

# Climate-Smart Agriculture in Borno state of Nigeria

## Climate-smart agriculture (CSA) considerations

**P** The economy of Borno state is largely agrarian, with livestock husbandry, crop production and fishing on the Lake Chad dominating the economic activities of the population. Agriculture is mainly subsistent, with over 70 percent of her population depending on it directly or indirectly for their livelihoods. It provides the bulk of employment, income, food, and clothing for the rapidly growing population as well as supplying raw materials for agro-based industries. In Borno state, agriculture contributes up to 65 percent of the state's Gross Domestic Product.

**P** Major cash crops are cotton, sesame and groundnut while food crops include maize, yam, cassava, sorghum, cowpea, sorghum, millet, sweet potato and rice. Cattle and other livestock also have enormous value chain growth opportunities. With the recent insecurity that worst hit Borno state, food production (crop/animal and fishing) contribute to only 5.9 percent of the food needs of the state. Virtually, 94 percent of food consumed in Borno are imported either in form of credit or gift from non-governmental organizations (NGOs), World Food Program (WFP), and civil societies among others.

**A** Declining soil fertility, climate change, low farm input lets, limited investment and poor infrastructure continue to hamper agricultural productivity and developments in the agricultural sector.

**I** The Borno state and indeed Nigeria has made efforts to enhance the resilience of the agriculture sector to climate change. The ongoing development of the Agricultural Promotion Policy (APP), the development of a National Policy on Climate Change and Response Strategy (NPCCRS) and the numerous plans, strategies and policy

enabling environment are thought to set the state on the path towards sustainable development under the realities of a changing and varying climate.

**A** Some CSA practices (e.g. intercropping/multiple cropping, agroforestry, conservation agriculture etc.) are quite widespread and their proliferation has been facilitated by ease of adoption, and multiple benefits such as food, income diversification and improved resilience.

**I** Although there are a wide range of organizations conducting CSA-related work, most have focused largely on food security, environmental management and adaptation. There is the need to also integrate mitigation into the state's climate-smart agriculture development efforts. In addition, off-farm services related to CSA need to be enhanced, including weather-smart and market-smart services.

**\$** Funding for CSA is limited in the state and Nigeria in general, however there are opportunities to access and utilize international climate finance from sources such as the Green Climate Fund and Global Environment Facility and through readiness and capacity building programmes. At the national level, the National Agricultural Resilience in Nigeria, an arm of the Federal Ministry of Agriculture and Rural Development which targets reforestation, agriculture and livestock, is a useful mechanism for directing climate finance to CSA-related activities. Others are the fund set aside for the National Climate Change Adaptation Strategy and Action Plan for Climate Change in Nigeria (NASPA-CCN) which can benefit CSA-related activities the Borno state.

**A** Adaptation    **M** Mitigation    **P** Productivity    **I** Institutions    **\$** Finance

The climate-smart agriculture (CSA) concept reflects an ambition to improve the integration of agriculture development and climate responsiveness. It aims to achieve food security and broader development goals under a changing climate and increasing food demand. CSA initiatives sustainably increase productivity, enhance resilience, and reduce/remove greenhouse gases (GHGs), and require planning to address tradeoffs and synergies between these three pillars: productivity, adaptation, and mitigation [1]. The priorities of different countries and stakeholders are reflected to achieve more efficient, effective, and equitable food systems that address challenges in environmental,

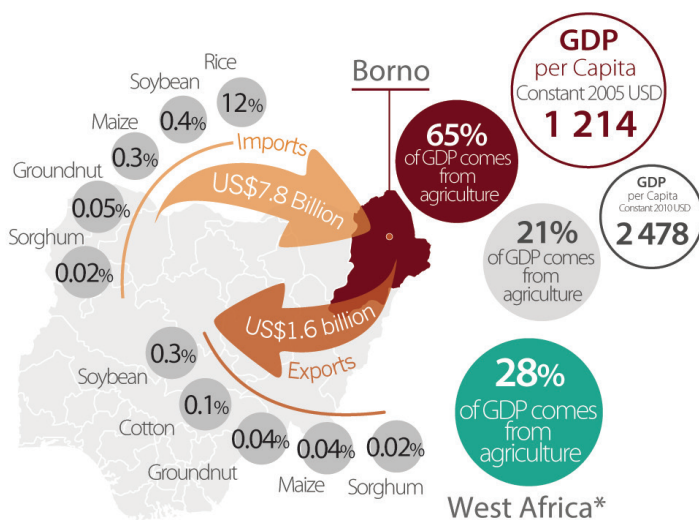
social, and economic dimensions across productive landscapes. While the concept is new, and still evolving, many of the practices that make up CSA already exist worldwide and are used by farmers to cope with various production risks [2]. Mainstreaming CSA requires critical stocktaking of ongoing and promising practices for the future, and of institutional and financial enablers for CSA adoption. This state-level profile provides a snapshot of a developing baseline created to initiate discussion, both within the state and nationally, about entry points for investing in CSA at scale.

## State context

### Economic relevance of agriculture

Agriculture is the main stay of Borno state's economy with over 70 percent of her population depending on it directly or indirectly for their livelihoods. It provides the bulk of employment, income, food, and clothing for the rapidly growing population as well as supplying raw materials for agro-based industries [3]. In Borno state, agriculture contributes up to 65 percent of the states GDP [4]. The economy is largely agrarian, with livestock husbandry, irrigated agriculture, and fishing on the lake Chad dominating the economic activities of the population. Uncensored fishing activities are also seen in many rivers, lakes and ponds in the rural areas. Major cash crops are cotton, sesame and groundnuts while food crops include maize, yam, cassava, sorghum, cowpea, millet, and rice. Cattle and other livestock also have enormous value chain growth opportunities. The manufacturing industry is still at developing stage in Borno, and it accounts for less than one percent of Nigeria's national industrial output [4]. With the recent insecurity that worst hit Borno state, food production (crop/animal and fishing) contribute to only 5.9 percent of the food needs of the state. Virtually, 94 percent of food consumed in Borno are imported either in form of credit or gift from non-governmental organizations (NGOs), world food program (WFP), and civil societies among others. Food insecurity stood at 45.6 percent [3].

### Economic relevance of agriculture in Borno



\*West Africa: Benin, Burkina Faso, Cape Verde, Ivory Coast, Ghana, Guinea, Guinea Bissau, Mali, Mauritania, Niger, Sao Tome and Principe, Senegal, Sierre Leone, Togo, Liberia, Gambia

■ Borno ■ West Africa ■ Nigeria

Source: [4,7,8,9]

As at 2016, the population of the Borno state was about 5.9 million (48 percent women) with a population density of 80.7 people per square kilometer [5]. A 2010 data from the Nigerian Bureau of Statistics showed about 55 percent of the population live below the poverty line, a 13 percent increase from data collected in 2004 [5]. Increased poverty has been linked to limited employment opportunities, limited infrastructure development, illiteracy etc. Recent data showed unemployment rate of 29 percent (2011) and income inequality index of 0.38 (2010). About 80 percent of the population depend on agriculture and its related activities. With regards to education, adult and youth literacy stands at 37 percent (2008) and 53 percent (2008) respectively [5]. Most of the population (about 70 percent) have limited access to portable water. Development agencies through the Water, Sanitation and Hygiene (WASH) funded projects are increasing efforts to improve access of the population to clean portable especially for about 1.4 million of the population thought to have been displaced following the Boko Haram insurgency in 2013 [6].

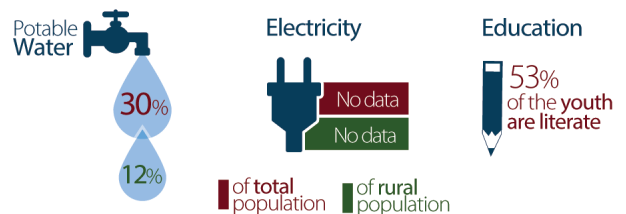
### People, agriculture and livelihoods in Borno

#### Demographics

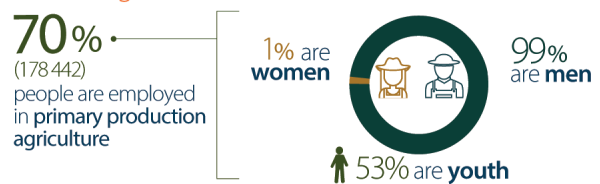
5 million people live in Borno



#### Access to basic needs



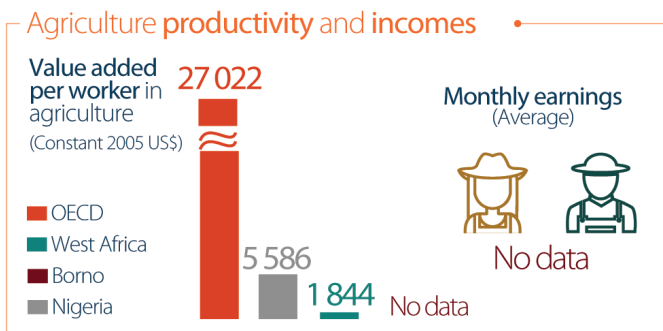
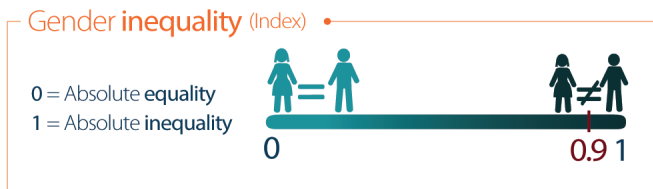
#### Jobs in agriculture



