FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

EBONYI STATE GOVERNMENT

EBONYI STATE CLIMATE SMART AGRICULTURE PROFILE

EBONYI STATE MINISTRY OF AGRICULTURE & NATURAL RESOURCES
Salt of the Nation

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Climate Change IS REAL

Be part of the Smart Solution

USAID FROM THE AMERICAN PEOPLE
MICHIGAN STATE UNIVERSITY
IFPRI INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
EBONYI STATE GOVERNMENT

Climate-Smart Agriculture (CSA) Profile for Ebonyi State, Nigeria

List of Consultants/Authors

Robert Ugochukwu Onyeneke is an academic staff at Alex Ekwueme Federal University Ndufu-Alike, Ebonyi State, Nigeria

Chukwuemeka Chinonso Emenekwe is an academic staff at Alex Ekwueme Federal University Ndufu-Alike, Ebonyi State, Nigeria

Mark Umunna Amadi is an academic staff at Alex Ekwueme Federal University Ndufu-Alike, Ebonyi State, Nigeria

Authors' Acknowledgment:
The Climate-Smart Agriculture (CSA) Profile for Ebonyi State, Nigeria is a product of collaborative research funded by the USAID Nigeria mission under the Feed the Future Nigeria Agriculture Policy Activity. The author team comprise faculty at Alex Ekwueme Federal University Ndufu-Alike, Ebonyi State, Nigeria with input from the Planning, Research and Statistics Department Ebonyi State Ministry of Agriculture and Natural Resources and the Ebonyi State Ministry of Environment.

Table of Contents

List of tables

List of figures

List of Acronyms and Abbreviations

Acronym/Abbreviation	Description
AFOLU	Agriculture, Forestry and Other Land Use
APS	Agricultural Performance Survey
BNRCC	Building Nigeria's Response to Climate Change
CBA	Community-Based Adaptation
CCF	Climate Change Fund
CRSA	Climate Resilient Sustainability Agriculture
CSA	Climate-smart agriculture
EBSMANR	Ebonyi State Ministry of Agriculture and Natural Resources
ETS	Emissions Trading Scheme
FAO	Food and Agriculture Organization
FCT	Federal Capital Territory
FGDs	Focus Group Discussions
FMARD	Federal Ministry of Agriculture and Rural Development
FtFNAPA	Feed the Future Nigeria Agricultural Policy Project
GDP	Gross Domestic Product
Ha	Hectare
IFAD	International Fund for Agricultural Development
IPCC	Intergovernmental Panel on Climate Change
IYCF	Infant and Young Child Feeding Practice
LULC	Land Use Land Cover
MDAs	Ministries, Departments, and Agencies
MSMEs	Micro, Small and Medium-Scale Enterprises
MSU	Michigan State University
MT	Metric tons
MUAC	Mid-Upper Arm Circumference
NAERLS	National Agricultural Extension and Research Liaison Services
NBS	National Bureau of Statistics
NCCP	National Climate Change Policy
NDC	Nationally Determined Contribution
NNHS	National Nutrition and Health Survey
NPK	Nitrogen, Phosphorus, and Potassium
RFIA	Rapid Flood Impact Assessment
SDP	State Domestic Product
SEMA	State Emergency Management Agency
TNC	Third National Communication
USAID	United States Agency for International Development

Introduction

Climate-smart agriculture (CSA) is an important strategy to address the challenges of climate change in the agricultural sector. As a strategy to address climate change, CSA simultaneously achieves the three critical goals of responding to climate change: boosting agricultural productivity and incomes, adaptation and mitigation (FAO, 2010). While climate change adaptation aims at adjusting to actual or expected climate change impacts, mitigation aims at reducing/removing/avoiding above and below-ground carbon emissions (IPCC, 2014). While CSA is one of the global strategies for tackling climate risks in agriculture, its implementation is location specific. This implies that there is no blanket recommendation as to what CSA is. Although CSA is still emerging, there are practices, services, and technologies relevant to this concept taking place across the world. To effectively implement CSA, it is necessary to take stock of already existing and future promising practices, and the existing institutional and financial frameworks that would support large-scale uptake of CSA. This is the core motivation of developing the Ebonyi State CSA. This CSA profile provides baseline information on the current CSA practices in the State and provides an entry point for investment in large-scale CSA implementation in the State.

STATE CONTEXT

Economic relevance of agriculture

Estimates by the National Bureau of Statistics (NBS, 2019) suggest that the State's GDP was N1,327,104.09 million in 2017. Additionally, the agricultural sector contributes significantly to the State's aggregate economic output. The agricultural sector contributed about 42.2% of the State domestic product (SDP) while other sectoral contributors to the State's economy are the services and industrial sectors, which accounted for about 49.4% and 8.4%, respectively in 2017 (NBS, 2019). Calculation from the State's agricultural GDP in 2017 suggests that crop production contributed about 91.24%, livestock contributed about 5.14%, fishing contributed about 3.17%, and forestry contributed 0.45% (NBS, 2019). Ebonyi State is endowed with a vast agricultural sector, mineral freshwater, and energy resources. The State produces crops such as yam, maize, cassava, and rice (Choko et al., 2019). Rice is an important crop in the agricultural program of the State (Okereke et al., 2017). The rice value chain in the State has witnessed significant development in recent years (Okonkwo et al., 2021). The State produced about 138,330 metric tons (MT) of rice in 2020 with a yield of 2.26 tons/ha (NAERLS & FMARD, 2020).

Ebonyi State is at the center of agricultural trade in the Southeast region. The State's soil is suitable for cultivating nearly all crops and rearing varieties of livestock, including poultry, sheep, goat, cattle, and rabbits. Ebonyi State is endowed with a network of rivers which provides reasonable grounds for artisanal fishing and river transportation. There are over six (6) State-owned farms, most of which are under-utilized. There are eleven (11) gazetted forests and game reserves. Although the industrial, commercial investments and tourism potentials of the State are enormous, about than 42% of the State's GDP comes from the agricultural sector (NBS, 2019).

Climate and Soil

Ebonyi State is located in Southeast Nigeria in a humid tropical agro-ecological zone and occupies an area of 7,465 square kilometers (km2) (Obiahu et al., 2021). In 2018, the composition of land use land cover (LULC) was as follows: forest area (2,410 km2), built-

up-area (2,315 km2), bare land (1,827 km2), farmland (911 km2), and water body (2 km2) (Obiahu et al., 2021).

Ebonyi State shares its northern border with Benue State, its western border with Enugu State, its eastern border with Cross River State, and its southern border with Abia State (Okereke et al., 2017). The state is situated in Nigeria's tropical rainforest (Okereke et al., 2017). There are two seasons in the State – wet and dry seasons. Typically, the rainy season lasts from April to October, whereas the dry season lasts from October to March (Agboeze et al., 2014). The temperature ranges from 27 to 34OC, and annual precipitation ranges from 1,313 to 2,186 millimeters, according to station-level data from the Federal College of Agriculture Ishiagu (Onyeneke et al., 2022). The soil in the State is ideal for cultivation of crops such as rice, cassava, yam, and maize. The State is located in the Cross-River plains, prone to flooding during the rainy season (Agboeze et al., 2014). For instance, the Aloma River's flooding patterns have become increasingly erratic, causing damage to nearby communities such as Onuenyim and residents of Onuenyim blame the flooding on altering rainfall patterns and deforestation (Olabisi et al., 2020). Erosion is another risk associated with climate change in the State (Choko et al., 2019) and it has also been linked to deforestation and flooding (Olabisi et al., 2020; Ogbodo, 2013).

Agricultural Production Systems

Traditional and modern farming practices are common in Ebonyi State. However, traditional farming practices dominate because the vast majority are smallholder farmers operating at a subsistence level with an average farm size of 1.5 to 3.0ha (Nwaobiala et al., 2010; Rahman & Chima, 2018) with many farmers practicing mixed cropping or intercropping (Umeh & Igwe, 2019). Umeh and Chukwu (2016) reported incidence of conflicts among herders and arable crop farmers in some parts of the State. According to them, crops and livestock were lost during the conflicts.

Ebonyi State is primarily an agricultural region. Based on data obtained from reports of the Wet Season Agricultural Performance Surveys (NAERLS & FMARD, 2017, 2018, 2019, 2020) in Nigeria, the State cultivates several crops. It is a major rice and yam-producing and supplying State in Nigeria (Federal Ministry of Agriculture and Rural Development, 2022; NAERLS & FMARD, 2022). Additionally, it produces maize, cocoyam, potatoes, beans, cassava, cowpea, groundnut, and oil palm, among others (NAERLS & FMARD, 2020; Federal Ministry of Agriculture and Rural Development, 2022). Most of the vegetables planted are native (e.g., okra, peppers, tomatoes, eggplant, and green leafy vegetables) and produced mainly for subsistence, while any surplus is sold. Most crop production activities in the State occur on the floodplains of several rivers across the State (Olabisi et al., 2020; Federal Ministry of Agriculture and Rural Development, 2022). Traditional livestock rearing (i.e., sheep, goat, pig, poultry, and rabbit farming) is common in the State. Besides, cattle rearing is also practiced in the State (Federal Ministry of Agriculture and Rural Development, 2022). Aquaculture is also practiced in the State at different scales by micro, small and medium-scale enterprises (MSMEs).

Crop and livestock production data for Ebonyi State as of 2020 are reported in Table 1 based on data from the 2020 Agricultural Performance Survey (APS) in Nigeria (NAERLS & FMARD, 2020).

Crop	Land area (Ha)	Production (MT)	Yield (Ton/Ha)
Rice	61,220	138,330	2.26
Maize	90,120	164,000	1.82
Cowpea	71,560	43,590	0.61
Groundnut	5,030	5,210	1.04
Yam	288,730	2,888,370	10
Cocoyam	139,810	283,650	2.02
Tomato	55,880	55,360	0.99
Okro	14,020	15,560	1.11

Animal	Number
Cattle	14,455
Sheep	223,679
Goat	1,144,434
Chicken	7,268,929
Rabbits	5,757
Aqua.*	MT
Fish (Clarias sp and Heterobranchus sp)	10,000

Note: *Aqua. (Aquaculture); No data was reported for artisanal fisheries for the state in 2020.
Source: Authors' table based on data from the 2020 Agricultural Performance Survey in Nigeria (NAERLS & FMARD, 2020)

By harvested area and production quantity, Ebonyi State's yam production constitutes the largest share of crop production in 2020, with about 2,888,370 metric tons, and it is a significant rice-producing State in Nigeria—about 138,330 metric tons in 2020 (NAERLS & FMARD, 2020). In the same year, its cocoyam and maize production were the next most significant, with 283,650 and 164,000 metric tons, while the total land area (in hectares) for rice, maize, cowpea, groundnut, yam, cocoyam, tomato, and okro in 2020 was 1,497,840 ha (NAERLS & FMARD, 2020). The total number of cattle, sheep, goats, chicken, and rabbits reared were 14,455, 223,679, 1,144,434, 7,268,929, and 5,757, respectively while aquaculture production (Clarias sp and Heterobranchus sp) was 10,000 metric tons in 2020 (NAERLS & FMARD, 2020).

Agriculture in the State mainly depends on rain-fed conditions (Onyeneke et al., 2020). Although the 2020 Agricultural Performance Survey (APS) did not report the quantity of fertilizer consumption per unit of arable land, it reported that production systems generally have inadequate availability and, thus, low fertilizer and pesticide inputs (NAERLS & FMARD, 2020). The survey report indicated that the Ebonyi state government procured and distributed agrochemicals to farmers, namely some selective herbicides (200,000L) and non-selective herbicides such as glyphosate (300,000L) (NAERLS & FMARD, 2020). Further, the state procured and distributed 2,500 MT and 1,250 MT of NPK and Urea fertilizers, respectively (NAERLS & FMARD, 2020).

There are many challenges facing agriculture in Ebonyi state, including limited access to critical markets for the sale of their harvests, low private-sector investment, climate change, declining soil fertility, and low capacity development (Choko et al., 2019; Okereke et al., 2017; Olabisi et al., 2020; Onyeneke et al., 2021). Organic matter soil amendment, fallowing, utilizing traditional farm tools, creating big soil mounds, bush burning, legume planting, etc., are all examples of traditional agricultural practices used in the State.

