

## A Review of Resilience Concept and Content in Recent Nigerian Agriculture Policy Trends

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**Abstract:** The nexus between climate change and agriculture, and the formidable (but not insurmountable) barriers to achieving sustainable development in Nigeria are the themes of this paper. Among the economic sectors, agriculture is the most vulnerable to climate change. With more than 60% of its population directly or indirectly relying on agriculture as a source of livelihood, Nigeria will be adversely affected by this external factor. Disruptions in food supply will also have negative impacts on the wider population of food buyers. More importantly, as Nigeria accounts for a sizeable proportion of sub-Saharan Africa's and the world's supply and demand for grains, any significant changes in the food systems of Nigeria will have global implications on food availability, access, and utilization. The Paper recommends among others the Institutionalization of early warning systems through the strengthening and coordination of the nation's meteorological services and the integration of indigenous knowledge of climate and early warning signals

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### 1. Introduction

In the wake of unprecedented disasters in recent years (e.g., tsunamis, earthquakes, floods and droughts), "resilience" has become a popular buzzword across a wide range of disciplines, with each discipline attributing its own working definition to the term. A definition that has long been used in engineering is that resilience is the capacity for "bouncing back faster after stress, enduring greater stresses, and being disturbed less by a given amount of stress" (Pimm 1984; Holling 1996). This definition is commonly applied to objects, such as bridges or skyscrapers. However, most global risks are systemic in nature, and a system—unlike an object—may show resilience not by returning exactly to its previous state, but instead by finding different ways to carry out essential functions; that is, by adapting.

For a system, an additional definition of resilience is "maintaining system function in the event of disturbance" (Holling 1973; Adger *et al.* 2005; Folke 2006). The working definition of a resilient system in this sense is, therefore, one that has the capability to 1) adapt to changing contexts, 2) withstand sudden shocks and 3) recover to a desired equilibrium, either the previous one or a new one, while preserving the continuity of its operations. The three elements in this definition encompass both recoverability (i.e., the capacity for speedy recovery after a crisis) and adaptability (i.e., timely adaptation in response to a changing environment).

The issue of resilience brings to mind issues of susceptibility to forces of nature, such as (a) climatic shocks, which reduce food supply and raise the price

of food and vulnerability of the poor; (b) health shocks, which affect productivity and income earning potentials; (c) unstable markets, which affect incomes, employment and wages; and (c) environmental damages, which compromise the ability of agro-ecosystems to support sustainable agricultural growth. To assure food and nutritional security, policies and institutions are needed to enhance the ability of individuals, households and production systems to recover from the impact of shocks. Policymakers need to develop short-term and long term strategies to reduce food and nutrition vulnerability, while enhancing social-ecological resilience.

The agricultural sector of Nigeria has not been productive enough to have a positive impact on the country's economy and has instead been associated with environmental degradation. Consequently, the country is experiencing mounting food deficits and declines in both gross domestic product (GDP) and export earnings, while retail food prices and import bills are increasing. These problems could be further exacerbated by climate change, if the nation's agricultural policies do not incorporate issues aimed at understanding and mitigating its impacts. There is therefore a need to establish agricultural strategies that promote political stability, self-reliance, public participation, sustained production, and environmental security.

The overarching objectives of the nation's current agricultural policy, which was put forth in 2001, consist of:

- Achievement of self-sufficiency in basic food

supply and the attainment of food security.

- Increased production of agricultural raw materials for industries.
- Increased production and processing of export crops with improved production and processing technologies.
- Generation of gainful employment.
- Rational use of agricultural resources; improved protection of agricultural land resources from drought, desert encroachment, soil erosion, and floods; and the general preservation of the environment for the sustainability of agricultural production.
- Promotion of the increased application of modern technology to agricultural production.
- Improvement in the quality of life for rural dwellers.

Resilience to climate change is crucial for attaining these Objectives. Therefore, policy measures for mitigating the impacts of climate change on Nigeria's agricultural sector should actively consider the potential impacts of climate change on the nation's agricultural resource base.

Although this analysis highlights common uncertainties related to the nature, intensity, timing and effects of climate change (e.g., Deser *et al.* 2012; Trenberth *et al.* 2014), it is still useful in that it assists with the development of policies and actions for mitigating the detrimental effects of climate change on the livelihoods of vulnerable groups in Nigeria, particularly farmers.

