



# CLIMATE CHANGE ADAPTATION ACTION PLAN FOR THE AGRICULTURE SECTOR IN EBONYI STATE



**act:onaid**

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His Excellency  
**Engr. David Nweze Umahi, Fdate, Fnse**  
Governor of Ebonyi State

**Climate Change  
Adaptation Action Plan  
for the Agriculture Sector  
in Ebonyi State**

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# List of Acronyms and Abbreviations

| <b>Acronym/Abbreviation</b> | <b>Description</b>                                    |
|-----------------------------|---|
| ADP                         | Agricultural Development Programme                    |
| AE.FUNAJ                    | Alex Ekwucme Federal University Ndufu-Alike           |
| AR5                         | Fifth Assessment Report                               |
| BNRCC                       | Building Nigeria's Response to Climate Change         |
| CCAP                        | Climate Change Adaptation Action Plan                 |
| Co <sub>2</sub>             | Carbon Dioxide  |
| CSO                         | Civil Society Organisation                            |
| OCM                         | General Circulation Models                            |
| GHG                         | Greenhouse Gas  |
| IPCC                        | Intergovernmental Panel on Climate Change             |
| MANR                        | Ministry of Agriculture and Natural Resources         |
| MEnv                        | Ministry of Environment                               |
| MOE                         | Ministry of Education                                 |
| MWR                         | Ministry of Water Resources                           |
| NGO                         | Non-Governmental Organizations                        |
| NIMET                       | Nigerian Meteorological Agency                        |
| RCPs                        | Representative Concentration Pathways                 |
| TNC                         | Third National Communication                          |
| UNFCCC                      | United Nations Framework Convention on Climate Change |
| USAID                       | United States Agency for International Development    |

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The opinions and data provided by these stakeholders greatly improved the contents of the Action Policy. Finally, the efforts and dedication of the staff members in the Office of Senior Special Assistant to the Governor of Ebonyi State on Climate Change are very well acknowledged.

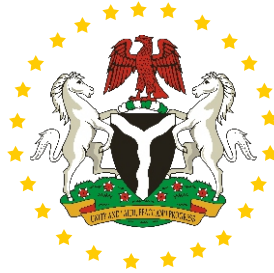


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## Foreword



# **EBONYI STATE GOVERNMENT OF NIGERIA SECRETARY TO THE STATE GOVERNMENT**

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## **EBONYI STATE CLIMATE CHANGE POLICY DOCUMENT AND ACTION PLAN ON AGRICULTURE**

### **Foreword by Secretary to Ebonyi State Government/Coordinating Commissioner:**

This report represents a major landmark in the effort of Ebonyi State Government to take a serious and structured approach in combating the menace of climate change in the state, as well as turn climate change into an opportunity to achieve sustainable low-carbon development.

Many will agree that the central purpose of any serious government is to help people meet their needs for secure and decent livelihood. It was the desire of Ebonyi State Government to play her own part in helping the people of Ebonyi State to attain better levels of development and reap the dividends of democracy that propelled His Excellency, Engr. Dr. David Nweze Umahi, FNSE, FNATE, to seek political office.

It has now become very obvious that climate change is a major threat to development all over the world and most especially to states like Ebonyi, where the vast majority of people are highly vulnerable to the impact of long term climate variability due mainly to the dependence on substance rain-fed agriculture, wide-scale poverty and weak adaptive capacity. In the past years, we have witnessed increased flooding and thought in the state among other climate impacts, all of which have affected lives and property and reduced crop yield. Large places across the state have become uninhabitable because they are either flooded frequently or get hardly any rainwater at all. Heavy waves have also become more regular in the state.

When we saw the increasing threat of climate change to the safety livelihood and development of the state, and the need for serious effort to address the problem, His Excellency moved quickly to create the Ebonyi State Climate Change Office and instructed the team, headed by Dr Obianuju Aloh, to work with the Ministry Environment, Ministry of Agriculture and other relevant stakeholders to come up with plans and initiatives to combat the menace and promote green and sustainable growth in Ebonyi State.