#### People living below



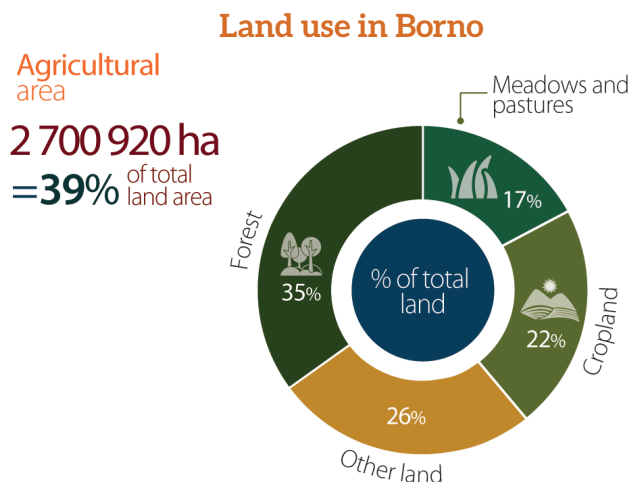
Source: [5, 9,10,11]



Source: [12, 13, 14, 15]

## Land use

Borno state in northeastern Nigeria covers an area of 72 609 square kilometer [5]. Three major agroecological zones can be distinguished: guinea savanna, sudan savanna and sahel (annex 1). The state ranges from the northern guinea savanna in the southeast to the sahel in the north, and a larger part of the state lies in the sahelian zone [8]. Most of Borno consists of semi-arid savannah or sub-desert, with flooded pastures towards lake Chad and montane regions in the extreme south-east [16]. The vegetation is mostly light foliage and thorns. Grasses are short, discontinuous, wiry and tussock. They are much used by cattle and sheep. There is no real gallery or fringing forests but only riparian woodland of certain acacias, tamarind and baobab. The soils in the north-central part of Borno are largely aeolian sands, formed by wind-drift from the desert. The basic agriculture of the savannahs is upland rainfed cultivation with crops such as maize, sorghum, cowpea, groundnut, rice, and recently soybean [17]. In most areas, the cereal cropping systems are being intensified and new crops are replacing the old ones.



Source: [5, 13, 18]

The annual rainfall ranges from 600 mm in the north to 1 200 mm in the south and extends over a growing season of between 100 and 180 days. Annual rainfall varies from year to year, with decreasing trends during the past two decades [16]. The Sambisa forest (covering 518 square kilometer) used to be a major forest reserve for the Borno state and other parts of northeastern Nigeria [18]. Home to a variety of wild animals (e.g. bush elephants, leopards, lions, hyenas, baboons, monkeys of various species, gazelle, about 62 different species of birds) and flora such as acacia, baobab, rubber, tamarind, terminalia, and date palm etc., the forest has seen intense degradation due to Boko Haram insurgency [18].

## Agricultural production systems

In the Borno state, agriculture is characterized by small-scale and subsistence production systems. Food and cash crops and livestock produced include, (a) cereals: maize, millet, sorghum, rice and wheat; (b) legumes: cowpeas, groundnuts, soya beans and bambara nuts; (c) fruits: orange, lemon, mango and guava; (d) root and tubers: yam, cassava and sweet potato; (e) vegetables: tomatoes, pepper, onions, okra, pumpkin and melon; (f) tree crops: gum arabic and ginger, (g) livestock and fishes: cattle, sheep, goats, pigs, poultry, rabbits and (h) fish of different varieties [5]. In Borno state, crop production (tonnes) as at 2011 were 192 613, 217 795, 199 884, 41 512, 60 335, and 117 378 respectively for sorghum, millet, maize, rice, groundnut, and cowpea that made a total 829 517 tonnes [19]. Similarly, in 2012, numbers of livestock reared were 1 300 250, 1 320 450, 1 097 250, 810 050, and respectively for cattle, sheep, goats, camels, and poultry, making a total of 505 050 animals. Fish production was 323 tonnes in 2011 [5].

Agriculture in the Borno state is largely dependent on rainfall with less than 5 percent of land under cultivation equipped with irrigation. The total irrigable land in Borno state was estimated to be about 460 000 hectares [19]. These include areas irrigable under public project, private individual farmers, and those under farmers' cooperative organizations. Out of this figure, only 17 000 hectares were cultivated in the public irrigation projects [19]. Production systems generally have low input of fertilizers and pesticides. Fertilizer consumption per unit of arable land is about 5.95 kg/ha which is about two times lower than the West Africa regional average [5]. Farmlands are generally small scale with dominant production of millet, groundnut, rice, maize and sorghum. Agriculture in the Borno state is challenged by poor infrastructure, climate change, terrorism, soil fertility depletion, declining agriculture commodity prices, limited agricultural extension services, weak manpower development, soaring prices of production inputs and low private investment [19].

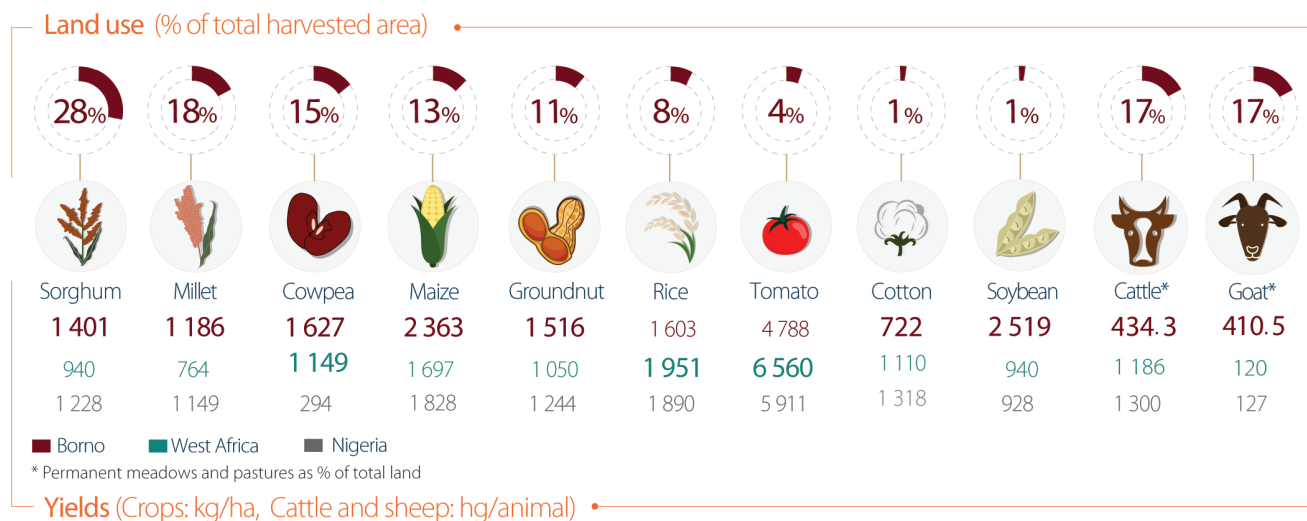
By harvested area and quantity of production, Borno state is one of the leading states in rice production in Nigeria due to the presence of the Jere Bowl and the lake Chad areas.

There are different rice cultivation practices in Borno state based on the location of farmers. Rice farming takes place in low lands or river basin, and highlands. Farmers in the low lands or near the river basin generally do not use fertilizer because the siltations on their lands by yearly floods keep the land very fertile [20]. The farmers from highlands which is far from river basin generally use fertilizer. Rice is grown mainly during the (april-august) rainy season harvested during the (september-january) dry season. There is usually a scarcity of rice during rainy season; and oversupply is observed in the market during the dry season as most farmers dispose of their harvests. The varieties of rice grown in Borno state include, zaranzaran, agric, cp, wita 4, O2, zazzabi, yar ai, jamiya, yar-sada, yar-audu etc [16]. Farmers generally sell rice to rice traders, parboilers and processors (who buy rice and sell processed rice). They sell their produce in the local markets as well as from the house. Mostly the local parboilers come to their house to buy rice. Maize production takes place in various local government areas across Borno state. The weather is suitable for the commodity as it is characterized by the north easterly wind blowing across the country from sahara desert known as harmattan wind.

The temperature ranges from 13.6 °C to 31.9 °C in january and 9.0 °C to 28.5 °C in august [16]. The annual rainfall in the area is between 400 mm and 1000 mm with rainfall duration from 4 to 5 months. For sorghum, Borno state is one of the states that produces over 150 000 tonnes annually with Kaduna, Zamfara and Borno being the leading producing states with production levels in 2006 attaining 610 000, 601 000 and 534 000 tonnes, respectively. Like most parts of Nigeria, ruminants, comprising sheep, goats and cattle, constitute the farm animals largely reared by farm families in the country's agricultural system [16].

The following infographic shows a selection of agricultural production systems considered key for food security in the Borno state of Nigeria. The selection is based on the production system's contribution to economic, productivity and nutrition quality indicators. For more information on the methodology for the production system selection, consult annex 2.