The remainder of this paper is structured as follows: section two further articulates concepts of resilience; section three describes the three main types of stress Nigerian agriculture contends with; section four addresses the profile and vulnerability of Nigerian agriculture to climate change; and section five examines government policy shorts for resilience in agriculture. The paper closes with remarks and recommendations for additional climate change mitigation.

### Concepts of Resilience

Resilience is the capacity to adapt and to thrive in the face of challenge. Resilience is usually defined as the capacity of a system to tolerate shocks or disturbances and recover. In human systems, this is closely linked to the adaptive capacity of the system—the ability of individuals and the group to adapt to changing conditions through learning, planning, or reorganization (World Bank, 2008). In the context of rural communities, we can speak of three forms or dimensions of resilience.

Ecological resilience is the level of disturbance that an ecosystem can absorb without crossing a threshold to a different ecosystem structure or state (Adesina, 2013). The disturbance may be natural (e.g.,

a storm) or human-caused (e.g., deforestation, pollution, or climate change). The new ecosystem structure that results after crossing a threshold may have lower productivity or may produce different things that are not as desirable to those remaining in the ecosystem. Overfishing, forest clearance, and overgrazing are typical disturbances that can challenge ecosystems and ultimately overwhelm their ability to recover, forcing them over the threshold to a new and, from the standpoint of nature-based livelihoods, less desirable state (Walker & Salt 2006). Social resilience is the ability to face internal or external crises and effectively resolve them (IPCC, 2007). In the best cases it may allow groups to not simply resolve crises but also learn from and be strengthened by them. It implies an ability to cohere as a community and to solve problems together in spite of differences within the community. Social capital and a shared sense of identity and common purpose support this aspect of resilience. Economic resilience is the ability to recover from adverse economic conditions or economic shocks (World Bank, 2008). It encompasses having a variety of economic options available if a particular economic activity fails, or being able to create more options, if necessary. Economic resiliency implies an ability to call on a wide variety of skill sets and contacts (UNDP, 2007; WRI, 2008).

The concept of resilience has emerged in response to the need to manage interactions between human systems and ecosystems sustainably. Humans depend on ecosystem services (e.g., water filtration, carbon sequestration, and soil formation) for survival, yet the ability of institutions to manage these natural systems sustainably has not kept pace with the changes occurring within these systems. Socioeconomic institutions have considered ecosystems and the services they provide to be infinite and largely in a steady cycle of regeneration (Resilience Alliance, 2012). This attitude has led to the creation of economic instruments and incentives that use ecosystems deterministically, from extraction to consumption. The concept of resilience, however, recognizes that social and environmental systems are interlinked, complex, and adaptive; process dependent—rather than input dependent—and self-organizing rather than predictable (Walker and Salt 2006). The lens of resilience is useful in analyzing climate change because it is founded on the recognition that human existence within ecological systems is complex, unpredictable, and dynamic, and that institutional measures and responses should be based on this principle (UNISDR, 2006).

According to World Bank (2008), when the poor successfully and sustainably scale up ecosystem-based enterprises, their resilience can increase in two dimensions. They can become more economically

resilient—better able to face economic risks. They—and their communities—can become more socially resilient—better able to work together for mutual benefit.

There are at least six principles of resilient systems. First is the *homeostasis* principle, which holds that the system is maintained through feedbacks between its components (Walker and Salt, 2006). These feedbacks signal changes, drive responses, and enable learning. Resilience is enhanced when feedbacks are transmitted effectively. The second principle is the *omnivory* principle, which holds that external shocks are mitigated by the diversification of resources and the diversification of the means by which resources are delivered (Barnet, 2001). Thus, the more diverse the resources and the more diverse the means of delivery, the less likely it is that the supply of vital items will falter. In this way, a crisis of supply in one place does not trigger a crisis in other overly-dependent places. The third principle is the *high flux* principle, which holds that the faster the rate of movement of resources through the system, the more resources will be available at any given time to help cope with perturbation, and hence, the more resilient the system (Barnet, 2001 citation).