We also started to take meaningfully practical steps to combat the adverse effect of climate change. Thus, in this regard His Excellency embarked on the construction of a pulverization plant at Umuoghara, Ezza North Local Government Area, the biggest in Nigeria with the capacity to process 200 metric tons every day. His Excellency established a number of solar power panel that contributes a good fraction of the State's power supply, and he have procured Carbon Free Environment Friendly Tricycle which are already in use in our dear state. Under the Ebonyi Green Project, the governor directed that trees should be planted along all major roads and rural areas (especially those constructed under this administration). Worthy of note too, is the recent action of sending a bill to the State House of Assembly on Climate Change.

His Excellency also approved the drafting of Ebonyi State Climate Change Policy Document and Action plan on Agriculture because he believed that we need to have document(s) that will provide a strategic and a clear framework that can help Ebonyi State to take coordinated, structured and ambitious action on climate change. I am delighted that these reports have been completed. I believe that this will put Ebonyi among the few states in the Federal Republic of Nigeria that have developed a clear climate change policy.

I thank the lead Consultant for the project, Prof. Chuwumerije Okereke and his team for an excellent report, the international organizations that helped to fund the project and the Senior Special Assistant to the Governor on Climate Change, Dr. Obianuju Aloh, for her good leadership in the effort to complete the project.

I hereby request that all key stakeholders identified in the report, as having key roles to play in the efforts to address climate change, to study the report and come up with actionable plan on how we can work together to put Ebonyi State in the path of Climate Resilient and prosperous green economy in the interest of the present and future generations.



Dr. Kenneth Ugbala  
Secretary to the State Government/Coordinating Commissioner

# Climate Change Adaptation Action Plan for the Agriculture Sector in Ebonyi State

## 1. Introduction

This document sets out a Climate Change Adaptation Action Plan (CCAAP) for Ebonyi State. The Ebonyi State Government has developed a climate change policy that recognizes the huge impact that climate change poses to agriculture in the state and outlines a number of policy measures intended to tackle the challenge and build resilience in the sector. Agriculture is the most important source of livelihood for a great majority of the people of Ebonyi State, also the sector is one of the most vulnerable to climate change. It is therefore top priority to further elaborate a CCAAP that can offer a guide to manage the threat of climate change in the agricultural sector of the State.

There is growing evidence that climate change has become one of the most important developmental challenges confronting many states in Nigeria, including Ebonyi State. The impact of climate change is so severe that if not put on check is capable of stagnating the economic growth and development of the State. A study of some rural communities in the state shows increased incidence of floods, erosions, prolonged dry spells, irregular rainy seasons, heat waves, and wind storms [1], all of which characterize climate change.

Ebonyi State plays a vital role in agriculture in Nigeria as one of the major rice (the most important staple food for Nigeria) producing states. Many agricultural interventions in Nigeria have Ebonyi State as either a pilot state or a target beneficiary state, which goes to emphasize the importance of the state with regards to agricultural policy and planning in the country. In addition to being the main means of livelihood of a significant proportion of the inhabitants of Ebonyi State, agriculture offers significant opportunities for the state to realise its potentials of raising the standard of living, achieving sustainable structural transformations and achieving inclusive growth and development. With increasing impacts of climate change, it is obvious that if decisive and coordinated actions are not taken, the developmental plans of the state will be truncated and the potentials may fade away. There is therefore an urgent need for Ebonyi State to have a climate change adaptation strategy plan of action especially for the agricultural sector which must be religiously pursued and vigorously implemented and applied in order to salvage the large rural population that depend on agriculture and also ensure sustainable economic growth.

### 1.1. Geographical Background of Ebonyi State.

Ebonyi State is one of the States in southeast Nigeria and has an average annual rainfall of 1200-2000mm, which tends to favour rain-fed agricultural production [2]. In addition, the state is largely situated in the Cross-River plains with regular rainy-season flooding owing to inadequate drainage, stagnating rivers and ponds. The State has a tropical climate with high insolation and unimodal rainfall. The agricultural farming systems are broadly classified into upland (rain-fed), lowland (swamp) and irrigated lands. Upland (rain-fed) system is predominantly used while the irrigation method is the least practiced. Crop production supplies a variety of food, feed and biomass residue products and plays a key role in rural development. Both traditional and modern farming practices are practiced in the State. However, the traditional farming practices are more common; significant proportion of the farming population are small scale farmers operating at a subsistence level. Ebonyi State is located in the southeast geo-political zone of Nigeria and enjoys a