### Production systems key for food security in Borno



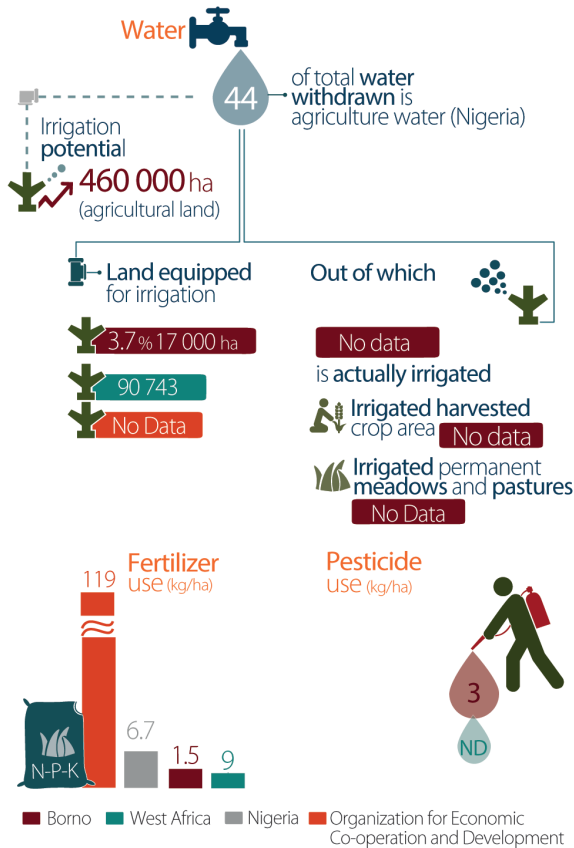
Source: [13, 21]

### Food security and nutrition

Following an emergency food security assessment, the World Food Programme reported that 64 percent of the population of Borno state were food insecure [4], which is a significant increase (31 percent) from data reported by the Nigerian National Bureau of Statistics in 2010. Food security index in Borno state is that 4 percent are food secure, 43 percent are marginally food secure and 52 percent are classified as food insecure [4]. Market disruption, occasional border closure, high food and fuel prices, consistent inflation, Naira's depreciation against the US dollar heavily affected households' purchasing power and their food access.

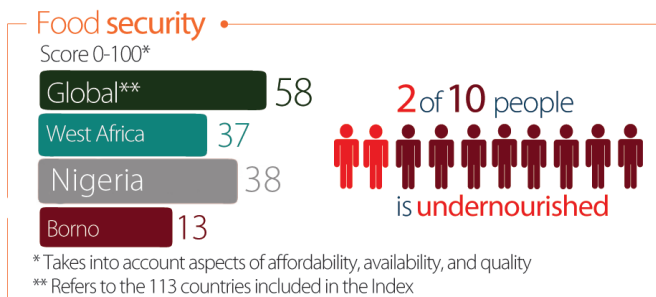
A recent situational report from the Food and Agriculture Organization of the United Nations (FAO) indicate that the main food security, nutrition and livelihood indicators are at alarming levels with more people projected to be severely food insecure particularly during lean seasons (june-august) [22]. The driving factors of food insecurity are enormous. With declining soil fertility, climate change, degradation of vegetation, increasing incidences of terrorism and poverty the state's food production is no longer sufficient to feed the growing population [5]. The Borno state has one of the lowest prevalence rate of HIV in Nigeria. According to the Nigerian National Bureau of Statistics, HIV prevalence is about 2 percent [5].

## Agriculture input use in Borno



Source: [5, 13, 21, 23, 24]

## Food security, nutrition, and health in Borno

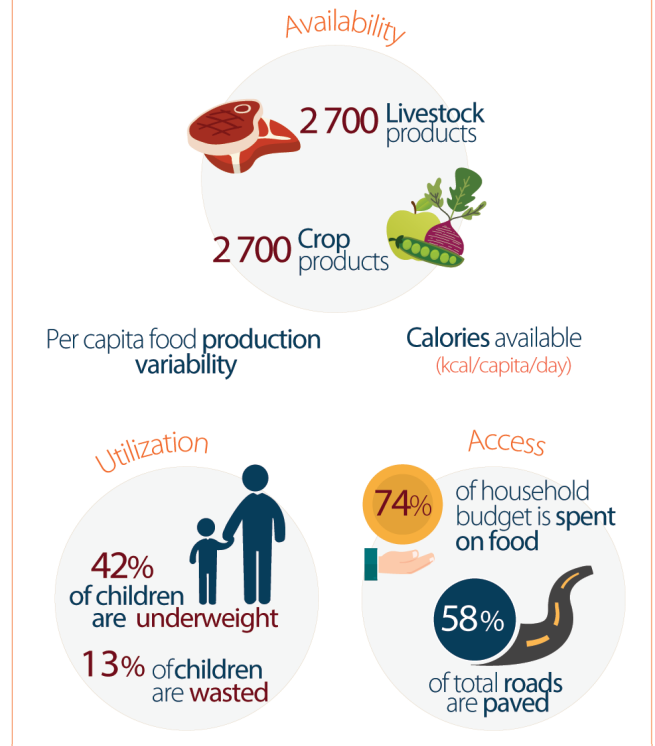


## Food aid (2012)

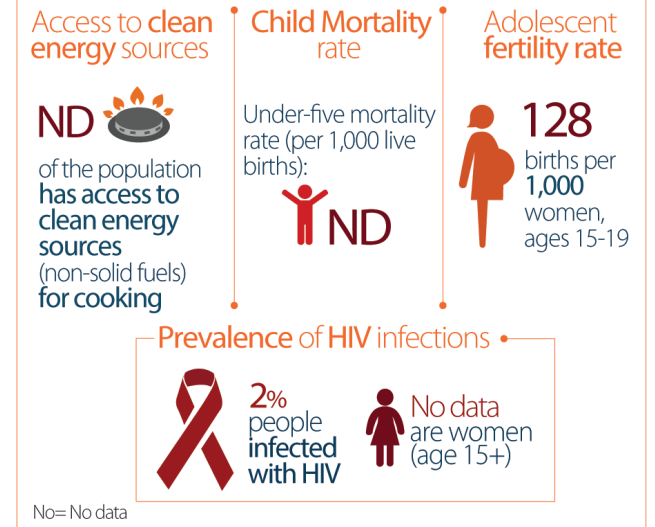


Source: [25]

## Food security indicators (selection)



## Health



Source: [26, 27, 28]

## Agricultural greenhouse gas emissions

Like most parts of north-east Nigeria, around 14 percent of human-generated greenhouse gases are estimated to come directly from agriculture in Borno state; for example, almost half of all methane and nearly 60 percent of nitrous oxide emissions are generated by agricultural activities, including livestock production, and fertilizer and pesticide applications [29]. A further 18 percent of greenhouse gases come from land use changes (e.g. clearance of forests for crops and pasture), soil erosion or machine intensive farming methods, which also contribute to increased carbon dioxide concentrations in the atmosphere. Reducing agriculture's carbon footprint is therefore an important consideration to limiting climate change [30].

## Challenges for the agricultural sector

### (a) Growth in population and food demand

Agriculture is the principal source of food and livelihood in Borno, making it a critical component of programs that seek to reduce poverty and attain food security. To meet the rapidly increasing demand for food by an ever-expanding human population, production from crop agriculture must expand by 4 percent annually while the production of food from animal agriculture must expand by more than 3 percent annually, between now and the year 2050. This will result in great pressure on land, leading to intensification of land use. Under these conditions, full integration of crop and livestock production offers the greatest potential for increasing agricultural productivity [31].

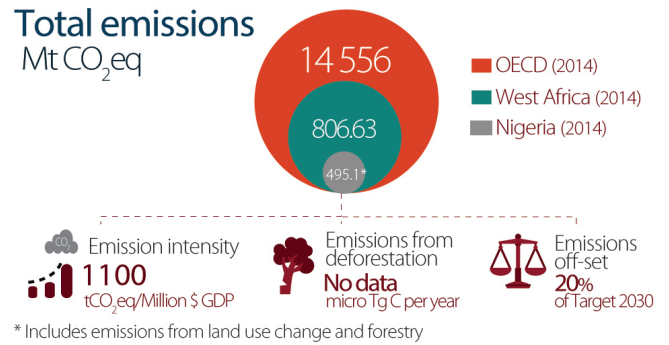
### (b) Natural resource scarcity/depletion

Soil fertility depletion is a common phenomenon in Borno and regarded as the fundamental biophysical cause for declining per capita food production. This challenge will continue as population pressure increases and degradation of soil resources is aggravated. Overgrazing, constant bush burning, extensive tree felling for timber, fuel wood and continuous land cultivation have contributed negatively to soil fertility. Soil degradation due to inappropriate land use system is threatening the livelihood of thousands of people. Presently, large areas of land in Borno state have been abandoned due to soil fertility depletion as the result of continuous cultivation. In order to make sound decisions regarding land use, knowledge of specific properties related to soil functioning under different land use systems are necessary [31].