The primary rice cultivation practices in the State are upland (rainfed), lowland (swamp) and irrigated lands (Chidiebere-Mark et al., 2019). The Upland (rain-fed) system is predominantly used, while the irrigation method is the least practiced. Yam, cassava, potato, rice, maize, and cocoyam productions take place in the three agricultural zones areas across the state.

Food security and nutrition

Food insecurity is a problem in Ebonyi State. About 36.7% are extremely poor and severely hungry (see Figure 1).

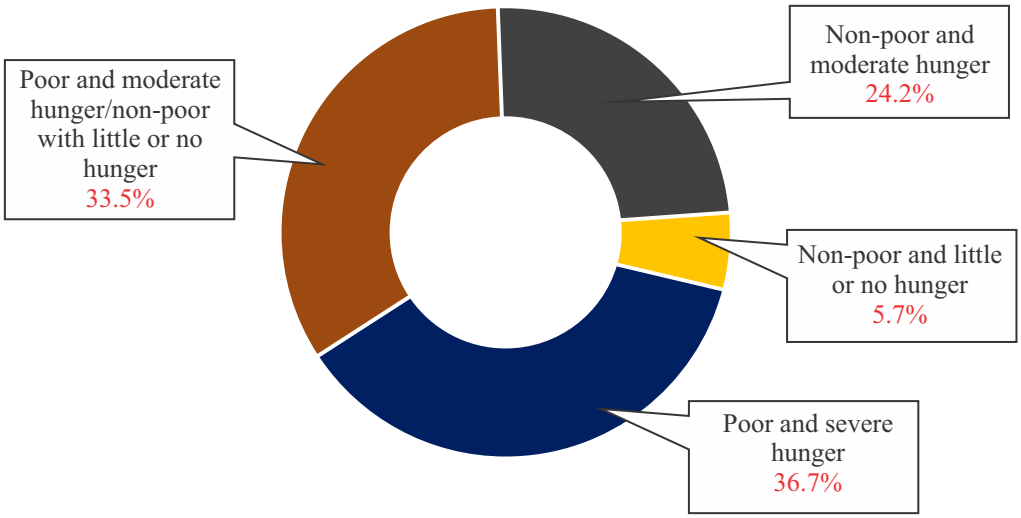
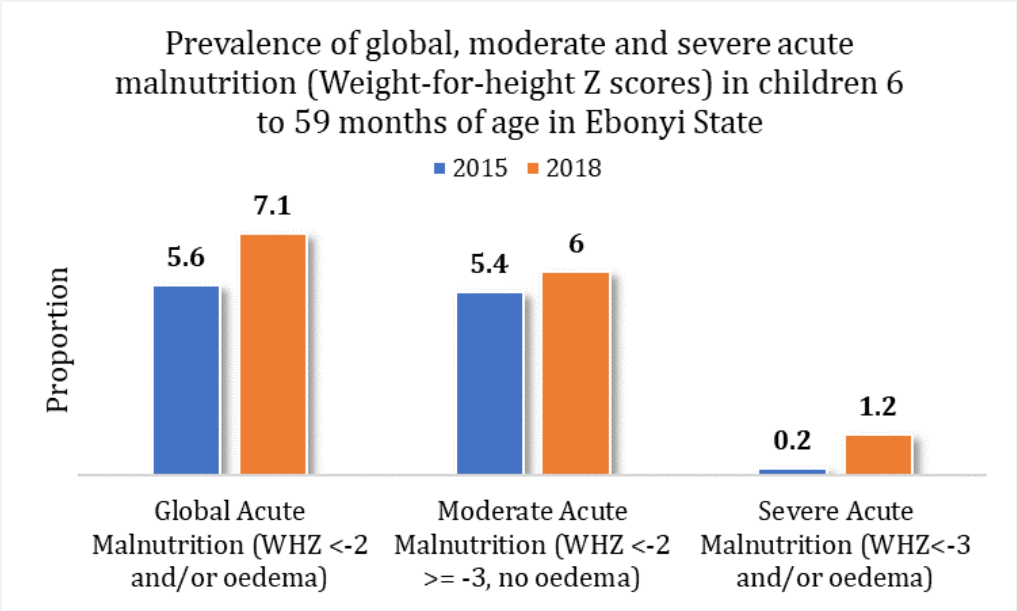


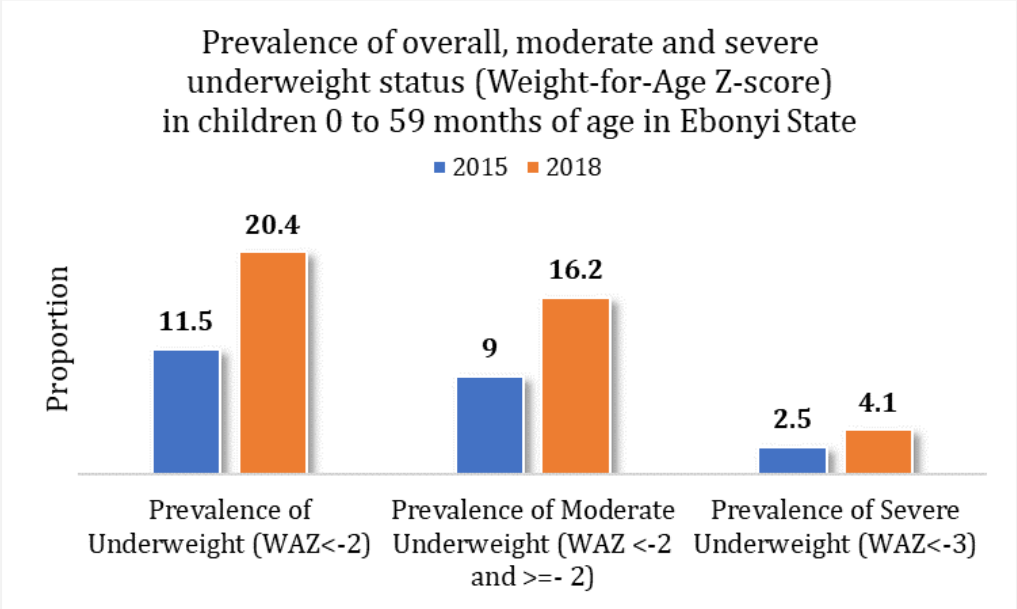
Figure 1. Result of combining hunger and poverty (% of households) in Ebonyi State

Source: Okike et al. (2021).

Both under- and over-nutrition fall on the malnutrition continuum. Malnutrition occurs when people do not get enough to eat or when their bodies cannot properly absorb the food they eat (often because of illness). Consequently, it stunts their growth and development (Umeokonkwo et al., 2020). Stunting, wasting, and underweight are all symptoms of undernutrition, the most common form of malnutrition in nations with limited access to food and medical care (Umeokonkwo et al., 2020). The Nigerian National Nutrition and Health Survey (NNHS) (NBS, 2015; NBS, 2018) reports child malnutrition indicators across States. Acute Malnutrition, Underweight, Stunting, and Overweight are the four measures of child malnutrition covered in these reports. Both weight-for-height and the presence of bilateral oedema and the presence of Mid-Upper Arm Circumference (MUAC) and Bilateral Oedema are used to estimate acute malnutrition in the reports. Acute malnutrition data are based on children aged 6 to 59 months, whereas underweight, stunted growth, and overweight estimates are based on children ages 0 to 59 months, while Z-scores from a standard population are used to quantify these metrics (NBS, 2015; NBS, 2018).

The NNHS reports (see Figure 2) show that, in 2015 and 2018, the proportion of global acute malnutrition among Ebonyi children under five increased from 5.6% to 7.1%, the prevalence of underweight among children under five increased from 11.5% to 20.4%, while the prevalence of stunting increased from 20.6% to 25% (NBS, 2015; NBS 2018). Moreover, the prevalence of global acute malnutrition, underweight, and stunting (25%) in Ebonyi State were 7.1%, 20.4%, and 25%, respectively (NBS, 2018). These findings suggest that Infant and Young Child Feeding Practice (IYCF) practices are still poor in Ebonyi State. Moreover, these findings are consistent with overall national levels findings. Thus, while the NNHS does not provide reasons for the deteriorating cases in individual States, it reported that only one-in-four infants under six months is exclusively breastfed, while fewer than two-in-ten children aged six to twenty-three months receive the minimum appropriate diet (NBS, 2018, p. 134).





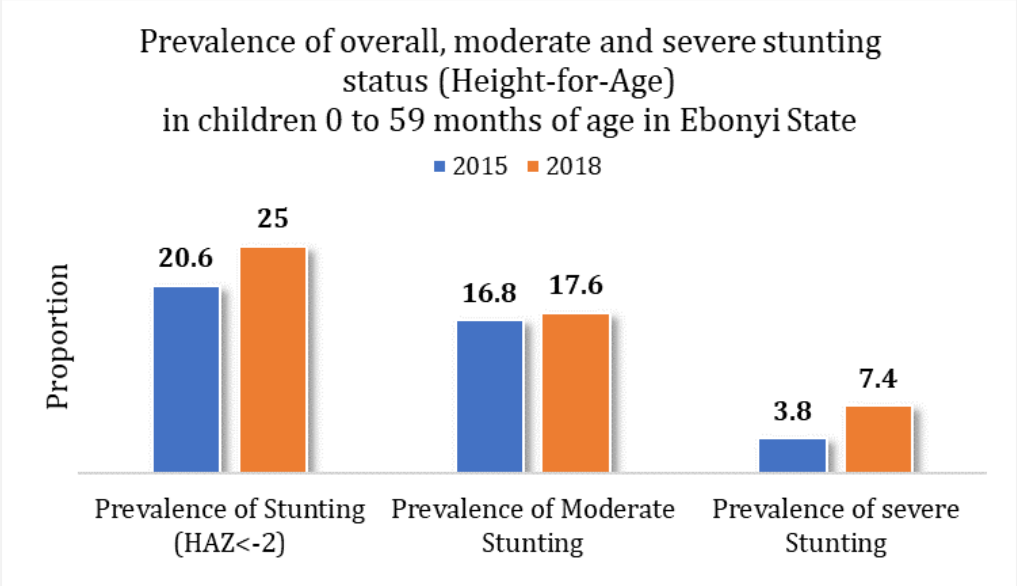


Figure . Nutrition attainment in Ebonyi State, 2015 and 2018
Source: Authors' diagram based on data from the National Nutrition and Health Survey

Numerous factors influence food insecurity in the State and its capacity to satisfy the increasing food demand caused by population increase. Climate change and declining soil fertility are some of the factors responsible for food insecurity in the State (Choko et al., 2019; Onyeneke, 2021).

CLIMATE CHANGE AND IMPLICATIONS FOR AGRICULTURE

Climate change in Ebonyi

Ebonyi State occupies areas in both tropical rainforest and guinea savannah agro-ecological zones in Nigeria (Aduo & Nwadili, 2019). Figure 3 shows 21 years of average rainfall and temperature in Ebonyi State. The observed historical trends show that temperature is increasing in Ebonyi State (see Figure 3). Additionally, the 2021 Wet Season Agricultural Performance Survey (NAERLS & FMARD, 2021) reports that Ebonyi recorded the highest mean temperature of 33.9°C in 2021 in southeast Nigeria.

On the other hand, rainfall has increased and decreased in the State without a clear trend. Further, using the same data and trend analysis, Onyeneke et al. (2020) estimate that temperature has significantly increased in the State. Conversely, their result showed no statistically significant trend for yearly rainfall in Ebonyi State. Moreover, the 2021 Agricultural Performance Survey (APS) (NAERLS & FMARD, 2021) reports that Ebonyi recorded total rainfall of 1082.6mm in 2021.