The fourth principle is the *flatness* principle, which refers to the number of hierarchical levels relative to the base in an organization, and holds that the greater the number of participants higher in the system (i.e., the more top-heavy), the less resilient a system (WRI, 2008; Barnet, 2001). Overly hierarchical systems are less flexible and hence less able to cope with surprise and adjust behavior. The fifth principle is the *buffering* principle, which refers to the surplus or slackness in the system, and holds that a system which has a capacity in excess of its needs can draw on this capacity in times of need, and so is more resilient (Barnet, 2001). Finally there is the *redundancy* principle, which holds that a degree of overlapping function and redundancy in a system permits the system to change by allowing vital functions to continue while formerly redundant elements take on new functions (WRI, 2008).

Redundancy also allows for interchangeability when one part fails to perform.

From the perspective of the study of natural disasters, a number of strategies enable systems to both absorb and recover from sudden changes, and to learn from and adapt to changed conditions. In addition to designing slackness, redundancy, and speed of supply into social systems (i.e., the buffering, redundancy, and high flux principles, respectively) and decentralizing decision making (i.e., the flatness principle), other strategies which enhance resilience to disasters include: mobility, including ability to relocate temporarily or permanently; diversification of supply of food, fiber and income (i.e., the omnivory principle); mobilizing social networks and systems of redistribution (i.e., the whole insures the parts); alleviation of absolute poverty; learning from past events and changing practices; transmission of knowledge across space and time; experimentation and innovation; and sustainable intensification of resource use (Barnett, 2001).

Agriculture is a form of natural resource management for the production of food, fuel, and fiber (i.e., ecosystem services). As such, it depends on the resilience of both social and ecological systems (i.e., social-ecological resilience). In social systems, resilience varies greatly among households, communities, and regions, depending both on the assets and knowledge farmers can mobilize and the services provided by governments and institutions. On the other hand, the resilience of agriculture-related ecosystems depends largely on slowly changing variables, such as climate, land use, nutrient availability, and the size of the farming system (Olowa and Olowa, 2014). In addition, agriculture is a source of livelihood for billions of people—particularly poor people—and their income directly contribute to a society's resilience. As a result, enacting measures to build agricultural resilience requires an understanding of strategies to reduce vulnerability, while at the same time, generating income and reducing poverty.

**TABLE 1. Education and labor statistics for Nigeria, 1980s and 2000s**

Indicator	Year	Percent
Primary school enrollment (percent gross, three-year average)	2006	96.7
Secondary school enrollment (percent gross, three-year average)	2006	31.9
Adult literacy rate	2007	72.0
Percent employed in agriculture	1986	46.8
Under-five malnutrition (weight for age)	2003	27.2

Source: Authors' calculations based on World Development Indicators (World Bank 2009).

### Types of Stress in Nigerian Agriculture

Agriculture in sub-Saharan Africa contends with

three main types of stress: shocks, cycles and trends (citation). Shocks strike with little or no warning and

their immediate impacts can be hard to prepare for and cope with. Covariate shocks, such as spiking international food and energy prices (e.g., as in 2007–2008 and 2010–2011), affect the entire food system. Idiosyncratic shocks, such as when a household member loses a job or falls ill, affect individual households and communities. Cycles, with their longer gestation, include seasonal harvests and the associated rise and fall in demand for agricultural labour, and are often more predictable. Trends also unfold gradually, allowing for adaptation. Examples of trends include the effects of soil erosion on agricultural productivity and some of the impacts of climate change. Despite these distinctions, shocks, cycles and trends are interrelated. For instance, in sub-Saharan Africa, climate change (a trend) and El Niño (a weather cycle) contribute to more frequent droughts and floods (shocks). Some changes arise from exogenous factors (e.g., climate change, civil conflict, and globalization of agricultural trade), whereas others result from endogenous factors (e.g., household power relations and demographic changes that affect the demand for food and the supply of labour) (Africa Human Development Report, 2012).