comparative advantage in many food and cash crops such as rice, cassava and yam [2]. Ebonyi State is among the key rice producing states in the country. Rice is widely cultivated across the three agro-ecological zones of the state, making it one of the most important staple food crops. The crop is also a significant source of income for rural farm households. The estimated land area cultivated for rice in the State in 2018 and 2019 were 1 26,700Ha and 133 ,730Ha, respectively with rice yield per ton increased from 2.12 ton/Ha in 2018 to 2.21 tons/Ha in 2019 [3]. The common cropping system consists of mixed cropping or intercropping system with a focus on root crops such as cassava, yam, cocoyam and maize and vegetables. Common agricultural activities in the State of Ebonyi include large dependence on rain-fed conditions, the use of organic matter soil improvements, use of basic tools for planting, planting on high and large soil mounds, bush burning and legume cultivation, etc.

The livestock sub-sector contributes significantly to rural livelihoods in Nigeria. Significant population of rural households in Ebonyi State are engaged in livestock production as part of their livelihood strategy. Livestock production is a source of employment and revenue in Ebonyi State. Additionally, livestock production serves as a productive asset to generate income, and an important contributor to food security strategies. The sub-sector also provides manure for crop production in the State. Livestock production in the State is carried out mainly in smallholder systems. Fish consumption is an essential nutritional factor and one of the sources of animal-based protein accessible to many Nigerians. In Ebonyi State, fish production is dominated by smallholder producers. Furthermore, the common fish production practices are aquaculture and artisanal fishing. Common species of fish are the Tilapia and Catfish (*Clarias*). The most widely grown fish species in the State is catfish; grown mainly in ponds and tanks. Cat fish constitutes the dominant species of aquaculture produced by tonnage in the State of Ebonyi as a result of techniques for raising fingerlings for *Clarias* species and their hybrids.

## **1.2. Objectives of the CCAAP**

The main objective of this CCAAP is to provide policy prescriptions toward climate change response in the agricultural sector in Ebonyi State. The specific objectives are to:

- review the current impacts of climate change in the agricultural sector
- discuss the connections between climate change and agriculture
- review the adaptation actions and strategies in place in the Agricultural sector.
- use inputs from above to develop and submit a climate change action plan for Ebonyi State.

This will inform an important part of the implementation of the Ebonyi State CCAAP.

## **1.3. Methodology**

A collaborative approach was employed to develop CCAAP for Agriculture.

First, an Ebonyi State Climate Policy and Action Plan for Agriculture team comprising the Special Assistant to the Governor on Climate Change, the consultants, academics and government officials was formed. This team had several meetings with the funding agencies to discuss the scope and objectives of the policy. Detailed outlines were then circulated and reviewed by the members of the team and by the funding organizations. An inception stakeholder workshop involving the Chairman of the Committee on Environment in the State House of Assembly, Non-Governmental Organizations (NGOs), directors of relevant agencies and representatives from all the local governments of the state was held. The inception meeting was used as an opportunity to administer a survey on several aspects of climate change to different stakeholders including relevant state

ministries, local governments, the private sector and NGOs. The survey yielded valuable information about climate threats that people are facing, on-going activities and suggestions on priority mitigation and adaptation actions. The Action Plan drafting also involved extensive literature review and analysis. The CCAAP for Agriculture adopted the table templates (all the tables contained in this Action Plan for Agriculture) provided in the Climate Change Adaptation Strategy Technical Report of the Building Nigeria's Response to Climate Change [4].