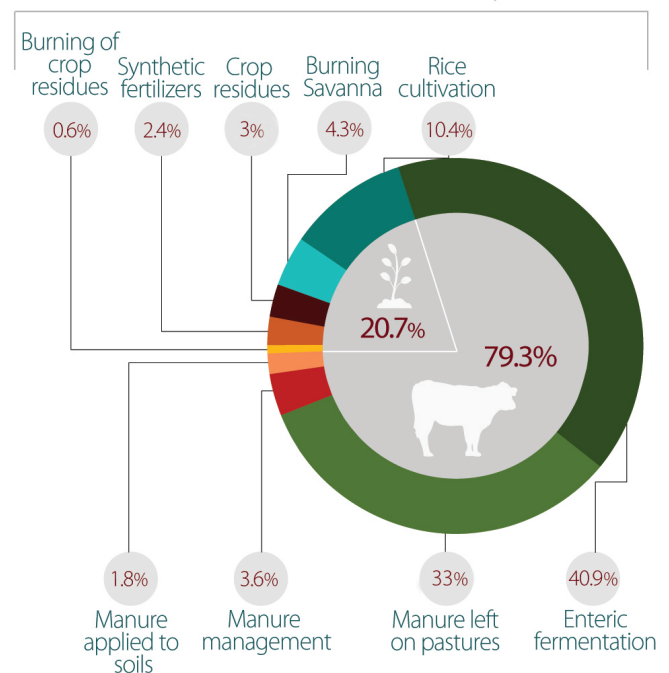
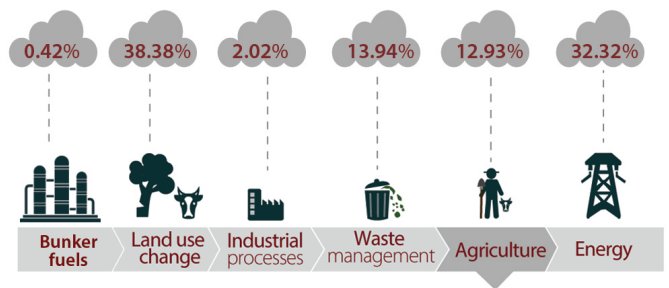
### (c) Poverty and inequality

Majority of the Borno population lives in poverty, despite the wealth in Nigeria. Nigeria's inequality level was 0.45 in 2010 which is relatively high and indicates that income is held in the hands of relatively few. In the northeast where Borno state belongs, the poverty rate is 69.1 percent. With increased poverty, a large proportion of farmers are resource-poor to meet the agricultural input requirements on their farmlands.

## Greenhouse gas emissions in Nigeria



## Sectoral emissions (2014)



Source: [21, 32, 33]

This poses threats to food production and challenges efforts to improve food and nutritional security in the Borno state [31].

**(d) Poor Infrastructure and limited financing schemes**

Agricultural performance in the Borno state is greatly impaired by the low level of development of social infrastructure. In the rural areas, where majority of the smallholders operate, inadequate infrastructure constitutes a major constraint to agricultural investment, production and trade. In addition, many farmers and value chain operators have no access to formal credit to finance their operations. With the scarcity and rising cost of farm inputs and processing, it is difficult for value chain actors to engage in commercial agriculture projects especially in view of their low level of income and savings, and access to credit challenges [31].

**Agriculture and climate change**

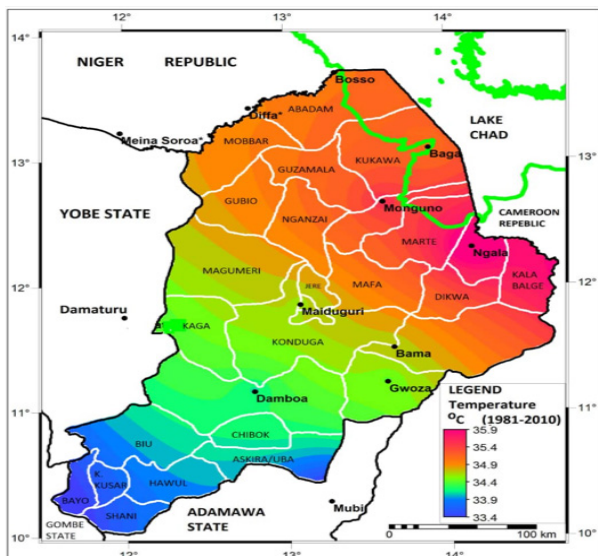
Borno state, being in the arid region, is exposed to the effects of climate change. The state has experienced serious droughts and floods that have a greatly impacted negatively on the state’s agricultural productive capacity. Figures 1 shows the variations in rainfall and temperature respectively across the state. The rainfall amounts decreases progressively as one traverses the state from the southern to the northern part. Similarly, temperature gets higher as one approach the northern section of the state. The variations also mean the state is prone to effects of climate changes, and is likely to affect agriculture negatively. For instance, if there is an increase in temperature by 1 °C, the temperature in more than two-third of the state would be above the optimal for both crop and livestock production [34].

With climate change, increase in temperature and decrease in relative humidity, rainy days and rainfall amounts will be experienced. The implication is that the climatic conditions will become marginal or even fall short of the optimum crops’ climatic requirements. This will translate to substantial increase in poverty, hunger, and general food security challenges as a consequence of decrease in all agricultural production systems in response to the climate change. This scenario will impact more in the developing countries. As a means of adaptation, farmers will have to adjust their choice of crops produced to suit the prevailing climatic conditions if the trend of climate continues. On the other hand, while climate change is impacting negatively on crops production in Nigeria, studies have shown that the industrialized countries which are currently the major polluter of the atmosphere are going to experience extended growing season, and more yield in most of their cereal crops, while the melting ice means more arable land and water for irrigation but exposing the developing countries to more risks of malnutrition. Possible remediation measures are:

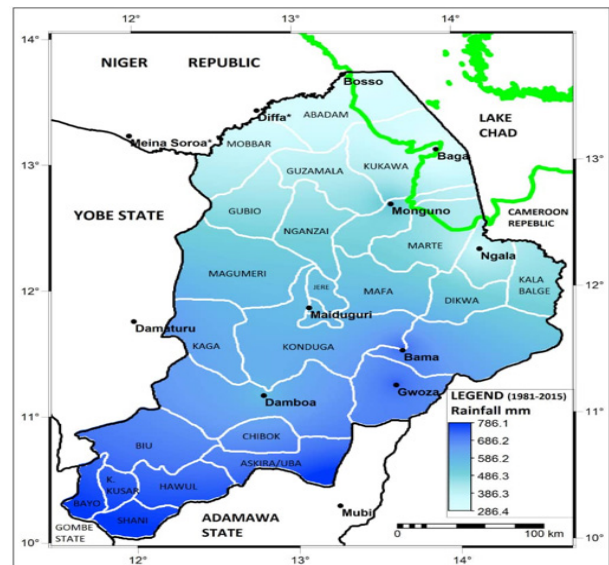
- (1) Extension service should be strengthened through organizing adult education programmes for farmers to expose them to climate change coping strategies.
- (2) Programmes and policies should be put in place to attract young people into farming, especially young school leavers and young graduates. This is achievable through strengthening institutions, policies and that promote agricultural and food security measure.
- (3) Affordable climate change adaptation technologies should be appropriated and developed and made available for resource-poor farmers to adopt.

**Mean temperature and precipitation in Borno state**

Annual mean temperature (°C)



Mean precipitation (mm)



Source: [34, 35]

## CSA technologies and practices

CSA technologies and practices present opportunities for addressing climate change challenges, as well as for economic growth and development of the agriculture sector. For this profile, practices are considered CSA if they enhance food security as well as at least one of the other objectives of CSA (adaptation and/or mitigation). Hundreds of technologies and approaches around the world fall under the heading of CSA. Evidence from the literature suggests that farmers are using several agricultural innovations developed from indigenous knowledge or introduced technologies to improve their adaptive capacity to climate change and variability. Some of these practices are *ex ante*, meaning they are based on pre-informed climatic events while others are *ex post* (measures adopted after a climatic event has been realised). Below, we used evidence from the literature to discuss some agricultural technologies and practices in the Borno state have been promising in achieving one or more of the three pillars of CSA: productivity, mitigation and adaptation:

**a. Conservation agriculture** – like most farming communities in Nigeria, conservation agriculture (CA) is a common practice in the Borno state with soil and water conservation attributes. Building on conventional slash-and-burn agricultural systems, CA approaches involve: (a) minimum or zero-tillage; (b) maintenance of soil cover through cover cropping or mulching; and (c) crop rotation [36]. CA delivers on one or more of the three pillars of climate-smart agriculture. The use of CA is driven by increased soil degradation throughout the dry areas of north-east Nigeria where crop yields are relatively low due to low soil organic matter, limited use of fertilizer inputs and recurrent droughts. In terms of productivity and adaptation, empirical evidence confirm CA increase the biological yield of major food crops such as maize, sorghum and millet even on poor soils and offer economic benefits from diversified crop rotation systems [36]. Maintaining adequate soil cover through mulching offer multiple benefits to the farmer in dealing with climate-related risks. These include reduced run-off, increased water infiltration, improved soil organic matter and improved soil moisture retention [36]. The encouragement of zero or minimum tillage in CA also minimizes labour costs in land preparation and enables early planting to synchronize the onset of rainfall.