#### Profile and Vulnerability to Climate Change of

#### Nigerian Agriculture

Vulnerability has many dimensions. In this paper the focus is on income level and sources, as described above. Table 1 provides data on Nigeria's performance in the following additional indicators of vulnerability and resiliency to economic shocks: the level of education of the population, literacy, and the concentration of labor in the agricultural sector. The rate of enrollment in secondary school is low in Nigeria, whereas the rates of primary school enrollment and adult literacy are relatively high those who had less. A similar result was reported by Nkonya *et al* (1997).

Annual farm income ( $X_{11}$ ) – The coefficient and t-value of annual farm income were 0.0219 and 3.3692 respectively. The result implies that a unit increase in Naira from annual farm income resulted to 2 percent increase in the probability of the sustained adoption decision behaviour of maize/cassava intercrop. Increased annual farm income increased a farmer's capital base. This predisposed to sourcing agricultural information, purchasing farm input, employing farm staff and paying wages. The result is in consonance with that of Karki and Bauer (2004).

TABLE 2. Income distributions in Nigeria, 2004

Indicator	Measure
Gini coefficient (0 = perfect equality; 100 = perfect inequality)	42.9
Percent of total income earned by the richest 20 percent of the population	48.6
Percent of total income earned by the poorest 20 percent of the population	5.1
National poverty rate (percent)	54.7
Poverty rate, urban population (percent)	43.1
Percent of population living on less than US\$1.25 a day (PPP)	63.1
Percent of population living on less than US\$2.00 a day (PPP)	83.1

Source: World Bank (2012).

Notes: PPP = purchasing power parity; US\$ = US dollars.

The percentage of the population employed in agriculture is lower than in many West African countries, suggesting that alternative livelihoods are available. Nigeria's rate of under-five malnutrition is also relatively lower than in many neighboring countries (Hassan, Ikuenobe, Jalloh, Nelson, and Thomas, 2013).

Some statistics related to income distribution in Nigeria show that Income inequality is relatively high, as indicated by a Gini coefficient of 51, and the high level of poverty—with over 70 percent of the population living on less than US \$1 a day—despite a GDP per capita of around US \$500 (Table 2). Given that the child malnutrition rate is also relatively high in Nigeria, special attention needs to be given to the most vulnerable in the country, particularly those who are food insecure. Circumstances that restrict the

movement of food from surplus areas to deficit areas—for example, flooding in areas of the Niger, Jigawa, Sokoto, and Kebbi States in 2010—could decrease food availability and affordability and increase the vulnerability of the poor to lack of access to food. Therefore, for a country with as a high population growth rate as Nigeria, policy measures should aim to provide enhanced resources that support the poorest and most vulnerable, a considerable proportion of whom are farmers. This underpins the *buffering principle* of resilient system. Many poor farmers are located in the north-central part of the country where the majority of the poor living on less than US \$2 per day also reside (Olowa and Shittu, 2012; Hassan, Ikuenobe, Jalloh, Nelson, and Thomas, 2013).

Table 3 shows key agricultural commodities in

terms of area harvested. Table 4 reports the value of the harvest of these commodities and Table 5 the quantity consumed. All commodities in these tables are significant to Nigeria because they are important to the food culture of the people or are cash crops providing significant income to farm families and national foreign exchange earnings; an example is cocoa beans. Cassava and yams are the most important food crops in the country. Other major food crops include sorghum and maize.

Various climate models have predicted an increase in precipitation throughout the country except in the central part. Specifically, increased rainfall is expected in the coastal areas and the southeastern portion of the country, along the border with Cameroon. Meanwhile, temperature has been predicted to increase by 2.0°–2.5°C, on average, across the country (Hassan, Ikuenobe, Jalloh, Nelson, and Thomas, 2013).

The effects of climate change on key crops in Nigeria have been predicted (Hassan, *et al.*, 2013). All the crop modeling results predict a loss of yield in areas planted with sorghum in the northern Sahelian zone, which is already prone to desertification. This means that the temperature increase will make it too

hot for sorghum cultivation in these areas. Except in pockets of areas in Kebbi and some inland valleys, all the models predict yield losses on the order of 5–25% below baseline, with a few areas showing even greater losses. Maize will perform relatively better in the face of climate change, with a gain in yield of between 5 and 25 percent, with some areas predicted to have a yield increase greater than 25 percent. Less area is predicted to be lost to maize than to sorghum. As in the case of sorghum, the areas predicted to be lost to maize fall within the Sahelian region of the northeastern extreme of the Nigeria. Apparently, the present scenarios in Nigeria reveals scientific predictions are already unfolding themselves. What then is the government doing about it?