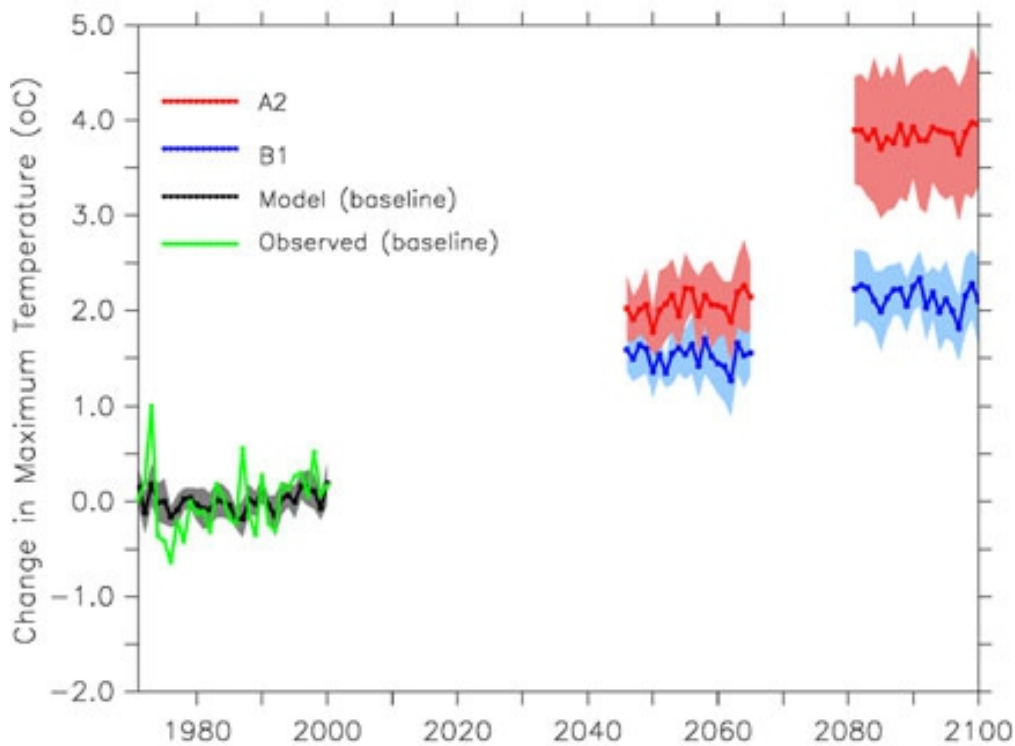
## **2. Expected Impacts of Climate Change on Agriculture in Ebonyi State**

Building Nigeria's Response to Climate Change (BNRCC) conducted a study on the future climate scenarios across Nigeria's major ecological zones [5]. The study analysed current and future climate trends in Nigeria by analysing historical records between 1971 and 2000 and future projections after 2046 [5]. The future climate projections were divided in two phases (2046 to 2065; 2081 to 2100) and were further downscaled to two scenarios (A2 and B1) using the nine General Circulation Models (GCMs). The A2 scenario assumes that future development will follow economic and regional considerations, while the B1 scenario assumes environmental and global considerations predominate [5].

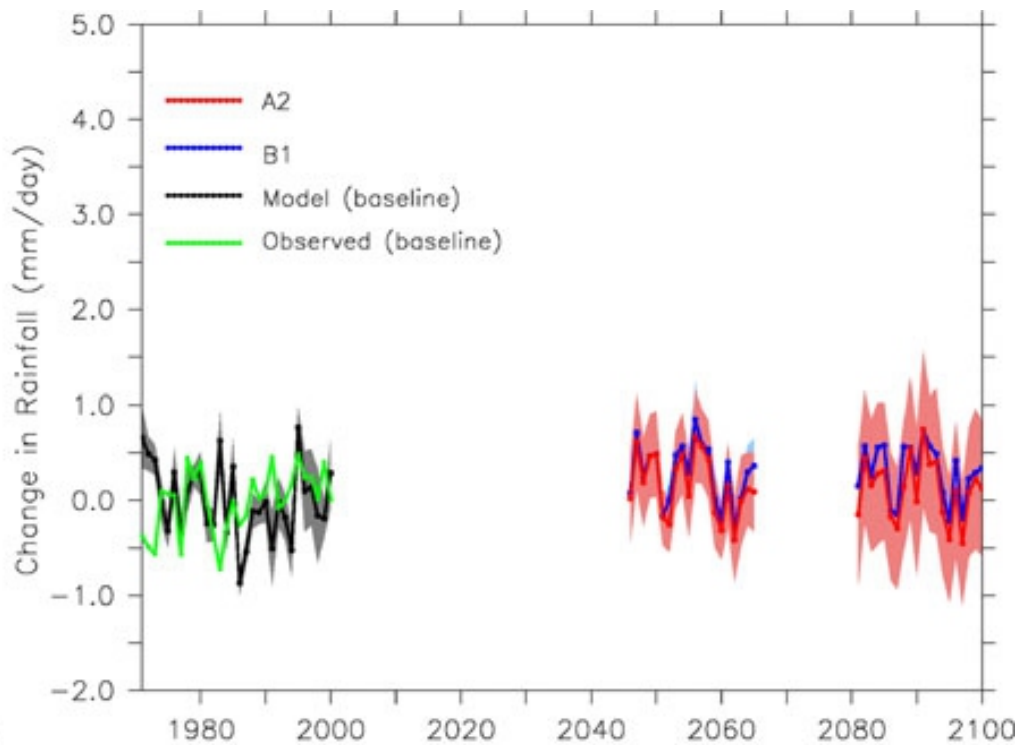
Ebonyi State is located predominantly in the derived savanna (approximately tall grass savanna) zone of Nigeria. The results from the BNRCC study indicate significant climate change hazards across Nigeria, compared with the base line period. The findings of the study in relation to the derived savanna ecological zone(s) are as follows [5]:

- Across the country, both A2 and B1 scenarios project that temperature will rise by 0.04°C and 0.02°C, respectively, per year from 2000 to 2100;
- Both scenarios project more rainfall of at least 0.2 mm/day in the southern zones of the country;
- Both scenarios project a prolonged time of the rainfall season (this implies earlier start and later stop) in the future, over the ecological zone.

Furthermore, both scenarios project a rise in the number of days of rain, a rise in days with extreme rainfall and flooding during 2046 to 2065 and 2081 to 2100 future periods, over most ecological zones.



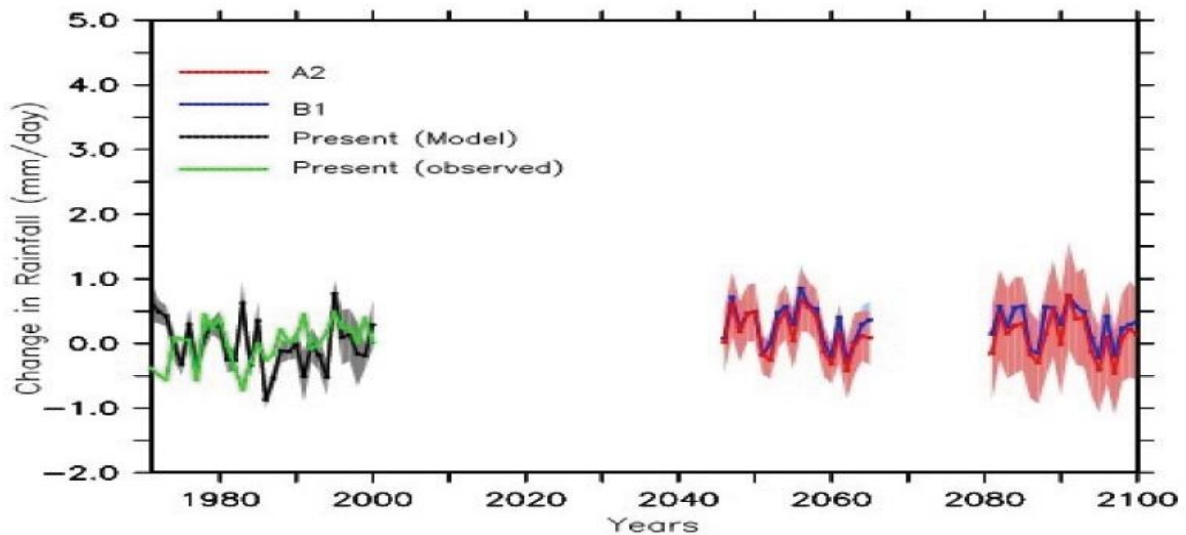
**Figure 1.** Historical (1960-1990) and projected mean annual precipitation (mm) over Nigeria for 2050- and 2070-time horizons for RCP 4.5 and 8.5. Source: Federal Ministry of Environment [3]



**Figure 2.** Time series of changes in maximum and minimum temperature for observed and future climate in Nigeria under B1 and A2 scenarios.

Note that observed values from the station are represented by dashed lines; the models' averages are represented by full lines, while the shaded areas represent the standard deviation away from the average [5]

Source: Abiodun, B. J., Salami, A. T. & Tadross, M. [5].



**Figure 2.** Time series of changes in rainfall (mm/day) for observed and future climate of Nigeria under B1 and A2 scenarios.

Note that observed values from the station are represented by dashed lines; the models' averages are represented by fill lines, while the shaded areas represent the standard deviation away from the average [5].

Source: Abiodun, B. J., Salami, A. T. & Tadross, M. [5].

