature of the existing ecosystems. The heavy concentration of GDP-generating industries and infrastructures like agriculture, fisheries, and oil explorations in locations that are highly vulnerable to climate change (southern coastline of Nigeria) makes Nigeria vulnerable to climate change effect of sea level rise and flooding ^{7,19}. Hence, the need to enhance capacity to mitigate and/or adapt to climate risks associated with frequency and vulnerability to rainfall and extreme weather events like coastal and flash flooding.

The northern part of the country forms part of the Sahel which is at risk of further desertification and droughts. It has been observed that agricultural water shortages or drought, increased diseases and associated social disruption could well give rise to a vicious cycle of economic degradation and social conflict ^{8,19}. Similarly, several reports of the Inter-governmental Panel on Climate Change (IPCC) have reported potential negative impacts of climate change on GDP ^{7,19}. This goes to indicate the nexus between climate change and economic development ⁴. Therefore, climate change presents a challenge for attaining sustainable development which seeks to promote economic, environmental and social prosperity.

Economic Sectors and Vulnerability

As noted earlier, the Nigerian economy is dependent on climate-sensitive resources like agriculture which employs up to 70% of the workforce and contributes up to 40% of the total national GDP^{9,21}. Similarly, all the sectors and regions of Nigeria's economy are being impacted by climate change^{13, 14, 16}. Infrastructure such as water, transport, power and livelihoods are extremely susceptible^{2, 7, 8}. However, some gains are expected in some sectors of the economy, such as the production and sales of renewable energy, flood protective devices, medicine, and domestic cooling equipment. Again, there would be need to development adaptive capacity to harness the opportunities from the expected gains from climate change. Overall, all regions of the country (north and south) and sectors of the Nigerian economy (including agriculture, health and education) are impacted by climate change-induced rainfall variability and extreme events, particularly the southern coastal regions (flooding) and the far north (drought) of Nigeria. Hence, the country requires strong financial and infrastructural resources to improve climate change adaptive capacity and mitigation strategies.

Poverty Status and Vulnerability

Poverty is pervasive in Nigeria (see Table 1) with about 70 percent of the population in poverty¹¹. Poverty and food insecurity are linked to low agricultural productivity which is aggravated by climate change and variability^{8, 12}. The high level of poverty is linked to low level of resilience, low adaptation and low mitigation under climate change. The population of Nigerians in poverty has been increasing since 1980. Generally, poverty reduces adaptive capacity to climate change. Also, climate change-induced rainfall variability and impacts are worse for the agrarian economy and poor people especially for those whose livelihoods are from agriculture. The vulnerable, smallholders and poor people are

Table 1. Trends in relative poverty levels, 1980-2010, Nigeria¹⁰.

Year	Poverty incidence (%)	Estimated total population (Millions)	Population in poverty (Millions)
1980	8.1	65.0	18.26
1985	46.3	75.0	34.73
1992	42.7	91.5	39.07
1996	65.6	102.3	67.11
2004	54.4	126.3	68.70
2010	69.0	163.0	112.50

Table 2. Rainfall, flooding and irrigation in Nigeria, 1970-2012^{10, 11, 15, 17}.

Period	Duration (number of years)	Rainfall in millilitre	Change in rainfall in millilitre	Change in proportion of arable land under irrigation	Occurrence of flooding (number of time in years)
1970-1979	10	379.90 (57.09)	-	-	4
1980-1989	10	352.30 (70.44)	-27.60	-0.05	7
1990-1999	10	326.40 (93.91)	-25.90	0.19	3
2000-2009	10	354.96 (17.27)	28.56	0.17	2
2010-2012	3	382.07 (17.94)	27.11	0.13	2
1970-2012	43	355.39 (64.24)	-	-	18

less able to fend for themselves and are less able to adapt to changing circumstances^{8, 12}.

Trends in Rainfall and Flooding in Nigeria

The distribution and pattern of rainfall over the country has been witnessing some degrees of variability and fluctuation (increases and decreases). Where volume of rainfall has increased significantly, such increases have sometimes resulted in flash or coastal flooding in the country. Table 2 reveals average annual rainfall of 355 (± 64.24) ml. The frequency of extreme rainfall events (flooding incidences) in Nigeria has been on increase from 1970 to 2012, and reached a peak during 1980-1989. There were also fluctuations in rainfall over the years. Phenomenal occurrence in flooding incidences occurred during 1980-1989 period (7 years out of 10 years, representing 70 percent of the time), and recently during 2010-2012 period (2 years out of 3 years, representing 67 percent of the time). Overall, flooding incidences have been recorded for as much as 18 times representing 42 percent of times over the study period (see Table 2).