#### **Building resilience for food and nutritional security in Nigeria: Overview of Policies and Strategies**

In Nigeria, climate change is expected to continue unfolding as the human population of the country rises. United Nations (UN) population office (2009) projections for Nigeria indicate a doubling of population in the next 40 years, from about 150 million presently to about 310 million—based on the high variant projection—or about 240 million, a 60 percent increase—based on the low variant projection.

**TABLE 3 Harvest area of leading agricultural commodities in Nigeria, 2006–08 (thousands of hectares)**

Rank	Crop	Percent of total	Harvest area
Total		100.0	45,877
1	Sorghum	16.5	7,579
2	Millet	10.8	4,977
3	Cowpeas	9.6	4,395
4	Maize	8.5	3,898
5	Cassava	8.3	3,821
6	Oil palm fruit	6.8	3,142
7	Yams	6.7	3,068
8	Rice	5.5	2,519
9	Groundnuts	4.9	2,251
10	Cocoa beans	2.4	1,110

Source: FAOSTAT (FAO 2010).

**TABLE 4 Value of production of leading agricultural commodities in Nigeria, 2005–07 (Millions of US\$)**

Rank	Crop	Percent of total	Value of production
Total		100.0	66,008.7
1	Yams	29.4	19,380.3
2	Cassava	11.7	7,696.7
3	Sorghum	5.7	3,776.4
4	Other citrus	5.2	3,400.6
5	Millet	4.7	3,115.5
6	Maize	4.4	2,932.3
7	fresh vegetables	3.7	2,469.9
8	Plantains	3.1	2,075.1
9	Cowpeas	3.0	1,952.6
10	Groundnuts	2.7	1,811.3

Source: FAOSTAT (FAO 2010).

**TABLE5 Consumption of leading food commodities in Nigeria, 2003–05 (thousands of Metric tons)**

Rank	Crop	Percent of total	Food consumption
Total		100.0	81,884
1	Cassava	18.5	15,139
2	Yams	12.3	10,071
3	Fermented beverages	10.1	8,291
4	Other vegetables	7.9	6,445
5	Sorghum	7.0	5,765
6	Millet	5.8	4,770
7	Rice	3.8	3,079
8	Maize	3.7	3,054
9	Other citrus	3.4	2,763
10	Other fruits	3.1	2,555

Source: FAOSTAT (FAO 2010).

Challenges associated with a high rate of population growth will include providing food, shelter, and social amenities. When one takes into account the effects of climate change (e.g., higher temperatures, shifting seasons, more frequent and extreme weather events, flooding, and drought) on food production, these challenges are even more daunting. The global food price spikes of 2008, 2010, and 2012 are harbingers of a troubled future for global food security.

The long term solution to food insecurity in Nigeria is to raise agricultural productivity and boost food production. Nigeria embarked on a major transformation of its agricultural sector, with the launch of the Agricultural Transformation Agenda in 2012. The goal is to add 20 Million MT of food to the domestic food supply by 2015 and to create 3.5 million jobs. Government drives import substitution by accelerating the production of local food staples, to reduce dependence on food imports, and turn Nigeria into a net exporter of food. Nigeria has ended the approach of agriculture as a development program. Agriculture is now treated as a business to generate wealth for millions of Nigerians, while recognising the need to enhance resilience for food and nutritional security.

Six policy areas were pursued and implemented for improving resilience in Nigeria.

First, to assure increased agricultural productivity, it is critical that farmers get access to affordable agricultural inputs. Thus, the first ever database of farmers in the country was launched. 4.2 million farmers were registered in 2012 with a projection to expand this to 10 million farmers in 2013, fortunately this has been accomplished. This allows for capturing of comprehensive information about farmers and better target policies to support them.