**b. Intercropping/crop diversification** - with mixed cropping/crop diversification and use of varying intercropping approaches in CA, there is significant reduction in the risks of crop failure providing farmers important safety nets in the event one crop fails to perform as expected. Cereals (maize and millet) and legumes (cowpea and groundnut) are often grown in annual double-cropping systems in the Sudan and Guinea savanna zones. Typical double cropping systems in these zones include maize-cowpea, millet-maize, millet-cowpea and groundnut-maize. Intercropping is widely practiced in different parts of the state, particularly in the Sudan savannah.

Cereals are often intercropped with legumes or with other cereals for economic reason.

**c. Terracing** - although rainfall is important for farming

activities, excess rains cause flooding and erosion on farmers' fields causing crop destruction and removal of top soils. The use of innovative approaches such as terracing for reducing erosion and collecting run-off water for farming activities are becoming popular among farmers in Borno.

**d. Improved seeds** – over the past decades with increased temperatures and higher intensity of rain, many farmers have adopted the use of varieties that are resistant to extreme weather conditions. Some adopted seeds are also early maturing to evade consequences of reduction in amount of rainfall being experienced under varying and changing climate.

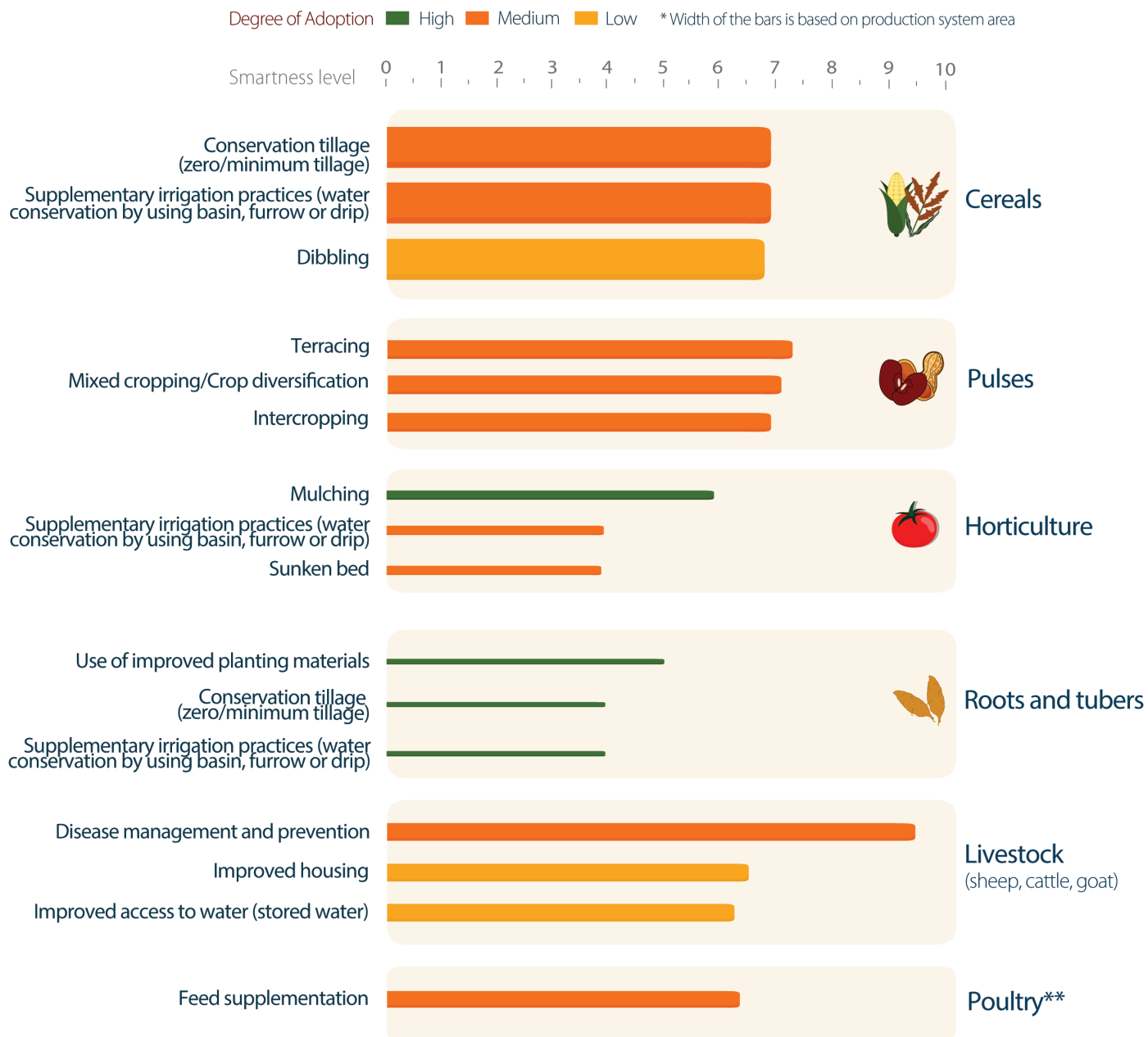
**e. Integrated soil fertility management** - farmers combine chemical fertilizers with other soil fertility improvement practices such as application of animal manure, compost. Crop residues etc. Addition of organic manures to improve soil aggregate stability necessary and improve soil nourishment through decomposition and nitrogen mineralization. Using integrated soil fertility management practices markedly reduce the need of large quantities of synthetic fertilizers which, apart from their high costs contribute to GHG emissions [2].

**f. In livestock production**- common CSA practices for cattle, sheep and goats identified are seasonal migration, especially during dry period in search of pasture and water for pastoralists, improved housing for sedentary herders to create microclimate to shield the animals from excessive heat and rainfall and provision of quality water that helps in production. Others are conservation of feed for off season utilization and improved medication. In addition, for poultry production routine vaccination and feed formulation with locally available materials to reduce cost are common practices.

The following graphics present a selection of CSA practices with high climate smartness scores according to expert evaluations. The average climate smartness score is calculated based on the practice's individual scores on eight climate smartness dimensions that relate to the CSA pillars: yield (productivity); income, water, soil, risks (adaptation); energy, carbon and nitrogen (mitigation). A practice can have a negative/ positive/ zero impact on a selected CSA indicator, with 10 (+/-) indicating a 100 percent change (positive/ negative) and 0 indicating no change. Practices in the graphics have been selected for each production system key for food security identified in the study. A detailed explanation of the methodology and a more comprehensive list of practices analyzed for Borno state, Nigeria can be found in annexes 3 and 4 respectively.



## Selected CSA practices and technologies for production systems key for food security in Borno



\*\* Unidentified production system area

## Case study: Terracing as a climate-smart practice in Borno state

Terracing is a climate-smart practice widely adopted in the southern and northern parts of Borno state. The topography of the southern part is predominantly rocky and undulating. Farming in such conditions is made unprofitable by excessive soil erosion. Therefore for time immemorial, terracing is used to check soil erosion and improve the soil's water and nutrient conservation.

A farmer, Mr. Baba Anjili provided an account of how he has benefited from terracing. He added that they have been using terracing for over forty years to prevent the negative effects of soil erosion on the farms, thereby maintaining adequate moisture and crop nutrients on the farm even after a heavy storm. Anjili said, on average, the yields of sorghum and maize are 47 percent higher on terraced farms relative to non-terraced ones. "Farm management procedures such as weeding, spraying, etc. are also made easier" he added. Anjili concluded that farming in the entire southern part of Borno state will certainly be unprofitable without practicing terracing. This notwithstanding, the major limitation of terracing is its interference with mechanization and the labor intensive nature of the practice. Complementing observations by farmers. Studies have also demonstrated terraces serve as important means for rainwater harvesting, reducing soil loss and improving infiltration rates.



©FAO/J. M. Dibal

Terraced field in Borno state.

**Table 1.** Detailed smartness assessment for top ongoing CSA practices by production system as implemented in Borno

CSA practice	Region and adoption rate (%) <30 30-60 60>	Predominant farm scale S: small scale M: medium scale L: large scale	Climate smartness	Impact on CSA Pillars
<b>Cereals</b> (67 percent of total harvested area)				
Conservation tillage practices (zero/minimum),	Sahel savanna northern guinea savanna <b>30-60%</b>	M		<p><b>Productivity</b> Enhances production per unit area; Diversifies income and food sources.</p> <p><b>Adaptation</b> Improves and conserve soil fertility and improves yield; minimizes soil erosion.</p> <p><b>Mitigation</b> Maintains or improves above and below-ground carbon stocks and soil organic matter content; reduces soil disturbance.</p>
Supplementary irrigation practices (water conservation by using basin, furrow or drip)	Sahel savanna northern guinea savanna <b>30-60%</b>	M		<p><b>Productivity</b> Improves crop yield and overall productivity.</p> <p><b>Adaptation</b> Improves water availability and utilization efficiency for increased resilience to drought.</p> <p><b>Mitigation</b> A reduction in energy required for irrigation can reduce emissions intensity per unit of output).</p>
<b>Pulses</b> (27 percent of total harvested area)				
Terracing	Sahel savanna northern guinea savanna <b>30-60%</b>	M		<p><b>Productivity</b> Enhances production per unit area.</p> <p><b>Adaptation</b> Reduces erosion and improves soil moisture.</p> <p><b>Mitigation</b> Reduces GHG emissions (carbon footprint) by reducing consumption of energy, synthetic fertilizers and other agricultural inputs.</p>
Mixed cropping/Crop diversification	Sahel savanna northern guinea savanna <b>30-60%</b>	M		<p><b>Productivity</b> Enhances production per unit area; Diversifies food sources.</p> <p><b>Adaptation</b> Provides important safety net to safeguard against climate-related risks; improves the prospects for income diversification.</p> <p><b>Mitigation</b> Reduces GHG emissions (carbon footprint) by reducing consumption of energy, synthetic fertilizers and other agricultural inputs.</p>



CSA practice	Region and adoption rate (%)	Predominant farm scale S: small scale M: medium scale L: large scale	Climate smartness	Impact on CSA Pillars
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**Roots and tubers** (0.2 percent of total harvested area)

Use of improved planting materials

Sahel savanna  
northern guinea savanna

30-60%



**Productivity**

High-quality planting materials can improve yields by 30-40 percent.