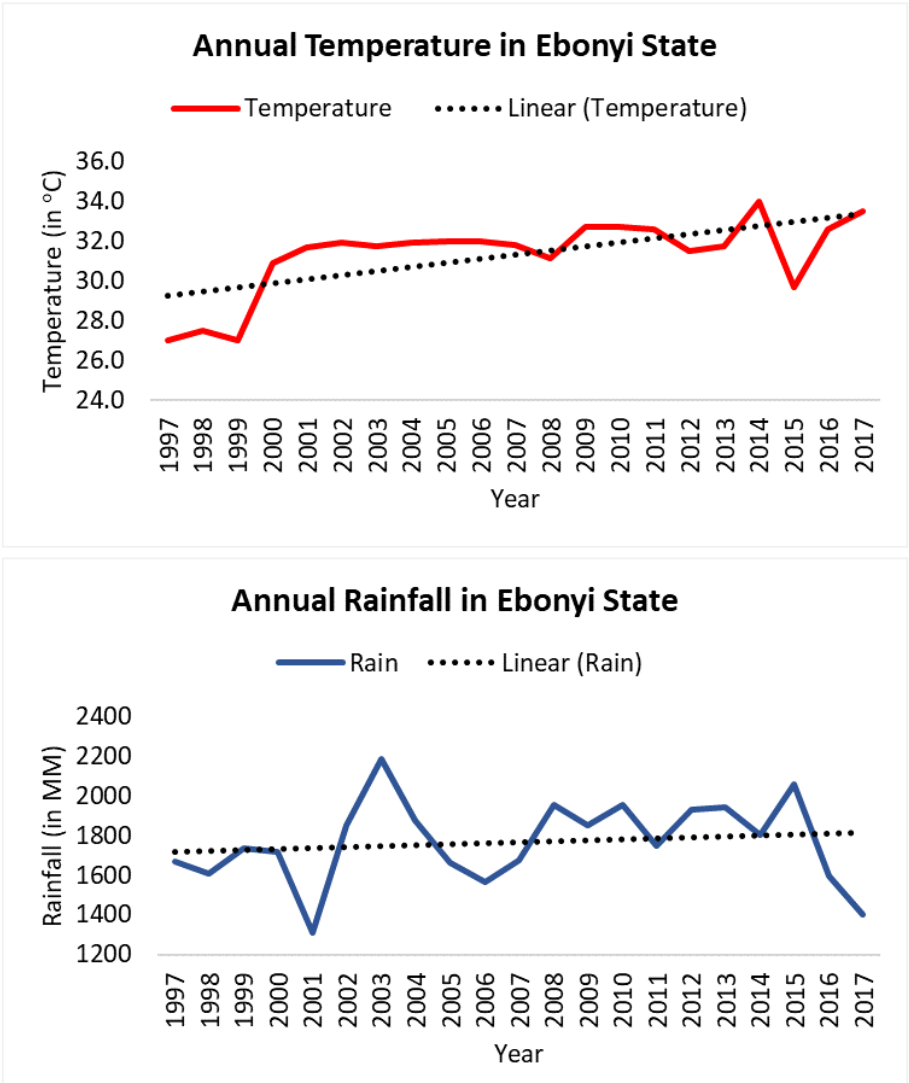


Figure . Historical annual temperature and rainfall in Ebonyi (1997 – 2017)
Source: Authors' diagram based on data from Federal College of Agriculture Ishiagu.

Moreover, relevant to Ebonyi State, the model results of a research commissioned by the Building Nigeria's Response to Climate Change project projected an increase in future extreme temperature and rainfall occurrences across all of Nigeria's ecological zones (Abiodun et al., 2011). Specifically, by mid-century (2046-2065), days with temperatures greater than 38°C would increase by five days in the rainforest ecological zones and days with heat waves would increase by thirty-two days in the rainforest (Abiodun et al., 2011). Besides, average rainfall trends in Nigeria (and other West African countries) are generally uncertain. However, it is expected that stronger rain events will occur under climate change (Chagnaud et al., 2022). In concrete terms, Abiodun et al. (2011) projects that the length of the rainfall season will increase by one to two weeks over the rainforest ecological zone in the late century.

Agricultural greenhouse gas emissions

Rice is an essential food crop globally, providing around two-thirds of the daily caloric intake of over three billion individuals (Nikolaisen et al., 2021). Rice is Nigeria's primary staple food and a significant economic contributor (Emenekwe et al., 2022). It is generally consumed and a significant nutritional value source for the country's populace (Emenekwe et al., 2022; Ogunleke & Baiyegunhi, 2019). Thus, it is vital for food security in Nigeria. It is estimated that rice production will need to expand by 8 to 10 million tons annually by as much as 40% by 2040 to meet rising demand in nations where rice is the main staple crop (Nikolaisen et al., 2021). This poses challenges in acquiring land for rice cultivation and water resources, boosting yields, decreasing water usage, and reducing GHG emissions (Nikolaisen et al., 2021). The Intergovernmental Panel on Climate Change (IPCC, 2019) estimates that rice production is responsible for about 24% of the overall GHG emission from agricultural soils. It also notes that Africa is responsible for 14% of global emissions, although this region's emissions are expanding at the quickest rate, approximately 2.5% each year (IPCC, 2019). Thus, a potential increase in emissions, predominantly methane (CH4), nitrous oxide (N2O), and carbon dioxide (CO2), due to calls for increased rice production is a critical source of concern (IPCC, 2019).

Ebonyi State is a major rice producer in Nigeria, and it is expected that a significant amount of CH4 will be emitted from its rice production activities. Also, the rice production system mainly depends on rainfed conditions, which increases the likelihood of methane emissions from flooded fields. Thus, finding practical solutions to mitigate emissions and limit the environmental effect and financial burden to farmers while boosting yield is therefore essential. However, there is no reliable State-specific GHG inventory. Consequently, there is no GHG inventory for the agricultural sector. There is a significant dearth of publicly available activity data to confidently carry out an accurate, detailed assessment of the GHG emissions for the whole agricultural sector. However, this Profile follows the examples set by the Third National Communication (Federal Ministry of Environment, 2020a) and First Biennial Update Report (Federal Ministry of Environment, 2018a) by using the IPCC Tier 1 methodology based on default values (i.e., emission factors and regional averages) to provide preliminary estimates of GHG for the rice production sub-activity of the agricultural sector. The choice of this activity is that rice is a mainstay food crop in the State regarding food security, employment, and contribution to the State Domestic Product (SDP). Furthermore, the recent APS (NAERLS & FMARD, 2020) provides the area harvested for rice in Ebonyi State, a critical input variable for the estimations. The results indicate that rice production contributes significantly to methane emissions.

While there is no detailed GHG inventory in the state, Nigeria's 2021 update to the Nationally Determined Contribution (NDC) reports that total emissions in 2018 were 347 MtCO2-eq. Furthermore, it noted that activities in the Agriculture, Forestry and Other Land Use (AFOLU) sector are the second most significant contributors to Nigeria's GHG emissions, accounting for about 25% of 347 MtCO2-eq of national total GHG emissions in 2018 (Federal Ministry of Environment, 2021a). Moreover, agriculture contributed 62.8%, while forestry and other land use contributed 37.2% of AFOLU sector GHG emissions in 2018 (Federal Ministry of Environment, 2021a). While the Revised NDC does not report the gas-specific emissions for AFOLU, the Third National Communication (TNC) (Federal Ministry of Environment, 2020a) reports that carbon dioxide (CO2) accounts for the largest GHG emitted with 85.3%, methane (CH4) accounts 8.5% and nitrous oxide (N20) 6.2% in the AFOLU sector. Additionally, livestock emissions are produced during enteric fermentation and management of manure from domestic animals and poultry (Federal Ministry of Environment, 2020a). This Profile notes that reducing agriculture's carbon footprint is essential to limiting climate change.

Impacts of climate change and implications for agriculture

Multiple channels of influence from climate change are felt in the agricultural production systems in the state. Higher rainfall intensity, a longer dry season, more recurrent floods, higher temperatures, more recurrent and intense windstorms, an irregular rainfall pattern and distribution, a later start time for rain, and an earlier end of rain are all examples of these channels (for details, see Choko et al., 2019; Olabisi et al., 2020; Onyeneke et al., 2021). Flooding affects agricultural production in the State (Olabisi et al., 2020). There are several adverse effects of constant flooding on the settlements along the Iyiokwu River in the State. Millions of Naira worth of property suffer damage, and due to the prolonged submergence of their farmlands, both small- and medium-scale farmers in the floodplain lose crops and livestock annually (NEWMAP, 2015).

Further, climate change affects soil nutrients and microbial activities and alters rainfall patterns and distribution, contributing to decreased crop yield. High temperatures and drought affect crop production. Climate change also increases the pests and diseases incidence harmful to crops, livestock and fisheries. Flooding reduces soil fertility and destroys farm assets. Climate change impacts are adverse since agricultural systems in the state depend primarily on rain-fed conditions.

Communities in the state are vulnerable to flooding, which destroys crops (Choko et al., 2019; Olabisi et al., 2020). Moreover, due to the combined effects of floods and degraded lands/soils caused by climate-induced erosion, the risk of decreased agricultural productivity and outputs/yields is very high (Onyeneke, 2021). Furthermore, the continuous dissection from gully formations reduces the cultivable land area available for agricultural production (Choko et al., 2019). It causes the removal of plant nutrients and organic matter from the soil, resulting in increased soil infertility. Agribusiness is negatively impacted, particularly in communities where feeder road networks' distortion, destruction, and breakage have decreased market access (Choko et al., 2019; Olabisi et al., 2020). As a result, decreased agricultural output, aquatic resources such as fish, degradation of watersheds, and contamination of surface water sources make smallholder households more vulnerable to food and nutrition insecurity (Nwajiuba et al., 2015; Ogbodo, 2013). Women and youth working in agricultural production and fishing in communities near streams and rivers are especially vulnerable to reaping lower economic gains due to these agro-ecological hazards. Rain-fed agricultural production systems are

vulnerable to adverse climate change effects. Thus, this could endanger food security in rain-fed-dependent systems while increasing poverty and hunger.

Periodic extreme climate change events (e.g., floods and droughts) affect livestock production, degradation of forage land and cause a shortage of fodder. Climate change-induced heat stress directly impacts livestock production because it reduces meat production, reproductive efficiency, and animal health, which places a significant financial burden on livestock producers (Godson-Ibeji et al., 2022). Alterations to ecosystems can have knock-on effects on livestock production systems (both grazing and non-grazing), animal feed resources, water demand, availability, quality, and security (Godson-Ibeji et al., 2022; Ani & Uwizeyimana, 2022).

The discharge of water from the Ladgo dam in Cameroon into the rivers in Nigeria, together with the impacts of global warming and considerable increases in rainfall compared to 2021, were mostly responsible for this year's floods, and these caused several rivers in the area to overflow their banks thereby washing away many farmlands and killing off many animals (NAERLS & FMARD, 2022). Around 500 individuals lost their lives and 1,411,051 were displaced when floodwaters covered 34 of the 36 states and the FCT this year; also, 37,633 houses were destroyed, livestock and crops in flooded farms were lost, and there were 1,546 recorded injuries (NAERLS & FMARD, 2022). Ebonyi State was one of the hardest hit States in the country due to the 2022 flood (NAERLS & FMARD, 2022).

The rainy season in Ebonyi State typically occurs annually with the greatest between the months of April and October. Ebonyi State was affected by unprecedented heavy rainfalls and floods that devastated various communities. Infrastructure, crops, and houses were damaged, which led to decimated livelihoods and the displacement of numerous households. Additionally increased water flows from river sources in Cross River State have contributed to local rivers overflowing their banks, leading to the flooding of several communities in Ebonyi State.

Given the destructive impact of the flood and the consequences on livelihoods across Ebonyi State, a Rapid Flood Impact Assessment (RFIA) was conducted in six communities in the State to fill urgent information gaps on the effects of flooding on people in the affected areas, and to provide support to the humanitarian response, government, and other key stakeholders. The RFIA used questionnaire and focus group discussion guide to collect data from community members.

The findings of the survey indicate that floods have greatly impacted households leading to property and infrastructural damage and left people in need of urgent assistance. Across the six communities in Ebonyi State, the survey and focus group discussions (FGDs) indicated that sampled households were adversely impacted by the 2022 flooding. Table 2 shows that the severity of the effect of floods on people is indicated by a reported total of 10 injured and 134 displaced persons because of the flooding across the communities. See Table 2 for the list below for the gender-based impacts of the recent floods across the surveyed communities.