Radical reforms of fertilizer and seed policies

were implemented by taking the government out of the procurement and distribution of fertilizers and seeds. The Growth Enhancement Support (GES) was launched through which farmers received subsidised seeds and fertiliser via vouchers on their mobile phones - or Electronic or E-wallets. These electronic vouchers were used just like cash to buy seeds and fertilizers directly from agro-dealers, making Nigeria the first country in Africa to launch an electronic wallet system for the delivery of subsidised inputs to farmers. According to Adesina (2013), within 120 days of the launch of the program, 1.2 million farmers received their subsidised seeds and fertilizers through mobile phones in 2012 while targeting 5 million farmers in 2013. The GES also stimulated major changes in the input supply system, as seeds and fertilizer companies developed supply chains to reach farmers in rural areas. Fertilizer companies sold \$100 million worth of fertilizers directly to farmers, instead of to government. Seed companies sold \$10 million worth of seeds directly to farmers. Banks lent \$20 million to seed, fertilizer companies and agro dealers (Adesina, 2013). The default rate under the scheme was zero percent. Because Ministry of Agriculture (MoA) was able to reach farmers directly with farm inputs, and stimulated wider markets for agricultural inputs, agricultural productivity and food production rose by 8.1 million MT in 2012.

Second, to complement the agricultural revolution, financial revolution program was launched. This program expanded farmers' access to financial services, allowing them build their productive assets, diversify income sources and enhance their resilience. To achieve this, the Central Bank of Nigeria established a \$350 million risk sharing facility (NIRSAL) to reduce the risk of lending by banks to farmers and agribusinesses. The facility is to provide leverage for \$3.5 billion of lending from banks to

agriculture. It will also reduce interest rates paid by farmers from 18% to 8 %. In 2013, NIRSAL will share risks with banks to lend \$ 400 million to the private sector seed and fertilizer companies and agro dealers. This will make agricultural inputs available to 5 million smallholder farmers across the country in 2013. The Nigerian Government is also recapitalizing the bank of agriculture to lend at single digit interest rates to farmers.

Third, government made efforts to increase its capacity to predict shocks to inform risk management. Satellite imagery and remote sensing tools were deployed to better assess the effects of climatic shocks on food production. This technology was deployed by MoA in partnership with the International Water Management Institute to determine the extent of the inundation across the country of the September of 2012 flood. The advantage of the deployment of satellite imagery and remote sensing tools was that government, rather giving in to pressure to act illogically was able to determine that no more than 1.4 million ha of land was inundated and only 467,000 ha of land were expected to suffer crop loss. This represented only 1.17% of the total cultivated area. To address the issue of recovery from the floods, MoA put in place a Flood Recovery Food Production plan, including provision of free early maturing seeds, fertilizers and farm implements to farmers affected by the floods. Government also released 40,000 MT of food from strategic food reserve to cushion the impacts on flood affected families and embarked on accelerated dry season cultivation of rice and maize, with expected production of 1.2 million MT of rice and 500,000 MT of maize.

Fourth, Government put in place policies to encourage the cultivation of drought-tolerant crops (e.g., cassava and sorghum) and develop markets for them to enhance resilience in food systems. It also launched a major effort to turn Nigeria into the largest processor of cassava and sorghum in the world. Through the use of fiscal policies government is trying to encourage the use of cassava for production of high quality cassava flour to replace some of the wheat we import for use in bread and confectionaries, production of starch, dried cassava chips for export, high fructose cassava syrup for sweeteners, sorbitol and ethanol. Cassava bread, made out of 20% cassava flour and 80% wheat flour, has hit the market in Nigeria, and is cheaper than 100% wheat flour bread. This will put over \$1 billion back into the pockets of cassava farmers and processors. MoA secured 3.3 million MT of contracts for export of dried cassava chips to China in one year and have attracted major global players, such as Cargill, Unilever and Nestle to invest in the production of starch, sweeteners and sorbitol from cassava.

Fifth, Because of the expectation that there will be greater variability of weather and greater incidences of floods and droughts under climate change, the Nigerian government is promoting policies to improve water management by emphasizing improved water management and greater water use efficiency. The availability of irrigation in Africa is low, as less than 3% of all arable land is under irrigation, compared to close to 50% in Asia. In Nigeria, despite having 200 dams, only 150,000 ha or less than 1% of cultivated area is irrigated (Adesina, 2013).