Similarly, Nigeria's Third National Communication (TNC) of 2020 has modelled the expected impact of climate change using two Representative Concentration Pathways (RCPs)—high emission scenario (RCP 8.5) and medium emission scenario (RCP 4.5) [6]. Climate change projections were determined for mean year 2050 (i.e., 2041-2060) and mean year 2070 (i.e., 2061-2080) using historical spatial baseline data for temperature and precipitation [6]. The TNC results for both RCPs emission scenarios show an increase in mean annual precipitation and mean annual temperature across Nigeria.

The TNC reported likely variable increase in precipitation across the country up to 2070. However, the southern part of the country is projected to record more areas with high annual rainfall season of up to 3000mm/year [6]. Similarly, the mean annual temperature increase is projected to be less in the southern part of Nigeria, but in general all agroecological regions will likely experience overall increasing temperature [6]. These imply that Nigeria's climate is projected to be changing in the future and the results may not be favourable to the agricultural sector in Ebonyi State. For instance, projections based on both emission scenarios (RCP4.5 and RCP8.5) also show a drop in crop/agricultural yield or productivity by 7 percent (short run) and even up to 25 percent in the long-run (mean year 2070) [6].

## 2.1. Crop Sub-Sector

The large dependence of the crop production system on rain-fed conditions suggests the sub-sector is highly vulnerable to weather variability and climate change. Changes in average temperature and rainfall distribution, weather and climate extremes already have impacts on crop production and productivity in the State. Based on the species, these impacts can be positive or negative, and dependent on a number of factors, these impacts include, though not limited to, changes in agro-ecosystems (caused by loss of pollinators and increased occurrence of pests and diseases), physical impacts (caused by increasing

temperature, variations in rainfall patterns and atmospheric CO<sub>2</sub> concentration) and human adaptive actions [7]. On the other hand, crop production systems contribute to greenhouse gas (GHG) emissions which then contribute to global climate change. Temperature, rainfall and ambient concentration of CO<sub>2</sub> will have impacts on crop production. Climate projections indicate that in the future, the State, like most of southern Nigeria, will experience decreased rainfall and droughts, while a decline in crop productivity is expected for major food and cash crops [5]. Also, crop production contributes significantly to climate change. Paddy rice farms, for instance, emit methane which is a greenhouse gas. Improper use of nitrogen fertilizers also contributes to greenhouse gas emissions.

Climate change affects crop production (therefore, food security) as well as the agro-ecosystems they depend on, directly or indirectly. The direct effects may include phenological and calendar changes, land displacement and soil degradation, water and irrigation demand changes and direct effects of elevated CO<sub>2</sub> levels. Indirect impacts may include spikes in pests and disease, reduction in income of farmers, and loss of livelihood. These impacts pose serious threat to food security and the livelihood of farm households in the State. For developing economy like Nigeria where rain-fed agriculture is mainly practised, adverse climate change effects like negative rainfall variability reduces agricultural crop productivity, with subsequent impacts on the household consumption. Based on the foregoing narrative, climate change affect crop production, and in turn, affects crop product prices, quantity and quality. Crop production in Ebonyi State is severely impacted by flood. This has been reported in the 2018 and 2019 Agricultural Performance Surveys [3,8]. For instance, the 2018 Agricultural Performance Survey ranked the severity of impact of flooding on cassava production as “heavy” while the 2019 Agricultural Performance Survey put the severity of the damages by flood on crops and access roads at >25% [3,7]. Furthermore, in 2018, about 30 working days were lost in crop production sector in the State as a result of flooding and the estimated income loss was put at N7,500,000,000 [8]. The 2018 Agricultural Performance Survey also reported that flooding significantly affected crop area cultivated especially for crops such as yam, maize, cassava and rice [8].

In the near term, socio-economic factors such as population growth, evolving diets, development of biofuels, and variations in climate conditions are likely to influence, amongst many, food demands and fluctuations in food prices [9]. The magnitude and the susceptibility of the system (or population) that is under stress depend on the cause of stress [7]. The adverse effects of climate change on crop production system components are magnified or reduced based on their level of vulnerability and exposure. In addition, climate change impacts are compounded by the limited adaptive capacity of small-scale farmers due to a shortage of financial capital and human capacity [7].