Table 1. Gender-based impacts of across selected communities in Ebonyi State

Flood experience and source of awareness	Gender of household head	
	Female	Male
Were you or any of your household members directly injured by the recent flooding?	4	5
Did you receive any warning notice of the flood?	3	15
If yes, who issued the notice?		
Individual	1	1
Radio	2	12
Ebonyi SEMA	–	2
Television	–	1
Total number of persons affected/injured in your household	5	5
Total number of persons displaced in your household by the flood	24	110
How many adult males were affected/injured?	4	3
How many adult females were affected/injured?	6	2
How many children were affected/injured?	6	1
How many affected/injured persons were physically challenged?	–	1
How many affected/injured persons were pregnant women?	–	1
How many adult males were displaced?	4	24
How many children were displaced?	15	52
How many displaced persons were physically challenged?	–	1
How many displaced persons were pregnant women?	–	4
How many displaced persons were lactating mothers?	–	5

Source: Flood impact assessment survey, November, 2022

Responses from community members interviewed indicate that assets worth hundreds of millions were destroyed by the floods in the communities. The RFIA estimates that households in the surveyed communities lost about ₦162,865,250 worth of properties to the 2022 floods. This estimate was based on household reported crop losses, livestock losses, household assets, and non-agricultural business activities and assets. Both male-headed and female-headed households employ several strategies, albeit modest, to cope with the adverse effects of the recent floods. The common strategies employed by both types of households include: (i) Relied on family members within the community for support, (ii) Made high mounds or ridges for crop, (iii) Relied on family members out of the community for support, and (iv) Use of canoe for transportation, (v) Temporarily moving to friends' or relatives' homes, (vi) Temporarily moving into an Internally Displaced Persons camp, and (vii) Selling off livestock to raise money to meet other household needs. While the households and communities employ several modest strategies to cope with the adverse effects of floods, there is a need to boost the scale of local capacity to adequately cope and adapt to the effects of current and future floods. The RFIA provides a list of households and community priorities/demands (from survey and FGDs) to boost their coping and adaptive capacities the effects of current and future floods.

Both male-headed and female-headed households employed some common coping strategies. These common coping strategies employed during the 2022 flooding include (i) Relied on family members within the community for support, (ii) Made high mounds or ridges for crop, (iii) Relied on family members out of the community for support, and (iv) Use of canoe for transportation, (v) Temporarily moving to friends' or relatives' homes, (vi) Temporarily moving into an Internally Displaced Persons camp, and (vii) Selling off livestock (see Figure 4). However, male-headed households employed more coping strategies than female-headed households.

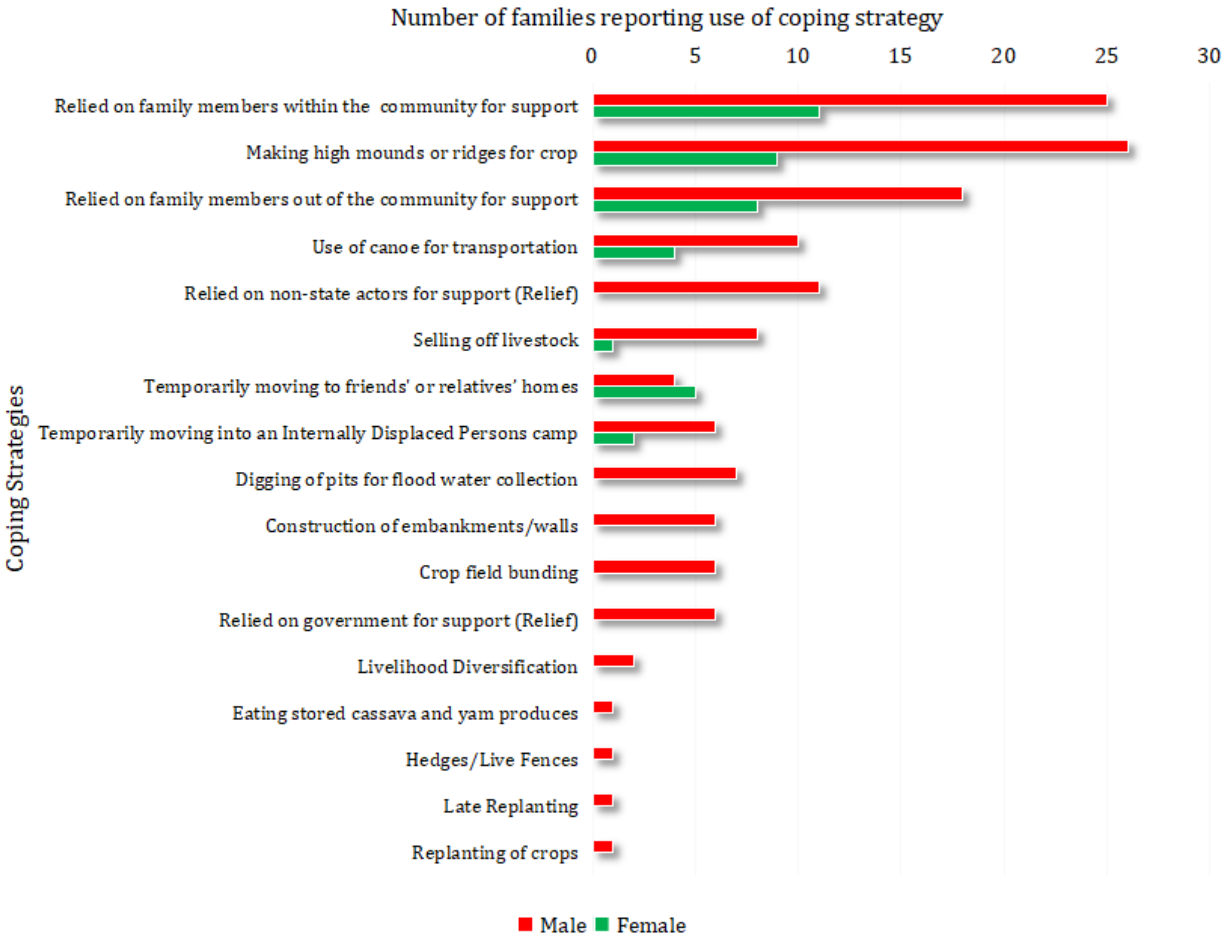


Figure 4. Households' coping strategies in response to the 2022 floods
Source: Flood impact assessment survey, November 2022

CONCEPTUALIZING CLIMATE SMART AGRICULTURE (CSA) IN THE EBONYI CONTEXT

Climate Smart Agriculture (CSA) is recognized broadly by the concurrently increase in resource use efficiency and productivity, climate change adaptation, and GHG reduction (FAO, 2010) (see Figure 5).

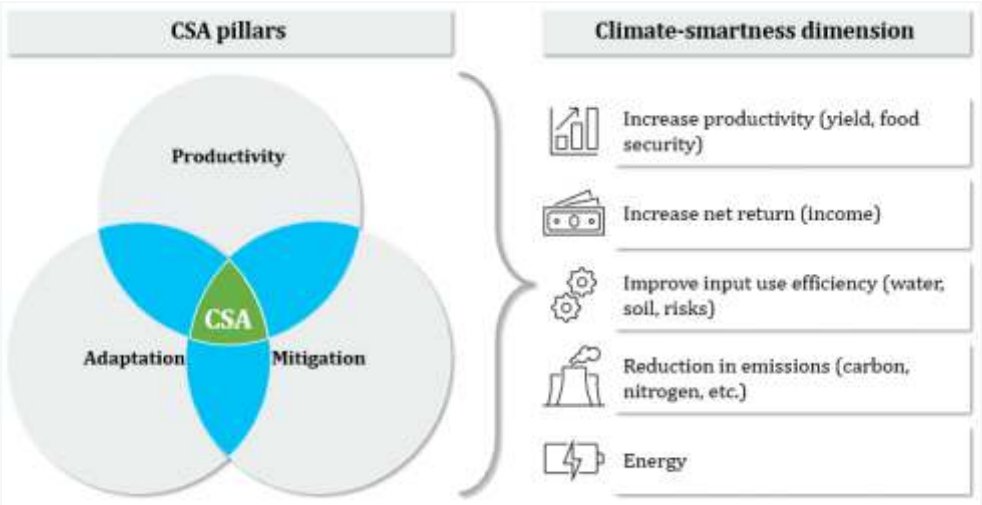


Figure . Conceptual Framework for Climate-Smart Agriculture and Expected Outputs
Source: Authors' diagram based on insights from FAO and Nwajiuba et al.

Identifying and promoting technologies and techniques concurrently achieving all three goals is a significant problem. However, it is crucial to connect this international comprehension of CSA to the actual peculiarities of farming systems in Ebonyi State. Low resource productivity in the State is the first peculiarity. Low productive use of available resources reduces the commercial viability of agriculture. This may explain why subsistence smallholder farmers have become so prevalent while large-scale commercial agriculture remains uncommon. Therefore new ideas, technologies, and management are essential in agriculture to increase productivity. Secondly, the State has a low adaptive capacity to climate change. Compared to other countries, Nigeria's carbon footprint is relatively small, yet the country is nevertheless at high risk from climate change's negative impacts. Food security can only be guaranteed if people have access to technology and innovations that protect biodiversity, manage the environment and natural resources, and create new means of earning a living (Nwajiuba et al., 2015). The third peculiarity is the contribution of current agricultural systems to reducing the effects of climate change. Carbon-neutral or emission-reducing techniques fall under this category. A significant way farming systems contribute to carbon emission is the widespread use of tillage and other forms of soil disturbance and the widespread destruction of forests, among others. The imperative desire to increase production and alleviate food insecurity and poverty makes all three factors challenging in research and policy in developing regions, and Ebonyi in particular.

CSA TECHNOLOGIES, PRACTICES AND CLIMATE SMARTNESS IN EBONYI STATE

CSA is emerging in the Ebonyi State. The State recently launched a climate change policy and action plan, which supports CSA activities in the agricultural sector. On the other hand, practices relevant to CSA are carried out by farmers in the State. Nevertheless, the farmers carry out practices that embody certain aspects of CSA for which the main objective is to increase production (Nwajiuba et al., 2015) but offer adaptation and mitigation benefits. Choko et al. (2019) provide results of a survey of six communities in Ebonyi State experiencing adverse climate change impacts, namely Akpoha, Ezzamgbo, Onueyim, Inyimagu, Nguzu–Edda, and Nkomoro. They show that affected community stakeholders have historically used both traditional and modern practices to respond to adverse climate change.[The traditional practices are the product of indigenous and experiential knowledge.] The practices include structural, behavioral, social, economic, and environmental interventions. Table 3 presents an overview of core climate change incidents in these communities and the primary traditional and modern adaptation practices used to address them.

Table 3. Residents' historical traditional and modern adaptation practices to climate risks in Akpoha, Ezzamgbo, Onueyim, Inyimagu, Nguzu–Edda, and Nkomoro communities of Ebonyi State

Climate change incident	Traditional adaptation practice	Modern adaptation practice
Flooding, prolonged dry season/windstorm, irregular rainy season, erosion, pest diseases, scorching heat	▪ Construction of water channels ▪ Financial contributions to victims ▪ Growing flood-resistant crops (e.g., rice) on flood-prone lands (floodplain farming) ▪ Road maintenance ▪ Discouraging cultivation in flood-prone areas ▪ Cooperation amongst flood victims in agricultural areas ▪ Adjust planting calendar ▪ Dry season irrigation farming ▪ Provision of relief materials ▪ Livelihood diversification ▪ Post-harvest crop and processing at the community level ▪ A platform for sharing information across communities	▪ Use of early-maturing varieties ▪ Construction rehabilitating damaged bridges and culverts ▪ Built embankments ▪ Sensitizing people to weather/climate forecasts ▪ Advisory services on climate risks

Source: A Resilience Approach to Community-Scale Climate Adaptation (Choko et al., 2019)

Identification of CSA Options

CSA could be broadly applied to encompass various technologies and practices. To compile this Profile, examples of agricultural technologies and practices in Ebonyi State that have shown promise in contributing to one or more CSA pillars were compiled from the literature (See Table 4 below).