**Adaptation**

Improved planting materials with drought-resistance improve the resilience of production systems.

**Mitigation**

Improves biomass, which may promote carbon sequestration.

Conservation tillage (zero/minimum tillage)

Sahel savanna  
northern guinea savanna

30-60%



**Productivity**

Enhances production per unit area; Diversifies income and food sources.

**Adaptation**

Improves and conserve soil fertility and improves yield; minimizes soil erosion.

**Mitigation**

Maintains or improves above and below-ground carbon stocks and soil organic matter content; reduces soil disturbance.

**Horticulture** (4 percent of total harvested area)

Mulching

Sahel savanna  
northern guinea savanna

60%



**Productivity**

Improves crop yield and overall productivity.

**Adaptation**

Improves soil moisture retention; minimizes erosion.

**Mitigation**

Application of organic residues promotes carbon sequestration.

Supplementary irrigation practices (water conservation by using basin, furrow or drip)

Sahel savanna  
northern guinea savanna

30-60%



**Productivity**

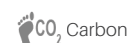
Improves crop yield and overall productivity.

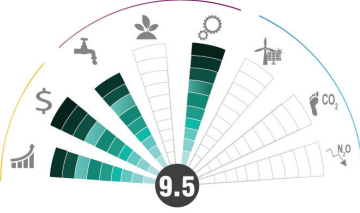

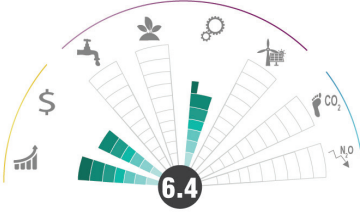
**Adaptation**

Improves water availability and utilization efficiency for increased resilience to drought.

**Mitigation**

A reduction in energy required for irrigation can reduce emissions intensity per unit of output).



CSA practice	Region and adoption rate (%) <span>&lt;30</span> <span>30-60</span> <span>60&gt;</span>	Predominant farm scale S: small scale M: medium scale L: large scale	Climate smartness	Impact on CSA Pillars
<b>Livestock</b> (17 percent)				
Disease management and prevention	Sahel savanna northern guinea savanna <span>30-60%</span>	M		<p><b>Productivity</b> Improves livestock production and quality, hence potential increases in income.</p> <p><b>Adaptation</b> Prevents diseases associated with livestock. Increases the potential to overcome climate shocks.</p> <p><b>Mitigation</b> Has no use of synthetic fertilizers and related GHG emissions/carbon footprint.</p>
Improved housing	Sahel savanna northern guinea savanna <span>&lt;30%</span>	S		<p><b>Productivity</b> Enhances production per unit area.</p> <p><b>Adaptation</b> Minimizes production losses and increases the potential to overcome climate shocks.</p> <p><b>Mitigation</b> Reduces GHG emissions (carbon footprint) by reducing consumption of energy, synthetic fertilizers and other agricultural inputs.</p>
<b>Chicken</b> (NA)				
Feed supplementation	Sahel savanna northern guinea savanna <span>30-60%</span>	M		<p><b>Productivity</b> Improves overall productivity and increases income.</p> <p><b>Adaptation</b> Provides alternative food source increasing adaptive capacity during periods of feed scarcity.</p> <p><b>Mitigation</b> Reduces GHG emissions (carbon footprint) by reducing consumption of energy.</p>



## Institutions and policies for CSA

The Borno state government placed high priority on the development of the agricultural sector in the state. The state ministry of agriculture is saddled with the responsibility of implementing the agricultural policies of the state government. The broad strategic goals include creating an operating environment that supports rapid modernization of agricultural production, processing, storage and distribution through supportive government policies. This aimed at making agriculture more responsive to the demands of other sectors of the state and national economies. The policy framework is structured to create more agricultural and rural employment opportunities and increase the income of farmers through the infusion of improved technologies and support infrastructure.

There are no known policies on CSA in the Borno state of Nigeria. However, the development and promotion of CSA can be envisioned in Federal and national level policies on agricultural development and food. The government's long-term economic blueprint is expressed in the Nigerian Vision 20: 2020 (2009), which aims to transform agriculture into a sustainable and profitable sector with a focus on increasing agricultural productivity and production for direct consumption and processing for local market and export. To implement Vision 20: 2020, the National Planning Commission developed a new medium-term plan for the period 2010–2013; meanwhile the Federal Ministry of Agriculture and Rural Development developed the National Agricultural Sector Strategy (NASS) and a five-point agricultural agenda, which is largely consistent with the four Comprehensive African Agricultural Development Plan (CAADP) pillars: water management, rural infrastructure, increasing food supply and technology transfer to the agricultural sector. Together with the vision 20: 2020, the overarching framework that guides agriculture, food and nutrition security in Nigeria is the National Agriculture and Food Security Strategy (NAFSS, 2010-2020), which is now embedded in the Agriculture Transformation Agenda (2013–2015). The agenda was launched in 2011 to diversify the economy and enhance foreign exchange earnings, with the objective of achieving a hunger-free Nigeria through an agricultural sector that drives equitable income growth and distribution, accelerates the achievement of food and nutrition security, generates decent employment and transforms Nigeria into a leading player in global food markets. These two strategic frameworks have provided the basis for the CAADP National Agricultural Investment Plan (NAIP, 2011-2014), which seeks to enhance agro-industrialization and employment; and the National Agriculture and Food Security Programme, which seeks to increase agricultural output and rural household incomes. In 2016, the Government of Nigeria developed the Green Alternative: the Agriculture Promotion Policy (APP, 2016-2020), which considers the agricultural sector a key instrument to long-term economic growth. It aims to prioritize specific crops; assist agricultural growth through private sector-led business; strengthen commodity value chains; improve market orientation through infrastructure and commodity exchanges; mainstream climate change measures and environmental sustainability into agricultural development; and implement nutrition interventions for vulnerable groups [37, 38].

In 2017, the government of Nigeria launched the Synthesis Report of the Nigeria zero hunger strategic Review, a strategic plan and road map to achieve Sustainable Development Goal 2 (end hunger, achieve

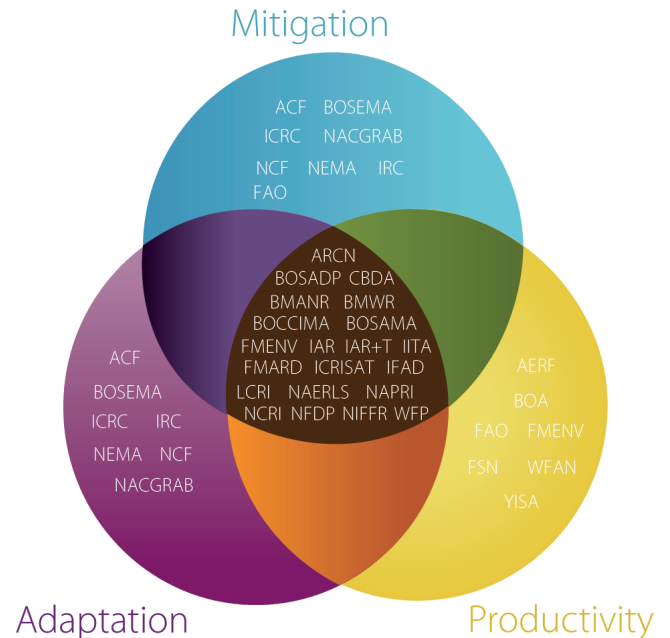
food security and improved nutrition, and promote sustainable agriculture) by 2030. Furthermore, the government formulated the Economic Recovery and Growth Blueprint [39] as the new medium-term plan to tackle the economic crisis, restore growth, and ensure sustainable and inclusive growth. Concerning social protection, in 2015 the government drafted the National Social Protection Policy, which aims to reduce poverty; improve the management of social protection projects and programmes; ensure access to basic social services and infrastructure; enhance social welfare and improve food security and nutrition; support decent employment and sustainable livelihoods; protect households from shocks; and foster coordination among all social protection intervention agencies. With regard to nutrition, in 2016 the government developed the National Policy on Food and Nutrition, which aims at reducing hunger and malnutrition through a multi-sectoral and multidisciplinary approach encompassing various interventions at the community and national levels. By 2025, Nigeria expects to halve the proportion of people who suffer from hunger and malnutrition; decrease the stunting rate among under-five children; decrease the incidence of malnutrition among victims of emergencies; achieve universal access of all school children to school feeding programmes; and increase access to potable water. Few other policies, plans and strategies directly addressing one or more pillars of CSA at the Federal and State levels include:

- The National Adaptation Strategy and Plan of Action on Climate Change for Nigeria (NASPA-CCN) prepared by the Building Nigeria's Response to Climate Change (BNRCC) project for the Special Climate Change Unit of the Federal Ministry of Environment in 2011 seeks to minimize risks, improve local and national adaptive capacity and resilience, leverage new opportunities, and facilitate collaboration with the global community.
- The Federal executive council of Nigeria in 2012 approved the adoption of a National Policy on Climate Change and Response Strategy (NPCCRS) as a national document for implementing climate activities in the country. The policy is meant to guide economic and social response of Nigerians to the global trend of climate change. The policy focuses on adaptation, mitigation, finance and technology [40].
- Nigeria is also a signatory to the Kyoto Protocol and ratified the United Nations Framework Convention on Climate Change (UNFCCC) becoming a contracting Party to the Convention, committed to develop, update, publish the National Communications on Climate Change and other strategic documents on the same theme and participate in the Conferences of the Parties (COP).