The percentage change in average decadal rainfall has also been increasing since 1990s. Thus, indicating a potential positive aspect of climate change for rainwater harvesting for agricultural purposes. Rather, much of the increases in the volume of rainfall in Nigeria have tended to recurring flash and coastal flooding incidences as shown in Table 2.

Synthesis of Policy Responses, Vulnerability to Agricultural Water Supply and Climate Change in Nigeria

The policy instrument for mitigating the impact of limiting water supply for agricultural production in the country has neither been transformative nor mitigating the impact of climate change. The average arable land area under irrigation increased only marginally since the 1990s. Whereas, the adoption of agro-technology like irrigation system is one of the policy thrusts of government of Nigeria in mitigating against drought or channelization (including dams) of flood prone areas as well as means of improving food security and welfare of the citizens¹⁻⁵. Therefore, there is need to substantially increase the average arable land area under irrigation in the country due to the dual advantages (at least) of building adaptive capacity to climate change impact and enhancing food security in the country.

Some of the policy frameworks in Nigeria are either climate change specific or climate change sensitive. These policy frameworks include, the River Basin Development Programme, Fadama Projects (I-III), National Integrated Water Resources Management Commission Draft Bill, and Vision 20 : 2020 – First National Implementation Plan Sectoral Plans and Programmes (see Table 3). The policy frameworks are described as climate change

sensitive or climate change specific because they make implicit or explicit provisions for climate change adaptation and mitigation measures in relation to agricultural water resources and supply, and other sectors. The particular reference to small-scale and large-scale irrigation is important for an agrarian economy and populous country like Nigeria for enhancing sustainable development.

The River Basin Development Authorities (RBDAs) is one of the enduring climate change sensitive policy responses of the government of Nigeria to agricultural development and combating climate change. Nigeria has history of policy changes and somersaults due to regime effects¹⁷, but the RBDAs has weathered different regime effects since its establishment in 1976. The RBDA is an anti-drought measure designed to facilitate the construction of irrigation facilities and extension of such facilities to cover 444,000 hectares of farmland³. However, the RBDA has not been able to meet the set target almost 40 years after its creation. The RBDA is thus an example of climate change sensitive policy framework that has fallen short of its target and thus intensified the impact of climate change in Nigeria.

Conclusions and Recommendations

Agricultural water resources-related climate change impacts in Nigeria are manifested in form of variability in rainfall pattern. The vulnerability of the country to climate change is due to a number of factors which include the geographical characteristics, limited capacity to adapt, dependence on climate-sensitive resources, teeming population, concentration of GDP-generating industry in locations that are highly vulnerable to climate change, and high levels of poverty.

The real impacts of rainfall-related climate risks in Nigeria are flooding and drought. Flooding incidences have been recorded more frequently in recent times. Flood disasters make the people vulnerable to the effects of inundation, pollution, contamination of taps and valves as well as falling groundwater levels and food security challenges, including loss of lives and properties.

The policy frameworks for enhancing agricultural water resources-related adaptive capacity and mitigation to climate change emphasize the development of small-scale and large-scale irrigation schemes for agricultural development and economic

transformation to sustainable development. The policies have not delivered effectively in the areas of climate change adaptation and mitigation. Therefore, there is need to ensure implementation of relevant policies on climate change and agricultural water resources. Such policies should also harness the positive aspects of climate change which include: rainwater harvesting, construction of drainage, and agricultural insurance. The adaptive capacity of farmers should also be enhanced through policy support for climate-smart agriculture. There is also need to ensure synergistic cooperation among relevant ministries of national government and donor agencies in ensuring effective agricultural and climate change sensitive policies for sustainable development in Nigeria.

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Table 3. Synthesis of policy responses to vulnerability to water supply and climate change in agriculture in Nigeria^{1,3,6}.

Climate change risk	Policy framework	Classification of policy framework	Remarks/coverage/relevance to agriculture
Increased or decreased precipitation (rainfall)	River Basin Development Programme	Climate change sensitive	Provide large scale irrigation and drainage for enhancing all-year round agricultural production
	Fadama Projects (I-III)	Climate change sensitive	Provide small-scale irrigation (surface and tubewells) for farmers in low-lying water areas
	National Integrated Water Resources Management Commission Draft Bill	Climate change sensitive	Has provisions for development of water catchment management plan and water efficiency strategies
	Vision 20: 2020 – First National Implementation Plan Sectoral Plans and Programmes	Climate change sensitive	Recognises climate change impacts on the environment and water resources for agriculture.
	National Adaptation Strategy and Plan of Action (NASPA)	Climate change specific	Climate change adaptation strategies for agriculture and other sectors of the economy

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