Table 4 . CSA technologies and practices in Ebonyi State

Sub-sector	Broad category	Specific technologies & practices	References
Crop production	Conservation agriculture	▪ Minimum or zero-tillage ▪ Cover cropping or mulching ▪ Crop rotation ▪ Retention of crop residues on farmland	(Ezeh & Eze, 2016; Onyeneke, 2021; Onyeneke et al., 2021; Oselebe et al., 2017)
	Risk management	▪ Intercropping ▪ Crop diversification ▪ Adopting mixed farming ▪ Crop insurance	(Enete et al., 2011; Ezeh & Eze, 2016; Onyeneke, 2021; Onyeneke et al., 2021)
	Improved seed varieties	▪ Early maturing varieties ▪ Drought- and flood-resistant varieties ▪ Pest- and disease-resistant varieties	(Chukwuone, 2015; Ezeh & Eze, 2016; Onyeneke, 2021; Onyeneke et al., 2021; Oselebe et al., 2016)
	Soil (including integrated) fertility management	▪ Inorganic fertilizer ▪ Organic fertilizer ▪ Effective use of pesticide ▪ Effective use of herbicides ▪ Combination of chemical fertilizers and other soil fertility improvement practices	(Chukwuone, 2015; Enete et al., 2011; Ezeh & Eze, 2016; Onyeneke, 2021; Onyeneke et al., 2021; Oselebe et al., 2017)
	Water management	▪ Irrigation (i.e., manual, surface, localized) ▪ Water harvesting/storage ▪ Use of bonds and drainage ▪ Construction of contour and channels	(Choko et al., 2019; Chukwuone, 2015; Enete et al., 2011; Ezeh & Eze, 2016; Onyeneke, 2021; Onyeneke et al., 2021; Oselebe et al., 2017)
	Intensification	▪ Systems of Rice Intensification	
	Other practices	▪ Adjusting planting and harvesting date	(Choko et al., 2019; Ezeh & Eze, 2016; Onyeneke, 2021; Onyeneke et al., 2021)
		▪ Planting of hedges	(Ezeh & Eze, 2016)
Livestock production (including poultry and aquaculture)		▪ Improved housing (e.g., Heat resistant roofing materials) ▪ Use of nutrient-dense diets ▪ Feed/fodder conservation ▪ Provision of good quality water ▪ Improved medication/vaccination ▪ Feed formulation with locally sourced materials ▪ Using heat-resistant varieties	(Ifeanyichukwu et al., 2018)
Forestry and land use		▪ Agroforestry ▪ Afforestation ▪ Planting of trees as shade	(Chukwuone, 2015; Enete et al., 2011; Ezeh & Eze, 2016)
Cross-cutting		▪ Weather-based crop agro-advisory ▪ Climate Information systems ▪ Livelihood diversification ▪ Resilient infrastructure development ▪ Post-harvest crop and processing at the community level	(Choko et al., 2019; Olabisi et al., 2020), observations

Measuring climate-smartness

Methodology for establishing climate-smartness

To establish the climate smartness for the identified CSA technologies and practices, this Profile uses expert evaluation from critical stakeholders in the agricultural and CSA space through surveys and expert consultations. These stakeholders are knowledgeable about agricultural practices in Ebonyi State. They include mainly researchers and agricultural development program workers in the State.

Further, this Profile uses a climate smartness score assigned to the climate smartness dimensions linked to the CSA pillars shown in Figure 5. These include incremental yield/food security [productivity]; increased income, conserves/saves water, soil fertility,

risk reduction [adaptation]; carbon reduction, nitrogen reduction, energy savings or conservation [mitigation]. A questionnaire with a list of the CSA technologies and practices listed in Table 5 was sent to the identified experts to rank the climate smartness of the CSA options using the climate smartness score. This score is based on a scale of 0 to 10 (where 0 represents no impact, 1 represents the lowest impact, and 10 represents the highest impact) on the smartness dimensions listed above. The expert ranking is based on the merit of the CSA technologies/practices. Table 5 reports the climate smartness score results.

Result of climate smartness score

Here, this Profile presents the result of the assessment of climate smartness of the identified CSA technologies and practices based on expert evaluation.

Sub-sector	Broad category	Specific technologies & practices	Productivity	Adaptation				Mitigation			CSS
			Incremental Yield / Food security	Increased Income	Conserves / saves water	Soil fertility	Risk reduction	Carbon reduction	Nitrogen reduction	Energy savings or conservation	
Crop production	Conservation agriculture	Minimum or zero-tillage	5	5	5	6	6	6	5	8	6
		Cover cropping	7	7	8	8	7	8	7	7	7
		Mulching	7	6	7	8	7	5	6	7	7
		Crop rotation	7	6	5	7	7	6	6	8	7
		Retention of crop residues on farmland	7	7	7	8	6	4	5	7	6
	Risk management	Intercropping	8	8	6	6	8	5	6	6	7
		Crop diversification	8	9	7	8	8	5	6	6	7
		Adopting mixed farming	9	8	6	9	8	5	6	5	7
		Crop insurance	4	5	3	2	8	2	2	3	4
	Improved seed varieties	Early maturing varieties	9	8	6	5	8	4	5	6	6
		Drought- and flood-resistant varieties	9	8	7	7	9	6	6	6	7
		Pest- and disease-resistant varieties	9	9	5	6	9	5	5	6	7
	Soil fertility management	Inorganic fertilizer	9	8	6	8	9	6	5	5	7
		Organic fertilizer	8	7	9	9	8	5	5	7	7
		Effective use of pesticide	7	7	6	6	7	5	5	5	6
		Effective use of herbicides	8	7	6	6	8	5	5	5	6
		Combine chemical with organic soil fertility improvement practices	8	8	8	8	8	5	4	6	7
	Water management	Irrigation	7	7	7	5	6	5	4	5	6
		Use of bonds and drainage	7	7	6	6	7	5	3	5	6
		Construction of contour and channels	7	7	6	6	6	5	4	5	6
	Intensification	Systems of Rice Intensification	9	8	7	6	6	5	5	5	6
	Other practices	Adjusting planting and harvesting date	8	7	5	4	5	4	3	4	5
		Planting of hedges	6	5	6	5	5	5	4	4	5
Livestock production (including poultry and aquaculture)	.	Improved housing (e.g., Heat resistant roofing materials)	7	7	6	5	6	4	4	4	5
		Use of nutrient-dense diets	7	7	4	4	6	4	5	5	5
		Feed/fodder conservation	8	7	5	4	5	4	3	5	5
		Provision of good quality water	8	8	8	5	6	5	4	6	6
		Improved medication/vaccination	8	8	5	5	6	5	5	6	6
		Feed formulation with locally sourced	7	6	5	4	4	4	4	4	5
		Using heat-resistant varieties	6	6	7	4	5	5	5	5	5
		Planting of tree as shade	6	6	6	5	5	6	5	7	6
Forestry and land use		Agroforestry	8	7	8	6	6	6	6	6	7
		Afforestation	7	7	6	6	7	6	6	6	6
Cross-cutting		Weather Based Crop Agro-Advisory	7	7	5	4	6	4	5	6	6
		Climate Information systems	7	6	6	4	6	5	5	6	6
		Use of improved cookstove	5	5	4	4	4	5	6	5	5

Note: CSS (Climate Smartness Score)

INSTITUTIONS AND POLICIES FOR CSA

Institutions

Several private, State, and federal institutions currently work on activities related to CSA in the State. Some development partners also promote CSA-related activities. The Ebonyi State Ministry of Agriculture and Natural Resources (EBSMANR) is responsible for formulating and executing agricultural policy, along with other climate-resilient projects and activities. The EBSMANR also supports the Federal Ministry of Agriculture and Rural Development (FMARD) in delivering federal support at the State level.

Further, international development partners have been identified in the CSA space. The State developed its climate change policy through a tripartite effort consisting of the Michigan State University (MSU)-led Feed the Future Nigeria Agricultural Policy Project (FtFNAPA), ActionAid Nigeria, and the Ebonyi State government through the Office of the Special Assistant to the Governor on Climate Change. Additionally, agricultural research faculties of higher education institutions (universities and colleges) and international research and development organizations have a footprint in CSA research activities in the State. Some important institutions involved in any CSA pillar with a footprint in Ebonyi State or at the federal level with implications for Ebonyi State include the Alex Ekwueme Federal University Ndufu-Alike, Nigeria, Ebonyi State University, Abakaliki, Federal College of Agriculture Ishiagu, Akanu Ibiam Federal Polytechnic Unwana, International Food Policy Research Institute, Michigan State University, USAID-funded Feed the Future Activities/Projects, World Bank-assisted projects, IFAD-supported projects and others.

CSA priorities, strategies, policies, plans, goals, and actions

As earlier noted, Ebonyi State has developed and launched a climate change policy and action plan for the agriculture sector. If carried out well, these initiatives could serve dual purposes as both adaptation and mitigation to climate change. Table 6 presents selected State- and National-level policies related to CSA activities.

Table . Key State and national level policies related to CSA activities in the State

Policy / Strategy / Action / Plan / Priorities / Goal	Period Active	Selected CSA-related elements relevant to the State	CSA pillar active			Status	
			P	A	M	In formulation	Currently implemented
Panel A: State Level							
Draft Ebonyi State agricultural policy (Ebonyi State Government, 2020a)	2020 – current	▪ Crop ➢ Support R&D as well as dissemination of climate-resilient and flood-tolerant varieties ➢ Use of early maturing varieties of crops in areas with below-average rainfall ➢ Sustainable water use practices and technologies (e.g., water harvesting and small-scale irrigation) ➢ Support agroecology and integrated farming ➢ Promote the use of agricultural risk insurance ➢ Promote mixed cropping and agricultural diversification to enhance adaptive capacity and resilience. ➢ Scale up agricultural practices that enhance the carbon storage capacity of lands (e.g., conservation agriculture and agroforestry) ➢ Promote the use of renewable energies to power agricultural processing mills and storage facilities in the State ➢ Promote research and enhanced capacity in climate information systems. ▪ Livestock ➢ Promote genetic improvement (early maturing, drought- and heat-tolerant, disease-resistant) of indigenous livestock breeds that are adapted to a changing climate ➢ Develop novel insurance products, in concert with financial services providers, for smallholder livestock farmers ➢ Facilitate production of improved feeds and regulate feed manufacturing practices ➢ Promote water availability and sustainable use practices and technologies ▪ Fishery ➢ Promote quality and sustainable fish-feeding ➢ Promote dissemination of weather and market information to fish farmers ➢ Promote insurance services for suppliers of fish and aquaculture farmers ➢ Encourage the use of improved and sustainable feeds ▪ Forestry ➢ Encourage responsible logging practices ➢ Encourage regeneration programs for the quick maturation of tree species ▪ Crop ➢ Promote initiatives/actions on the reduction of methane from rice paddies ➢ Create a program on soil nutrient management for farmers ➢ Development of active crop insurance and other risk management programs for farmers ➢ Provision of early warning information systems ➢ Introduce a program to scale up conservation agriculture ➢ Promote water management, irrigation and rainwater harvesting initiatives ➢ Promote agroforestry ➢ Support research for the improvement of climate-resilient crop varieties	✓ ✓	✓ ✓	✓ ✓	✓	