## **2.2. Livestock Subsector**

Despite contributing to the local economy, the sub-sector is confronted by many issues. Technical issues facing the sub-sector in the state are variable fodder supply, poor feed quality, inadequate water supply, low yield of local breeds, flooding and depletion of rangelands. Flood is another major constraint to livestock production in Ebonyi State. Floods affect livestock production through the displacement of fodder and the loss of livestock in flood-prone areas [1,4]. Livestock production is largely sedentary; however, policy support is required to intensify production in order to boost the State's Agricultural Policy goal of sustaining the sub-sector's economic contributions while adapting to climate



change. The Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (ARS) notes that the vulnerability of livestock-producing communities will increase as climate change combines with other livestock sector stressors such as variable fodder supply, poor feed quality; inadequate water supply, low yield of local breeds, flooding and depletion of range lands [7]. The changing frequency of adverse climate events, such as droughts and flooding, has a detrimental effect on the sub-sector and the household livelihoods dependent on it [10]. It is expected that climate change will impact livestock at both species and breed levels [Ii]. A higher temperature and heat stress may adversely affect the rearing of livestock by increasing demand for water. Additionally, climate change may affect forage supply and quality through changes in herbage growth and quality, changes in the floristic composition of vegetation and changes in the value of crop residues as animal feed [11]. The consequences of these impacts for livestock producing households would be worsened by factors such as increasing population, low-income levels and low technological development among farmers in Ebonyi State. The prevailing low adaptive capacity among livestock producers may increase their vulnerability to climate shocks and impacts. Furthermore, in 2018, about 30 working days were lost in livestock production sector in the State as a result of flooding and the estimated income loss was put at N30,000,000 [8].

Also, a key issue facing livestock producing communities is the risk of losing their traditional and intergenerational livestock-based livelihoods. Some climate models project increasing rainfall in parts of southern Nigeria [5,6]. Increasing rainfall could negatively affect livestock production through increased disease pressure. In addition, increased rainfall may result in the destruction of livestock asset. Conversely, climate models predict overall increase in temperature in the country in the coming decades [5,6]. Livestock production may also be adversely affected due to increased water needs.

### **2.3. Fisheries**

While the greenhouse gas (GHG) emissions from fisheries and aquaculture are not high relative to other sectors, GHG emissions from fisheries can be minimized by enhancing fuel efficiency. During fish capture or development, collection, transport and storage, fisheries and aquaculture contribute to emissions of GHGs. However, there are several different types of fisheries with varying fuel requirements. Climate effects on fisheries and the livelihoods based on fisheries are rapidly growing. The immediate and indirect consequences include impacts on production, biodiversity and on the cost and productivity of fisheries and aquaculture and the communities dependent on them. The effect of climate is illustrated by acidification, water body temperatures and circulation patterns change, adverse events occurrence and intensity, and related changes in environmental conditions [12,13,14] Furthermore, fish feeding, migration and breeding behaviour are directly affected. Changes in their physical environments indirectly affect growth, mortality and reproduction. Rising temperature will lead to high acidity which eventually makes eventually increase vulnerability in fish development [13,14] This can worsen the food security and livelihoods of fish-producing households. Also, flooding affects fish production in Ebonyi State. The 2018 Agricultural Performance Survey reported a loss of 50 tonnes of fish from earthen ponds and 20 tonnes from concrete ponds across the State [8].

## **2.4. Highlights of the Existing Situation in the Various Sub-Sectors**

### **2.4.1. Crop**

Crop production in the state is facing adverse impacts from climate change-related hazards. These hazards include:

- Increasing temperature;
- High variability and intensity of rainfall; and
- Extreme climate events such as droughts and flooding.
- Furthermore, climate change-related events affect the crop production sub-sector in a different way in the state. These effects may include:
  - Crop loss due to high heat conditions
  - Incidence of pest and disease incidence
  - Leaching and loss of soil fertility
  - Withering
  - Scorching of crops
  - Change in fruit colour/architecture of crops
- Crop production in the State is highly vulnerable to climate change impacts because of farmers limited adaptive capacity, the sensitivity of crop production systems to the vagaries of climate and exposure of the sector to climate stressors. These could be the drivers of vulnerability in the crop sub-sector:
  - High incidence of poverty
  - Reliance on rain-fed conditions
  - Reliance on crop production for livelihoods
  - High cost of drainage and irrigation
  - High cost of leaving fallow areas prone to river surges
  - Major crops are unable to protect the soil from intense rainfall effects
  - Crop production on low-lying plains
  - Limited access to modern weather forecasting and climate change information