- The National Forest Policy is geared towards ensuring sustainable forest management, promoting participatory process of development, facilitating private sector forestry development and adopting an integrated approach to forestry development. Government is currently embarking on a number of afforestation programmes. Under the guidance of the African Union Commission, Nigeria is keying into the project on the “Green Wall Initiative” in which a “green wall” of trees (40 million trees annually in the next 10 years) will be planted across the dry-land area of Nigeria to not only push back deforestation and secure agriculture and livelihoods across the Sudano-Sahelian zone of the country, but also enhance the carbon sequestration of biological diversity resources in the region for climate change mitigation [41].
- The National Policy on Drought and Desertification, in particular, recognizes that climate change could intensify drought and desertification in the part of the country that are very prone to these environmental problems. Thus the policy emphasized the need to equip relevant agencies, institutions and citizens adequately to collect, analyze and use climate data effectively to ameliorate and combat drought and desertification. Specific implementation strategies for the policy include: (i) strengthening of agencies, institutions and facilities for the collection and analyses of meteorological and hydrological as well as for dissemination of information; (ii) upgrading the existing national early warning facilities for more efficient service delivery; (iii) developing appropriate awareness programmes for formal and informal education to enhance knowledge on climate and environment issues; and (iv) encouraging appropriate land use that enhances carbon dioxide sequestration, such as afforestation, reforestation and agro-forestry. This also reduces soil erosion and increase crop productivity for economic development [41].
- Agricultural Promotion Policy: The main objectives of the Nigerian Agricultural Promotion Policy include: (i) the achievement of self-sufficiency in basic food supply and the attainment of food security; (ii) increased production of agricultural raw materials for industries; (iii) increased production and processing of export crops, using improved production and processing technologies; (iv) generating gainful employment; (v) rational utilization of agricultural resources, improved protection of agricultural land resources from drought, desert encroachment, soil erosion and flood, and the general preservation of the environment for the sustainability of agricultural production; (vi) promotion of the increased application of modern technology to agricultural production; and, (vii) improvement in the quality of life of rural dwellers [37].

The following graphic highlights key institutions whose main activities relate to one, two or three CSA pillars (adaptation, productivity and mitigation). More information on the methodology and results from interviews, surveys and expert consultations is available in annex 5.

### Institutions for CSA in Borno

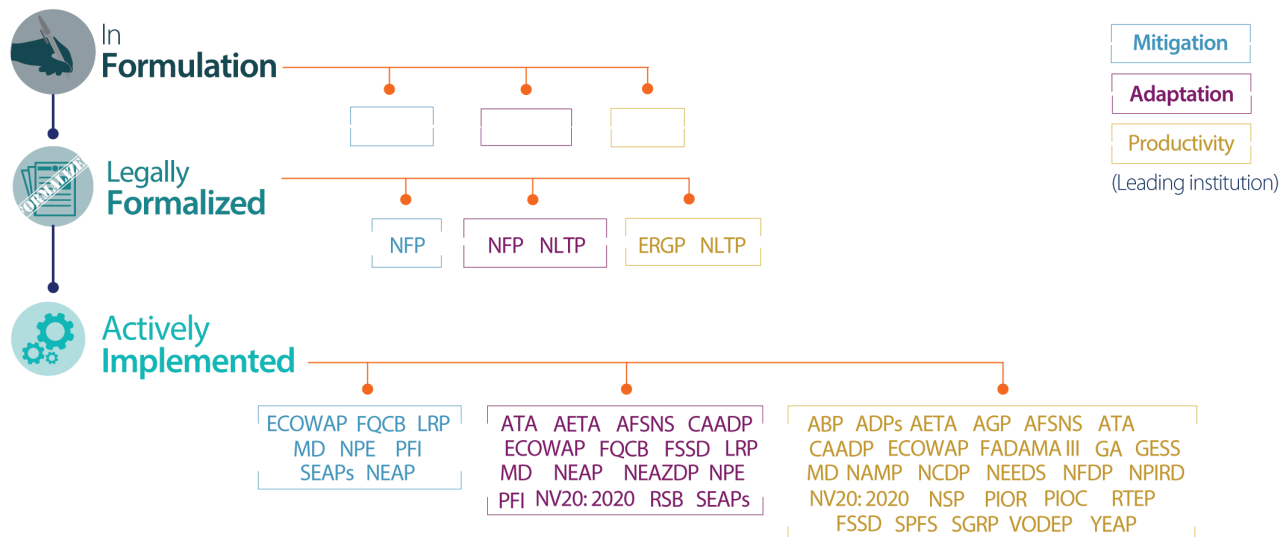


ACF Action against Hunger AEI Agricultural Educational Institutions  
 AERF African Ecological Restoration Foundation ARCN Agricultural  
 Research Council of Nigeria BMANR Borno state Ministry of Agriculture  
 and Natural Resources BMWR Borno state Ministry of Water Resources  
 BOA Bank of Agriculture BOCCIMA Borno state Chambers of  
 Commerce, Industries, and Agriculture BOSADP Borno State Agricultural  
 Development Authority BOSAMA Borno State Agricultural  
 Mechanization Authority BOSEMA Borno State Emergency  
 Management Authority CBDA Chad Basin development Authority FAO  
 Food and Agricultural Organization of the United Nations FMARD  
 Federal Ministry of Agriculture and Rural Development FMENV Federal  
 Ministry of Environment FRIN Forestry Research Institute of Nigeria FSN  
 Fisheries Society of Nigeria IAR Institute of Agricultural Research ICRC  
 International Commission on Red Cross ICRISAT International Crops  
 Research Institute for the Semi-Arid Tropics IFAD International Fund for  
 Agricultural Development IITA International Institute of Tropical  
 Agriculture IRC International Rescue Committee LCRI Lake Chad  
 Research Institute NACGRAB National Centre for Genetic Resources and  
 Biotechnology NAERLS National Agricultural Extension, Research, and  
 Liason Service NAPRI National Animal Production Research Institute  
 NCF Nigerian Conservation Foundation NCRI National Cereals Research  
 Institute NEMA National Emergency Management Authority NFDP  
 National Fadama Development Project NIFFR National Institute for  
 Freshwater fisheries Research NFDP NatioWFAN Women Farmers  
 Advancement Network WFP World Food programme YISA Youth  
 Initiative for Sustainable Agriculture

The graphic shows a selection of policies, strategies and programs that relate to agriculture and climate change topics and are considered key enablers of CSA in the country. The policy cycle classification aims to show gaps and opportunities in policy-making, referring to the three main stages: policy formulation (referring to a policy that is in an initial formulation stage/consultation process),

policy formalization (to indicate the presence of mechanisms for the policy to process at national level) and policy in active implementation (to indicate visible progress/outcomes toward achieving larger policy goals, through concrete strategies and action plans). For more information on the methodology and results from interviews, surveys and expert consultations, see annex 6.

### Policies for CSA in Borno



**ADPs** Agricultural Development Programme (2008) **AETA** Agricultural Extension Transformation Agenda (2011) **AFSNS** Agriculture Food Security and Nutrition Strategy (2017) **AGP** Agricultural Promotion Policy (2016) **ATA** Agricultural Transformation Agenda (2011) **CAADP** Comprehensive Africa Agriculture Development Program (2014) **ECOWAP** ECOWAS Agriculture Policy (2014) **ERGP** Economic Recovery Growth Plan (2017) **FADAMA III** Fadama III Programme (2008) **FSS** Food Security Strategy (2009) **FSSD** Food Security Strategy Document (2009) **FQCB** Fertilizer Quality Control Bill (2019) **GA** Agriculture Promotion Policy (APP), Green Alternative (2016) **GESS** Growth Enhancement Support Scheme (2011) **LRP** Land Resources Policy (2009) **MD** Malabo declaration (2014) **NAMP** National Agricultural Mechanisation Policy (2009) **NCDP** National Cooperative Development Policy (2009) **NEAP** Nigerian National Environmental Action Plan (1995) **NEAZDP** North East Arid Zone Development Programme (1988) **NEEDS** National Economic Empowerment and Development Strategy (1999) **NFDP** National Fadama Development Project (1990) **NFP** National Forest Policy (2018) **NLTP** National Livestock Transformation Plan (2019) **NPE** National Policy on Environment (1989) **NSP** National Seed Policy (2009) **NV20:2020** Nigerian Vision 20: 2020 (2009) **NPIRD** National Policy on Integrated Rural Development (2009) **PFI** Presidential Fertilizer Initiative (2016) **PIOC** Presidential Initiative on Cassava (2002) **PIOR** Presidential Initiative on Rice (2002) **RTEP** Root And Tuber Expansion Programme (2003) **RSB** Revised Seed Bill (2017) **SEAPs** States Environmental Action Plans (1995) **SGRP** Strategic Grains Reserve Programme (2015) **SPFS** Special Programme for Food Security (2008) **VODEP** Presidential Initiative on Vegetable Oil Development (2002) **YEAP** Youth Employment in Agriculture Programme (2014)