Climate Change Adaptation Action Plan for the Agriculture (CCAAPA) (Ebonyi State Government, 2020b)	2020 – current	▪ Livestock ➢ Intensification of crop-livestock production ➢ Production and proper management of fodder ➢ Sustainable production of breeds of endemic livestock ➢ Improving feed resource use efficiencies ➢ Proper choice of housing for livestock that is heat tolerant ➢ Improved water resources management ➢ Early warning systems for flood, drought, and disease outbreaks ➢ Develop novel insurance products ➢ Improved manure management ▪ Fishery ➢ Use of improved and sustainable feeds ➢ Use new diseases and preventive treatment methods ➢ Implementation of climate change awareness for the fisheries sector ➢ Develop initiatives for using renewable energy sources for fish-breeding and processing					
Panel B: National level							
2050 Long-Term Vision for Nigeria (LTV-2050) (Federal Ministry of Environment, 2021b)	2021 – current	▪ Conservation of water in irrigated rice farms ▪ Reduced methane fodders for livestock ▪ Low-input agriculture ▪ Introduction of carbon sequestration techniques and management ▪ R&D on carbon-efficient agricultural practices ▪ Utilization of solar, wind, and other eco-friendly energy sources in agricultural and fishing operations	✓	✓	✓	✓	
National Development Plan (NDP) (Federal Ministry of Finance Budget and National Planning, 2021)	2021 – current	▪ Enhance national agricultural output and decrease post-harvest losses ▪ Major programs on animal breeding and conservation,	✓	✓	✓		✓
Nigeria Economic Sustainability Plan (Budget Office of the Federation, 2020)	2020 – current	▪ Guarantee market and mitigate post-harvest losses ▪ Interest-free credit financing options small holder farmers ▪ Implement strategies to increase yield per hectare	✓	✓	✓		✓
Updated Nationally Determined Contribution (Federal Ministry of Environment, 2021a)	2021 – current	▪ Support for climate-smart agriculture ▪ Half of the farmland uses rice paddy fields with intermittent aeration. ▪ A 50% drop in the amount of crop waste that is burned by 2030 ▪ Better care for natural forests ▪ Increased forest protection ▪ Forest restoration	✓	✓	✓		✓
National Climate Change Policy (Federal Ministry of Environment, 2021c)	2021 – current	▪ Reduce the destruction and loss of forests. ▪ Use fuels other than wood for homes in rural areas. ▪ Increase the amount of carbon that is stored in agricultural soils. ▪ Promote agroforestry, reforestation, and afforestation.	✓	✓	✓		✓
National Rice Development Strategy II (Federal Ministry of Agriculture and Rural Development, 2020)	2020 – current	▪ Sustained production and improved access to quality seeds of improved rice varieties ▪ Sustainable increase in paddy production and storage ▪ Improve irrigation use ▪ Increase access and use of mechanization equipment and tools in rice production and processing ▪ Improve access to credit and use of financial services	✓	✓	✓		✓
National Action Plan on Gender and Climate Change for Nigeria (Federal Ministry of Environment, 2020b)	2020 – current	▪ Build and strengthen institutional understanding of gender and climate change ▪ Erect climate-resilient infrastructure ▪ Enhance local communities' participation in the forestry and agricultural sector					
National Agricultural Resilience Framework (FMARD, 2015)	2014 – current	▪ Expand access to drought-tolerant crops and livestock varieties ▪ Improve soil quality management system. ▪ Strengthen climate information systems. ▪ Develop enhanced resource management practices. ▪ Use irrigation and water collection systems more frequently. ▪ Develop efficient water management systems ▪ Increase planting of native vegetation cover ▪ Strengthen the capacity of federal institutions by designing and implementing climate-resilient development activities ▪ Promote climate-smart agricultural practices country-wide ▪ Encourage the application of on-farm digital technologies ▪ Providing digital capabilities to all agriculture initiatives to establish sustainable business models and possibilities ▪ Improved agricultural output Decreasing food waste ▪ Allowing farmers to access financial services, register land and cattle online, access detailed geographic and soil-related information	✓	✓	✓		✓
National Agricultural Technology and Innovation Policy (FMARD, 2022)	2022 – 2027	▪ Collating and digitizing relevant agricultural research content and carrying out joint research on agricultural productivity and exportation needs ▪ Promotion of sustainable land and water management practices ▪ Ensuring the timely provision of weather and climate information to farmers for crops, fisheries, and livestock production ▪ Building farmers' capacity on sustainable methods of water harvesting techniques for supplementary irrigation ▪ Promotion of greenhouse crops and vegetable production ▪ Setting up minimum standards for organic crops, fisheries, and livestock production in the country ▪ Promotion of organic crops, fisheries, and livestock production, and ▪ Supporting the establishment of Meteorological Stations in all FMARD State offices to have adequate and reliable data for forecasting purposes.	✓	✓	✓		✓
National Adaptation Strategy and Plan of Action on Climate Change for Nigeria (BNRCC and Federal Ministry of Environment, 2011)	2011 – current	▪ Adopt improved crops and livestock systems ▪ Improve climate information systems ▪ Strengthen financing and insurance services ▪ Strengthen extension services ▪ Enlarge food storage capacity ▪ Strengthen the capacity of federal institutions by designing and implementing climate-resilient development activities ▪ Promote climate-smart agricultural practices country-wide	✓	✓	✓		✓
National Policy on Drought and Desertification (Federal Ministry of Environment, 2018b)	2018 – current	▪ Improvements to current early warning systems ▪ Creating adequate awareness programs to increase understanding of climate and environmental issues ▪ Encourage appropriate land use practices that improve carbon dioxide sequestration		✓	✓		✓

Scaling up ongoing community CSA actions

Inadequate attention has been paid to community-level climate change adaptation actions in practice and the literature (Olabisi et al., 2020). However, as noted earlier, communities in the State have traditionally adapted their agriculture to climate change. The strategies and actions could be broadly classified as absorptive capacity, which implies a community's ability to cope with expected shocks (e.g., informal safety nets) (Olabisi et al., 2020) . Adaptive capacity and transformative capacities are low in the State. In the former case, one must be prepared to face future shocks (e.g., through cropping systems and livelihood diversifications). In contrast, the latter assumes the development of a novel system with the potential to lessen danger or exposure (e.g., institutional reforms in land tenure, financial markets, or cropping systems). Successful adaptation would likely include further adaptive and transformative actions; for instance, if flood patterns become increasingly uncertain, a community could choose to switch from cultivating in floodplains to a different type of cultivation regime (Olabisi et al., 2020).

In addition, the goal of scaled-up, community-driven adaptation initiatives requires attention to four factors related to the adaptation process. These factors include institutional arrangements, information and knowledge-sharing, capacity development, and finance. Mfitumukiza et al. (2020) discuss the approaches relevant to scale up local, community-based adaptation actions. Figure 6 provides details of the critical enabling factors relevant to the adaptation process necessary to scale up local or community-based adaptation actions and strategies and opportunities for learning (through monitoring and evaluation).

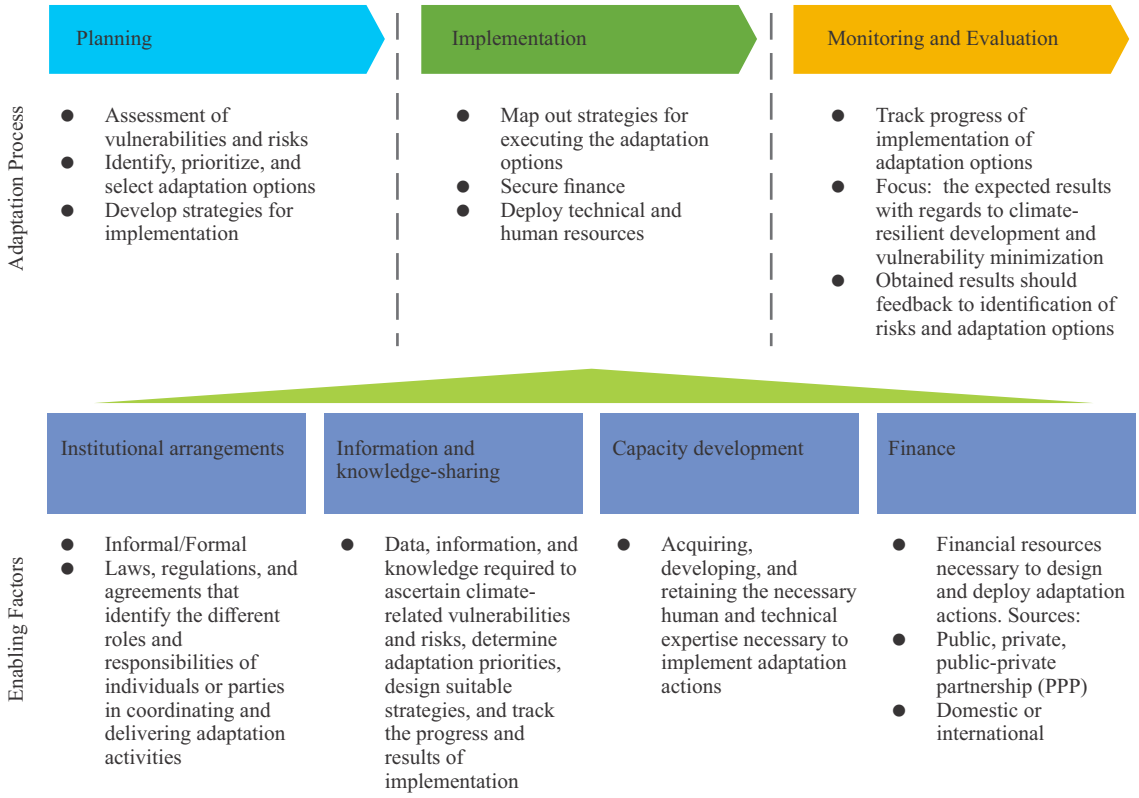


Figure 7. The adaptation process and its enabling factors
Source: Authors' diagram based on information from Mfitumukiza et al.

Financing CSA in Ebonyi State

Current financing landscape

Currently, no comprehensive assessment or support report as needed is available to implement all identified CSA technologies and practices in the State. Thus, this Profile contains information on the recent climate change financial flows in Ebonyi state sourced from desktop reviews. Domestic flows, which mostly come from the Ebonyi State government's budget, are separated from other types of flows, which come from outside the State. In contrast, the latter are funds obtained through collaboration with domestic and foreign partners.

Community-sponsored efforts

Several community-based adaptation (CBA) activities are common in the State across climate change-affected communities. Choko et al. (2019) document community-driven climate adaptation in six communities in Ebonyi State experiencing adverse climate change impacts, namely Akpoha, Ezzamgbo, Onueyim, Inyimagu, Nguzu–Edda, and Nkomoro. This exercise involves a qualitative participatory scenario analysis involving key community stakeholders, including farmers' groups, the king's cabinet, welfare groups, religious groups, and youth groups, among others. A noteworthy point here is that these stakeholders pool financial resources (either through contributory schemes or charity donations) to aid carry out CBA with minimal external support, albeit to varying degrees of effectiveness. The study broadly grouped the CBA practices into economic, structural, behavioral, social, environmental, legislative, religious, and technological categories. Concerning CSA, (i) the economic adaptation includes contributing funds to help victims to recover from climatic shocks; (ii) the structural adaptation includes providing physical structures such as on-farm earthen ponds and contour drainage systems; (iii) the social adaptation includes increasing awareness and educating farmers on how to adapt; (iv) the behavioral adaptation includes cultivating flood-resistant crops (e.g., rice) on floodplains (floodplain agriculture) and moving other crop and livestock production to non-flood-prone areas; (v) the environmental adaptation includes agroforestry practices; (v) technological adaptation includes technological advances, such as providing improved plant varieties and livestock breeds.

State government

Through its annual budgeting process, the State government has shown significant commitment to climate change action. The government allocated approximately ₦476 million, ₦397 million, and ₦112 million in 2019, 2020, and 2021, respectively, on climate change program in the State (Ebonyi State Government, 2021, p. 103). While the previous years' budgets provided broad allocation to climate change program, the 2022 budget specifically identified CSA financing through the expenditure item titled "Climate Resilient Sustainability Agriculture CRSA/Agric ecology", with a budget allocation of ₦10 million (Ebonyi State Government, 2022, p. 79).

There are limited direct connections between the State and bilateral and multilateral financing agencies supporting CSA. Nevertheless, donor-sponsored climate change response initiatives support the State's efforts to address climate change.

Complementary efforts

Improvements in rural livelihoods and food security are the focus of numerous recent agricultural support and CSA-related initiatives in Ebonyi State, many of which have been

supported by the World Bank, the United States Agency for International Development (USAID) funded Feed the Future Activities, and the International Fund for Agricultural Development (IFAD). Table 7 provides insight into selected donors and donor-assisted projects with deep presence and has provided financial support for agriculture and CSA-related activities in Ebonyi State.