Nigeria needs a fundamental paradigm shift on irrigation. Instead of large public-sector irrigation schemes with massive dams, greater priority should be put on small scale agricultural water management systems. The International Water Management Institute estimated in Sub-Saharan Africa that agricultural water management systems can employ 45 times more people and cover 35 times more land than large scale public irrigation schemes. Small scale reservoirs can reach 369 million people and generate \$20 billion per year; access to motor pumps can benefit 185 million people and generate \$22 billion per year; in-situ water harvesting can benefit 147 million people and generate \$ 9 billion per year; and communally managed river diversions can reach 113 million and generate \$14 billion per year.

Government proposed targeted policies for better agricultural water management, such as subsidies for the ownership of motorized pumps, especially by women farmers, financing the leasing of irrigation equipment, provision of community loans for the management of water sheds, establishing youth-led irrigation service providers who rent out motorized pumps, and provision of subsidies for alternative energy in rural areas to allow the powering of motorized pumps.

To reduce the risk faced by farmers, the government proposes to scale up of weather index insurance schemes for farmers. Because many farmers will not be able to afford the cost of insurance premiums, subsidies will be provided to support farmers and reduce the high fixed cost of development of insurance products by insurance companies. Area-based flood insurance schemes would be established in areas prone to floods.

Sixth, social safety net policies are being used to reduce vulnerability, especially for women and children. These include conditional cash transfers, school feeding programs and nutritional interventions. The "Saving one million lives" initiative targets the use of community management of acute malnutrition and integrated child feeding to reduce under-nutrition. Already, 200,000 severely malnourished children are receiving care. Nigeria released 3 pro Vitamin A

cassava varieties, in partnership with the International Institute of Tropical Agriculture, the Global Alliance for Improved Nutrition and the Bill and Melinda Gates Foundation. In partnership with the International Potato Center, Nigeria is promoting orange flesh sweet potato (which is rich in beta carotene), with the goal of reaching 1 million households by 2015.

Finally, to manage price volatility, silos with a total grain storage capacity of 1.3 million MT of capacity were constructed. These will be used for expanding strategic food reserves and developing a nation-wide agricultural commodity exchange to expand markets for farmers and reduce price volatility. Also needed are policies to promote improved farm-level storage systems to reduce high post-harvest losses in the food supply system. Regional food reserves should also be supported. In 2012, Nigeria contributed 32,000 MT of grains to support Niger republic to address food shortages.

### Concluding Remarks

Climate change poses a major challenge for agriculture at the global level and in Nigeria. Given the role of agriculture in employment, economic development, and global food security, adverse impacts on agriculture are of particular concern. Decreased agricultural production owing to climate change will result in higher food prices and decreased food consumption, especially among the poor, leading to an increased number of people at risk of hunger. Areas that are already lagging in achieving important human well-being outcomes will likely suffer the most.

Sound development policies are necessary, but not sufficient, to adapt agriculture to climate change in Nigeria and other areas. A pro-growth, pro-poor development agenda that supports agricultural sustainability and includes improved targeting of climate change impacts will improve resilience and climate change adaptation. Because climate change has a negative impact on agricultural production in most developing countries with Nigeria not an exemption, achieving any given food security target will require greater investments in agricultural productivity. Key areas for increased investment include agricultural research, irrigation, rural roads, information technologies, market support, and extension services. Public-private partnerships will play an important role in achieving advances in these areas. Even so, there is still uncertainty about where climate changes will have impacts. This uncertainty can be reduced through more spatial analysis and improved information.

In closing, successful management of agriculture in the face of shocks requires the integration of policies, institutions, technologies, systems and tools

for enhancing resilience. Research and development institutions need to be supported to develop technologies for reducing yield variability. Farm and non-farm employment should be promoted, as well as remittances. There must be cross-border effort to build regionally integrated weather monitoring systems for characterizing impacts of weather patterns and for seasonal rainfall forecasts. Generally, a shift from sector-based planning to system based planning (from a focus on the parts to a focus on the whole), and from resource management to sustainability incorporating the six principles- homeostasis principle, omnivory principle, high flux principle, flatness principle, buffering principle and redundancy principle- otherwise known as resilient system principles earlier discussed will turn out to enhance resilience of Nigerian agriculture to climate change.

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