## Financing CSA

Financing CSA activities in the Borno state is presently the prerogative of implementing agencies across the state. There are limited concrete linkages with funding organizations at the bilateral and multi-lateral levels in support of CSA. There are, however, donor-supported climate change projects at the Federal level that benefits the state. Presently, the United Nations Development Programme, United Nations Environment Programme, Food and Agriculture Organization of the United Nations, the World Bank and the African Development Bank have supported CSA-related initiatives and agricultural development projects that are geared towards rural livelihood improvement and food security in the Borno state. Nationally, the government of Nigeria is taking pragmatic measures to devote significant proportions of national budget to climate change especially in sectors of the economy like agriculture deemed highly vulnerable to climate change and variability. While Nigeria has been able to obtain funding from the Global Environment Facility Trust Fund for climate change-related projects in other states, very less can be said of the Borno states.

## Potential finance

Borno state may not have sourced a lot of funding from climate finance initiatives like the Green Climate Fund and the Global Environment Facility. However, the vulnerability of the region to climate change and the rising need for the adoption of innovative agricultural technologies that avert the risks posed by climate change, makes projects seeking to improve climate change adaptation and rural livelihoods appealing to donors. At present, Federal Government support are not sufficient with the state counting mainly on local and international development agencies operating in the region. According to the Federal Ministry of Environment, the Federal Government is in the process of putting in place a Nationally Strategic Climate Change Trust Fund (NSCCTF) as a response to the need to broaden the scope of national interventions for impact at all levels of governance. The scope of the NSCCTF is said to be broad to cover many activities related to climate change and sustainable development in Nigeria. Agricultural stakeholders in the Borno state seeking to design projects that have the potential to strengthen agricultural production systems (crop and livestock) and improve their resilience to climate change-induced weather extremes such as drought are likely to benefit from this funding scheme.

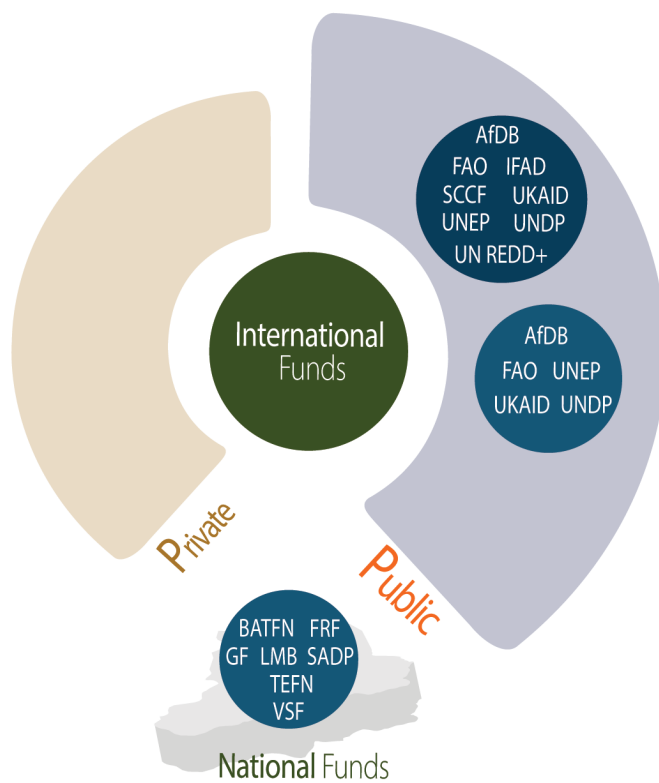
There have also been discussions on setting up an agricultural resilience fund that Borno state can benefit. The Bill to set up the National Climate Change Commission provides for “a fund into which all the monies accruable to the commission shall be paid and from which all the activities of the commission shall be funded”. This is the equivalent of a Climate Fund and would provide a pot from which the various economic sectors, including agriculture, could obtain their finances.

But there should also be a separate agricultural resilience fund to complement the National Climate Change Commission provision. Indeed, the National Policy on Climate Change explicitly recognizes the need for individual sectors to pursue additional measures against climate change.

Categorizing agriculture as a business invites greater involvement by the private sector in building finances to tackle climate change and develop climate-resilient agriculture. The private sector has many comparative advantages, including organized structures, experience, money and trained personnel, and will engage constructively in efforts to mitigate the shocks and stresses imposed by the changing climate. It understands the marketability and the profitability of climate-resilient agriculture and is willing to back that appreciation with the necessary level of investment.

The graphic highlights existing and potential financing opportunities for CSA in the Borno state of Nigeria. The methodology and a more detailed list of funds can be found in annex 7.

## Financing opportunities for CSA in Borno



- Funds actually accessed by country for CSA purposes
- Funds actually accessed by country for purposes other than CSA

AfDB African Development Bank BATFN British American Tobacco Foundation of Nigeria FAO Food and Agriculture Organization of the United Nations FRF Fertilizer Revolving Fund GF Guinness Foundation IFAD International Fund for Agricultural Development SADP State Agricultural Development Programme SCCF Special Climate Change Fund TEFN The Tony Elumelu Foundation of Nigeria UKAID United Kingdom Aid UNDP United Nations Development Programme UNEP United Nations Environmental Programme

## Outlook

Agriculture is the mainstay for the Borno state employing over 70 percent of the population. Agricultural practices are mainly rain fed with few irrigated fields. Land holdings rarely exceed 5 hectares. In the Borno state, agriculture is characterized by small-scale and subsistence production systems. Food and cash crops and livestock produced include, (a) cereals: maize, millet, sorghum, rice and wheat; (b) legumes: cowpeas, groundnuts, soya beans and bambara nuts; (c) fruits: orange, lemon, mango and guava; (d) root and tubers: yam, cassava and sweet potato; (e) vegetables: tomatoes, pepper, onions, okra, pumpkin and melon; (f) tree crops: gum arabic and ginger, (g) livestock and fishes: cattle, sheep, goats, pigs, poultry, rabbits and (h) fish of different varieties [9]. In Borno state, crop production (tonnes) as at 2011 were 192 613, 217 795, 199 884, 41 512, 60 335, and 117 378 respectively for sorghum, millet, maize, rice, groundnut, and cowpea that made a total 829 517 tonnes [9]. Similarly, in 2012, numbers of livestock reared were 1 300 250, 1 320 450, 1 097 250, 810 050, and respectively for cattle, sheep, goats, camels, and poultry, making a total of 505 050 animals. Fish production was 323 tonnes in 2011. Factors such as declining soil fertility, poor financial services, land tenure complications, limited infrastructure and underdeveloped markets continue to hamper agricultural growth. This notwithstanding the Borno state and indeed Nigeria has made efforts to enhance the resilience of the agriculture sector to climate change. The ongoing development of the Agricultural Promotion Policy (APP), the development of a National Policy on Climate Change and Response Strategy (NPCCRS) and the numerous plans, strategies and policy enabling environment are thought to set the state on the path towards sustainable development under the realities of a changing and varying climate.

Some CSA practices (e.g. intercropping/multiple cropping, agroforestry, conservation agriculture etc.) are quite widespread and their proliferation has been facilitated by ease of adoption, and multiple benefits such as food, income diversification and improved resilience. Although there are a wide range of organizations conducting CSA-related work, most have focused largely on food security, environmental management and adaptation. There is the need to also integrate mitigation into the State's climate-smart agriculture development efforts. In addition, off-farm services related to CSA need to be enhanced, including weather-smart and market-smart services.

While funding for CSA is limited in the state and Nigeria in general, efforts are underway to ensure that the country access and utilize international climate finance from sources such as the Green Climate Fund and Global Environment Facility and through readiness and capacity building programmes. At the national level, the National Agricultural Resilience in Nigeria, an arm of the Federal Ministry of Agriculture and Rural Development which targets reforestation, agriculture and livestock, is a useful mechanism for directing climate finance to CSA-related activities.

Others are the fund set aside for the National Climate Change Adaptation Strategy and Action Plan for Climate Change in Nigeria (NASPA-CCN) which can benefit CSA-related activities the Borno state.

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For further information and online versions of the annexes

**Annex 1:** Borno's agro-ecological zones

**Annex 2:** Selection of agriculture production systems key for food security in the Borno state of Nigeria (methodology and results)

**Annex 3:** Methodology for assessing climate smartness of ongoing practices

**Annex 4:** Long list of CSA practices adopted in in the Borno state of Nigeria

**Annex 5:** Institutions for CSA in the Borno state of Nigeria (methodology and results)

**Annex 6:** Policies for CSA in the Borno state of Nigeria (methodology and results)

**Annex 7:** Assessing CSA finances

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