Entity	Projects financed	CSA pillar		
		P	A	M
Nigeria Erosion and Watershed Management Project (NEWMAP)[1,2,3]	▪ Channelization and remediation works in flood sites ▪ Provision and installation of Greenhouse Equipment at Ebonyi State University ▪ Provision of solar-powered motorized boreholes to some communities in Ebonyi State ▪ Improved erosion risk mapping ▪ Reclamation of degraded lands ▪ Livelihood enhancement activities ▪ Cookstove distribution to households ▪ Stormwater management ▪ Provision of 995 household, and 23 institutional Clean and Efficient Energy Cookstove ▪ Provision of Waste Management Facility ▪ Provision of Customized Roadside Waste Bins ▪ Provision of Solar Powered Garri Processing Mill ▪ Provision and Installation of Weather Equipment, Laboratory Equipment and Green House to Ebonyi State University ▪ Provision of Waste Disposal Tricycles	✓	✓	✓
International Fund for Agricultural Development (IFAD) (VCDP)[4]	▪ Financing of rice and cassava crop post-harvest handing technology ▪ Provision of productivity-enhancing inputs for smallholder farmers engaged in rice and cassava production ▪ Infrastructure investment for increased market access for smallholder farmers ▪ Support for farmers' organizations (FOS) in the State ▪ Investment in value chain development program	✓	✓	
Feed the Future Nigeria Agribusiness Investment Activity[5]	The Activity focuses on improving the enabling environment for agricultural sector growth; broadening access to finance by mitigating the credit risks of agribusinesses; promoting and facilitating investment opportunities for agribusinesses to expand and scale up operations; and sustainably enhancing the performance of agribusiness micro, small and medium size enterprises	✓	✓	
Feed the Future Nigeria Agricultural Policy Project	▪ Support for research and policy efforts in Ebonyi State ➢ Climate change policy ➢ Climate change adaptation action plan for the agricultural sector ➢ Research on community-scale climate change adaptation research ➢ Using a participatory approach and scenario planning ▪ Support for the development of a CSA profile for Ebonyi State	✓	✓	✓
Actionaid International Nigeria	▪ Advocacy for including climate-resilient agriculture/agroecology investment projects in the State's annual budgeting process ▪ Support for climate change policy development	✓	✓	✓

Further, the Nigerian Federal Government has intensified efforts to finance climate change actions in the country and critical economic sectors that are climate-sensitive (e.g., agriculture) through its respective MDAs. Besides, the federal government can access critical global climate change action financing initiatives such as the Adaptation Fund, Global Environment Facility, and Green Climate Fund. Additionally, the federal government has raised capital for climate change action through the Green Bond facility (Moody's, 2019). Moreover, the federal government can raise (and has raised) critical financing for large-scale climate action in several States. This presents an opportunity for Ebonyi State to take advantage of potential global financing opportunities that have not been explored.

Potential finance

This Profile has identified the key CSA technologies and practices in the State's agricultural system. This Profile has also reported the prevalent adverse climate change impacts in the State. Given the agricultural sector's critical role in food security, employment, and overall State domestic value added in Ebonyi State and its high climate

change vulnerability, there is a need to foster technologies and practices that seek to boost resilience and rural livelihoods. Although the State may not have (sufficiently) accessed critical global climate change action financing initiatives such as the Adaptation Fund, Global Environment Facility, and Green Climate Fund, there is sufficient potential to obtain such financing as well as other donor support through appropriate packaging of an individual or a basket of CSA technologies and practices to make them sufficiently appealing to attract financing support.

There is inadequate local and federal financing for these CSA technologies and practices. This situation creates the need to seek external financial support (e.g., from the organized private sector and local and international development partners operating in Nigeria.) Recognizing the necessity of concerted efforts to combat climate change, the private sector has begun financing mitigation efforts (Federal Ministry of Environment, 2018a). Classifying agriculture as a business activity provides the opportunity for more private investment and fostering agricultural systems that can withstand extreme climate change impacts. The private sector has several advantages, such as organized structures, expertise, capital, and skilled human resources. It recognizes the value of agricultural systems that can withstand extreme climate change impacts and is prepared to invest accordingly.

The federal government (Federal Ministry of Environment, 2021c) launched the National Climate Change Policy (NCCP) for 2021-2030 in 2021. The NCCP outlines the country's stance on climate change, describes what it will take for Nigeria to become a climate-resilient economy, and outlines sector-specific actions that can be taken to mitigate the impact of climate change. There is also the 2021 Climate Change Act. This Act establishes Climate Change Fund (CCF) to finance climate actions in Nigeria[Climate Change Act 2021].

Mitigation efforts constitute a co-benefit in using the identified CSA technologies and practices. It is not actively pursued by farmers in the State, compared to the need for increased productivity and yield (and marginally, adaptation). However, there is an opportunity to formalize and foster this CSA pillar in the State. In August 2022, the Nigerian Federal Government launched its first Emissions Trading Scheme (ETS) (Department of Climate Change, 2022). In this incentive-based system, the government established an upper limit emission amount and grants permits or allowances for every unit that could be traded by individuals and businesses (UNFCCC, 2022). Thus, in this scheme, people can reduce their GHG emissions or willfully purchase/sell permits or allowances from the government, businesses, and individuals (PWC, 2022). This implies that emissions could be traded like commodities. This presents an opportunity to scale up mitigation activities in the agricultural sector and increase farmers' incomes if they adopt mitigation technologies and practices. Moreover, the farmers could increase their income through emissions trading and invest in resilient technologies while reducing carbon emissions. Further, the State government could intensify efforts to boost the technical capacity, enabling her to develop bankable projects that attract funding from global financing initiatives.

Moreover, these funding programs can benefit stakeholders in the agricultural and CSA space in Ebonyi State, which aim to design projects and programs to boost agricultural productivity, resilience, and mitigation.

SUMMARY
Agriculture is a significant contributor to Ebonyi's total State domestic product. Further, it employs a vast majority of the State's residents. A vital feature of the State's agricultural system depends on rainfed conditions. Smallholder farmers dominate the system. Farming systems are constrained by low input use (i.e., seedlings, fertilizer, and other critical agrochemicals). The State cultivates a wide variety of crops; it is a major rice and yam-producing and supplying State in Nigeria. Additionally, it produces maize, cocoyam, potatoes, beans, cassava, cowpea, groundnut, and oil palm, among others. It also produces vegetable crops such as okra, peppers, tomatoes, eggplant, and green leafy vegetables). The livestock produced include cattle, sheep, goat, pig, poultry, and rabbit farming. Aquaculture is also practiced in the State at different scales by micro, small and medium enterprises (MSMEs). However, there remains a vast gap between food demand and food supply. The agricultural systems are under strain to increasing food demand caused by population increase, constrained further by increased climate variability and change. Other critical constraints for the agricultural sector include low soil fertility, low access to finance, poor infrastructure, and poor market access. Despite these challenges, the State government has made efforts to strengthen the agricultural sector's resilience to climate change. A significant effort at the State level is developing a draft climate change policy with significant policy directions to foster climate-smart agriculture (CSA) across the crop, livestock, forestry, and fisheries sub-sectors. This is complemented by national-level policies, plans, and strategies with significant implications for State CSA activities. Further, under the complexities of a changing and varying climate, these policies, plans, and strategies are expected for sustainable development.

Various CSA technologies and practices in the State, such as conservation agriculture, crop diversification, and organic fertilizer, are common, and their use is primarily informed by factors such as ease of adoption and several co-benefits, which include increased yield or food security, income diversification, and increased adaptive capacity. There is also the need to boost mitigation efforts. Although finance has been a challenge at both local and national levels, the recent launch of the Nigeria ETS presents a considerable potential for actors in the agricultural value chains (farmers, firms, and State government) to boost mitigation efforts and earn money while doing so. Furthermore, the Federal Government Green Bond program also presents opportunities for the State to create bankable CSA projects to augment its efforts to finance its CSA ambitions. Additionally, the State government should leverage the private sector's expertise and capital by incentivizing investment activities through enabling environment.

REFERENCES

Abiodun, B. J., Salami, A. T. & Tadross, M. (2011). Climate Change Scenarios for Nigeria: Understanding Biophysical Impacts. Climate Systems Analysis Group, Cape Town, for Building Nigeria's Response to Climate Change Project. Ibadan, Nigeria: Nigerian Environmental Study/Action Team (NEST).

Aduo, B. C., & Nwadili, C. O. (2019). A survey of indigenous farming systems and practices in Ebonyi state Nigeria: In search of sustainable plant disease management options. Global Scientific Journal, 7(9), 184–190.

Agboeze, J., Nguku, P., Nwankwo, L., Okeke, L., & Ajumobi, O. (2014). Evaluation of Malaria Surveillance System in Ebonyi state, Nigeria. Annals of Medical and Health Sciences Research, 7, 101–104.

Ani, K. J., & Uwizeyimana, D.E. (2022). Climate Change and Environmental Conflicts in Nigeria: Focus on Farmer-Herder Crisis in Ebonyi State. African Journal of Peace and Conflict Studies (Formerly Ubuntu : Journal of Conflict and Social Transformation), 11(1), 7–22.

BNRCC and Federal Ministry of Environment (2011). National Adaptation Strategy and Plan of Action on Climate Change for Nigeria (NASPA-CCN). Building Nigeria's Response to Climate Change (BNRCC) and Nigerian Environmental Study.

Budget Office of the Federation. (2020). Bouncing Back: Nigeria Economic Sustainability Plan (NESP). https://www.budgetoffice.gov.ng/index.php/nigeria-economic-sustainability-plan

Chagnaud, G., Panthou, G., Vischel, T., & Lebel, T. (2022). A synthetic view of rainfall intensification in the West African Sahel. Environmental Research Letters, 17(4), 1–9.

Chidiebere-Mark, N., Ohajianya, D., Obasi, P., & Onyeagocha, S. (2019). Profitability of rice production in different production systems in Ebonyi State, Nigeria. Open Agricultur, 4, 237–246.

Choko, O. P., Schmitt Olabisi, L., Onyeneke, R. U., Chiemela, S. N., Liverpool-Tasie, L. S. O., & Rivers, L. (2019). A Resilience Approach to Community-Scale Climate Adaptation. Sustainability, 11(11), 3100. https://doi.org/10.3390/su11113100

Chukwuone, N. (2015). Analysis of Impact of Climate Change on Growth and Yield of Yam and Cassava and Adaptation Strategies by Farmers in Southern Nigeria. African Growth and Development Policy Modelling Consortium (AGRODEP) and International Food Policy Research Institute (IFPRI).
https://akademiya2063.org/publications/agrodep/EN/Working papers/Analysis of Impact of Climate Change on Growth and Yield of Yam and Cassava and Adaptation Strategies by Farmers in Southern Nigeria_2015_ENG.pdf

Department of Climate Change. (2022). Nigerian Governement Launches Emission Trading Scheme, ETS. https://climatechange.gov.ng/2022/08/24/nigerian-government-launches-emission-trading-scheme-ets/

Ebonyi State Government. (2020a). Draft Ebonyi State Agricultural Policy. Ebonyi State Government

Ebonyi State Government. (2020b). Draft Ebonyi State Climate Change Adaptation Action Plan for the Agriculture (CCAAPA). Ebonyi State Government.

Ebonyi State Government. (2021). Ebonyi State Government of Nigeria 2021 Revised Budget.
http://ebonyistate.gov.ng/Laws_and_Financials/resources/20211231075104858320 21_Revised_Budget.pdf

Ebonyi State Government. (2022). Government of Ebonyi State 2022 Proposed Budget. http://www.ebonyistate.gov.ng/Laws_and_Financials/resources/20220131112603303 0Proposed_2022.pdf

Emenekwe, C. C., Onyeneke, R. U., & Nwajiuba, C. U. (2022). Assessing the combined effects of temperature, precipitation, total ecological footprint, and carbon footprint on rice production in Nigeria: a dynamic ARDL simulations approach [Forthcoming]. Environmental Science and Pollution Research. https://doi.org/10.1007/s11356-022-21656-2

Enete, A. A., Madu, I. I., Mojekwu, J. C., Onyekuru, A. N., Onwubuya, E. A., & Eze, F. (2011). Indigenous Agricultural Adaptation to aClimate Change: Study of Southeast Nigeria. African Technology Policy Studies Network Research Paper No. 6.

Ezeh, A. N., & Eze, A. V. (2016). Farm-level adaptation measures to climate change and constraints among arable crop farmers in Ebonyi state of Nigeria. Agricultural Research Journal, 53(4), 492–500.

FAO. (2010). "Climate-Smart" Agriculture: Policies, Practices and Financing for Food Security, Adaptation and Mitigation. Food and Agriculture Organization of the United Nations.

Federal Ministry of Agriculture and Rural Development (2022). Resettlement Policy Framework (RPF): Final Revised Report. https://ead.gov.ng/wp-content/uploads/2022/02/RPF.pdf

Federal Ministry of Agriculture and Rural Development (2020). National Rice Development Strategy II: 2020-2030. Federal Ministry of Agriculture and Rural Development (FMARD).

Federal Ministry of Environment. (2018a). First Biennial Update Report (BUR1) of the Federal Republic of Nigeria. Department of Climate Change (DCC), Federal Ministry of Environment Nigeria.

Federal Ministry of Environment. (2018b). Nigeria National Drought Plan. https://www.unccd.int/sites/default/files/country_profile_documents/1%2520FINAL_NDP_Nigeria.pdf

Federal Ministry of Environment. (2020a). Third National Communication (TNC) of the

Federal Republic of Nigeria: under the United Nations Framework Convention on Climate Change (UNFCCC). Federal Ministry of Environment (FMEnv).

Federal Ministry of Environment. (2020b). National Action Plan on Gender and Climate Change for Nigeria. Department of Climate Change, Federal Ministry of Environment (DCC-FMEnv).

Federal Ministry of Environment. (2021a). Nigeria's Nationally Determined Contribution (NDC): 2021 Update Submitted to the United Nations Framework Convention on Climate Change (UNFCCC).

Federal Ministry of Environment. (2021b). 2050 Long-Term Vision for Nigeria (LTV-2050): Towards the Development of Nigeria's Long-Term Low Emissions Development Strategy (LT-LEDS). Department of Climate Change, Federal Ministry of Environment.

Federal Ministry of Environment. (2021c). National Climate Change Policy for Nigeria 2021–2030. https://climatechange.gov.ng/wp-content/uploads/2021/08/NCCP_NIGERIA_REVISED_2-JUNE-2021.pdf

Federal Ministry of Finance Budget and National Planning. (2021). National Development Plan (NDP) 2021-2025 Volume 1 (1st ed.).

FMARD. (2015). National Agricultural Resilience Framework: A Report by the Advisory Committee on Agricultural Resilience in Nigeria. Federal Ministry of Agriculture and Rural Development, Abuja, Nigeria.

FMARD. (2022). National Agricultural Technology and Innovation Policy (2022 - 2027). Federal Ministry of Agriculture and Rural Development, Abuja, Nigeria

Godson-Ibeji, C., Ibe, M., Chikaire, J., & Aminu, G. (2022). Effects of climate change on agro-pastoralists' economy and adaptation strategies used in Southeast, Nigeria. Ecology & Environmental Sciences, 7(1), 18–22.

Ifeanyichukwu, U. S., Ezeano, C. I., & Anozie, R. (2018). Climate change and Adaptation Coping Strategies among Sheep and Goat Farmers in Ivo Local Government Area of Ebonyi State, Nigeria. Sustainability, Agri, Food and Environmental Researc, 6(2), 50–68.
IPCC. (2014). Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (Core-Writing-Team, R. K. Pachauri, & L. Meyer (eds.)). Intergovernmental Panel on Climate Change (IPCC).

IPCC. (2019). Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems (P. R. Shukla, J. Skea, E. C. Buendia, V. Masson-Delmotte, H. O. Pörtner, D. C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold., J. P. Pereira, P. Vyas, E. Huntley, … J. Malle (eds.)). Intergovernmental Panel on Climate Change (IPCC).

Mfitumukiza, D., Roy, A. S., Simane, B., Hammill, A., Rahman, M. F., & Huq, S. (2020). Scaling local and community-based adaptation. Global Commission on Adaptation

Background Paper. https://gca.org/wp-content/uploads/2020/12/Local_Adaptation_Paper_-_Global_Commission_on_Adaptation.pdf

Moody's. (2019). Nigeria, Government of: Green Bond Assessment - May 2019 issuance. Moody's Investors Service.

NAERLS & FMARD. (2017). Agricultural Performance Survey of 2017 Wet Season in Nigeria: National Report. National Agricultural Extension and Research Liaison Services (NAERLS) and Federal Ministry of Agriculture and Rural Development (FMARD).

NAERLS & FMARD. (2018). Agricultural Performance Survey of 2018 Wet Season in Nigeria: National Report. National Agricultural Extension and Research Liaison Services (NAERLS) and Federal Ministry of Agriculture and Rural Development (FMARD).

NAERLS & FMARD. (2019). Agricultural Performance Survey of 2019 Wet Season in Nigeria: National Report. National Agricultural Extension and Research Liaison Services (NAERLS) and Federal Ministry of Agriculture and Rural Development (FMARD).

NAERLS & FMARD. (2020). 2020 Wet Season Agricultural Performance in Nigeria. National Agricultural Extension and Research Liaison Services (NAERLS) and Federal Ministry of Agriculture and Rural Development (FMARD). https://fscluster.org/sites/default/files/documents/aps_national_report_2020.pdf

NAERLS & FMARD. (2021). 2021 Wet Season Agricultural Performance in Nigeria. National Agricultural Extension and Research Liaison Services (NAERLS) and Federal Ministry of Agriculture and Rural Development (FMARD).

NAERLS & FMARD. (2022). 2022 Wet Season Agricultural Performance in Nigeria - Executive Summary. National Agricultural Extension and Research Liaison Services (NAERLS) and Federal Ministry of Agriculture and Rural Development (FMARD).

NBS (2015). National Nutrition and Health Survey 2015: Report on the Nutrition and Health Situation of Nigeria. Abuja, Nigeria: National Bureau of Statistics. Available at: https://www.unicef.org/nigeria/media/1521/file/Nigeria-national-nutrition-and-health-survey-2015.pdf.pdf.

NBS (2018). National Nutrition and Health Survey 2018: Report on the Nutrition and Health Situation of Nigeria. Abuja, Nigeria: National Bureau of Statistics.

NBS. (2019). States Nominal Gross Domestic Product (2013-2017): Phase II. http://www.nigerianstat.gov.ng/pdfuploads/State_Nominal_GDP_2013_-_2017.cdr_(MAY_2019).pdf

NEWMAP. (2015). Environmental and Social Management Plan (ESMP) for Odunukwe-Nkaliki Hatchery Road Flood site in Abakaliki, Ebonyi State. https://documents1.worldbank.org/curated/en/387211523542839839/pdf/Environmental-and-social-management-plan-for-Odunukwe-Nkaliki-Hatchery-road-flood-site-in-Abakaliki-Ebonyi-state.pdf

Nikolaisen, M., Nayak, D. R., Smith, P., Hilier, J., & Wollenberg, E. (2021). A global methane model for rice cropping systems. In CCAFS Working Paper No. 365. GIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).

Nwajiuba, C., Tambi, E. N., & Bangali, S. (2015). State of Knowledge on CSA in Africa: Case Studies from Nigeria, Cameroon and Democratic Republic of Congo. Forum for Agricultural Research in Africa (FARA). https://library.faraafrica.org/wp-content/uploads/2019/10/nigeria-cameroon-and-DRC-climate-final.pdf

Nwaobiala. C.U. (2010). Economic Analysis of Swamp Rice Production in Ebonyi Southern Agricultural Zone of Ebonyi State, Nigeria. Journal of Agriculture and Social Research (JASR), 10 (2), 135 – 141

Obiahu, O. H., Yan, Z., & Uchenna, U. B. (2021). Spatiotemporal analysis of land use land cover changes and built-up expansion projection in predominantly dystric nitosol of Ebonyi state, Southeastern, Nigeria. Environmental Challenges, 4, 100145. https://doi.org/https://doi.org/10.1016/j.envc.2021.100145

Ogbodo, E.N. (2013). Assessment and Management Strategies for the Receding Watersheds of Ebonyi State, Southeast Nigeria. Journal of Environment and Earth Science, 3(3), 18 – 26

Ogunleke, A. O., & Baiyegunhi, L. J. S. (2019). Effect of households' dietary knowledge on local (ofada) rice consumption in southwest Nigeria. Journal of Ethnic Foods, 6(1), 24. https://doi.org/10.1186/s42779-019-0023-5

Okereke, C., Okpani, N., Oroke, E., & Onwe, P. (2017). Promoting Rice Productivity in Ebonyi State: Linking Data and Policy. Innovation Lab for Food Security Policy. https://www.canr.msu.edu/fsp/countries/nigeria/Ebonyi State Policy Note 4.pdf

Okike, I. G. B. A., Ogundapo, A., Ojide, M., Abdoulaye, T., Dashiell, K., & Manyong, V. M. (2021). Nigeria Zero Hunger/IITA Policy Brief No. 2: Nigeria Zero Hunger Strategic Review – Nutritional Status of Children under the Age of 5 in Ebonyi State, Nigeria. Journal of Food Science and Nutrition, 7(116). https://doi.org/10.24966/FSN-1076/100116

Okonkwo, U. U., Ukaogo, V., Kenechukwu, D., Nwanshindu, V., & Okeagu, G. (2021). The politics of rice production in Nigeria: The Abakaliki example, 1942-2020. Cogent Arts & Humanities, 8(1), 1880680. https://doi.org/10.1080/23311983.2021.1880680

Olabisi, S. L., Onyeneke, R. U., Choko, O. P., Chiemela, S. N., Liverpool-Tasie, L. S. O., Achike, A. I., & Aiyeloja, A. A. (2020). Scenario Planning for Climate Adaptation in Agricultural Systems. Agriculture, 10 (7), 274. https://doi.org/10.3390/agriculture10070274

Onyeneke, R. U. (2021). Does climate change adaptation lead to increased productivity of rice production? Lessons from Ebonyi State, Nigeria. Renewable Agriculture and Food Systems, 36(1), 54–68.

Onyeneke, R. U., Amadi, M. U., Njoku, C. L., & Emenekwe, C. C. (2020). Empirical Trend

Analysis of Climate Variability in Ebonyi State, Nigeria. Nigerian Agricultural Journal, 51(1), 34–46.

Onyeneke, R. U., Amadi, M. U., Njoku, C. L., & Osuji, E. E. (2021). Climate Change Perception and Uptake of Climate-Smart Agriculture in Rice Production in Ebonyi State, Nigeria. Atmosphere, 12(11), 1503. https://doi.org/10.3390/atmos12111503

Onyeneke R.U., Amadi M.U., & Njoku C.L. (2022). Climate change adaptation strategies by rice processors in Ebonyi State, Nigeria. Ekológia (Bratislava), 41 (3), 283–290. DOI:10.2478/eko-2022-0029

Oselebe, H. O., Nnamani, C. V., Efisue, A., Onu, D., Eze, S. O., & Ogunji, J. O. (2016). Perceptions of climate change and variability, impacts and adaptation strategies by rice farmers in south east Nigeria. Our Nature, 14(1), 54–63. https://doi.org/10.3126/on.v14i1.16441

PWC. (2022). Nigeria's Climate Change Act: things to know and prepare for. https://www.pwc.com/ng/en/assets/pdf/nigeria-climate-change-act .pdf

Rahman, S., & Chima, C.D. (2018). Food Energy Availability from Agriculture at the Farm-Level in Southeastern Nigeria: Level, Composition and Determinants. Agriculture, 8(5), 69. https://doi.org/10.3390/agriculture8050069

Umeh, G. N., & Chukwu, V. A. (2016). Socioeconomic Perspectives to Arable Crop Farmer-Herder Conflicts in Ebonyi North Zone, Ebonyi State , Nigeria. International Journal of Science and Research, 5(5), 135–142.

Umeh, G. N., & Igwe, G. V. C. (2019). Adoption of Sustainable Agricultural Practices among Farmers in Ohaukwu Local Government Area of Ebonyi State, Nigeria. Agricultural Extension Journal, 3(4), 224–232.

Umeokonkwo, A. A., Ibekwe, M. U., Umeokonkwo, C. D., Okike, C. O., Ezeanosike, O. B., & Ibe, B. C. (2020). Nutritional status of school age children in Abakaliki metropolis, Ebonyi State, Nigeria. BMC Pediatrics, 20(1), 114. https://doi.org/10.1186/s12887-020-1994-5

UNFCCC. (2022). Emissions Trading. https://unfccc.int/process/the-kyoto-protocol/mechanisms/emissions-trading

EBONYI STATE
CLIMATE SMART AGRICULTURE
STAKEHOLDERS MEETINGS

The Ebonyi State Climate Smart Agriculture Profile is the outcome of evidence-based research and analysis made possible with support from the United States Agency for International Development (USAID) through the Feed the Future Nigeria Agriculture Policy Activity jointly implemented by Michigan State University (MSU) and the International Food Policy Research Institute (IFPRI).