### **2.4.2. Livestock**

Livestock production in the state is facing adverse impacts from climate change-related hazards. These hazards include:

- Increasing temperature;
- High variability and intensity of rainfall; and
- Extreme climate events such as droughts and flooding.
- Furthermore, climate change-related events affect the livestock production sub-sector in different way in the state. These effects may include:
  - Higher rate of respiration by animals
  - Lower productivity and reproductive capability
  - High risk of stress and death of animals, leading to loss of sources of food and income by farmers
  - Extreme drought causes loss of pasture for livestock
  - Floods result in loss of livestock assets near river banks or which are under free range
  - Loss of livestock income
- Livestock production in the State is highly vulnerable to climate change impacts because of communities' limited adaptive capacity. These could be the drivers of vulnerability in the livestock sub-sector:
  - High incidence of poverty
  - Reliance on rain-fed conditions
  - Reliance on livestock production for livelihoods

- Limited access to modern weather forecasting and climate change information

### **2.4.3. Fisheries**

Fish production in the state is facing adverse impacts from climate change-related hazards. These hazards include:

- Increasing temperature;
- High variability and intensity of rainfall; and
- Extreme climate events such as droughts and flooding.

Furthermore, climate change-related events affect fish production sub-sector in different ways in the state. These effects may include:

- Loss in fish population due to high oxygen demand;
- Loss of food and income to farmers;
- Loss of sources of livelihood;
- Lower water level in reservoirs; and
- Reduced groundwater available for fish culture.
- The fisheries sub-sector in the State is highly vulnerable to climate change impacts because of farmer's limited adaptive capacity.

These could be the drivers of vulnerability in the fisheries sub-sector:

- Limited contacts with Extension Officers;
- High poverty levels;
- Limited capacity/knowledge to employ traditional technologies to manage fish resources; and
- Pervasive poverty.
- Existing Climate Change Adaptation Actions in the Sector

## **2.5. Opportunities for climate adaptation in the agricultural sector**

### **2.5.1. Crop**

There are significant opportunities for climate adaptation for some agricultural practices among farmers in the state. Despite their limited adaptive capacity, smallholder crop farmers have used several measures to adapt to adverse climate change impacts. Historically, many farming communities have been met with extreme environmental changes, and have tested, experimented and adopted multiple crop production management and adaptation strategies. Some of the important adaptation practices in the State are as follows:

- Selection and growing of improved crop varieties
- Growing of crops in midst of alley crops or trees to provide shade
- Irrigation
- Low/minimum tillage
- Adjusting planting dates
- Planting on mounds
- Digging ridges across slopes
- Early harvesting before flood season
- Cultivating cover crops to check erosion
- Planting different crops
- Good agricultural practices
- Crop rotation

Table 1 presents a detailed breakdown of climate change hazards, impacts, sources of vulnerability as well as adaptation practiced by crop farmers, in matrix form.<sup>5,8</sup>

### **2.5.2. Livestock**

Livestock farmers, over time, have adopted practices to help adapt to changing climate. In Ebonyi State, in response to changing climate, farmers tend to use hybrids of some livestock species and vaccination. Despite their limited adaptive capacity, smallholder livestock farmers have used several measures to adapt to adverse climate change impacts. Historically, as is the case with crop farming, many livestock farming communities have experienced extreme environmental changes, and have tested, experimented and adopted multiple livestock production management and adaptation strategies. Some of the important adaptation practices in the State are as follows:

- Rearing of livestock in pens and paddocks under shade
- Breeding of improved livestock breeds
- Rainwater harvesting
- Digging of boreholes
- Intensive livestock management
- Keeping livestock in pens and paddocks lowers losses and deaths due to floods
- Outward migration

Table 2 presents a detailed breakdown of climate change hazards, impacts, sources of vulnerability as well as adaptation practiced by livestock farmers, in matrix form. However, an effective policy environment is required to foster livestock sub-sector's adaptation to climate related hazards and vulnerability.

### **2.5.3. Fisheries**

Despite their limited adaptive capacity, smallholder fish farmers have used several measures to adapt to adverse climate change impacts. Historically, many fish farming communities have been met with extreme environmental changes, and have tested, experimented and adopted multiple fish production management and adaptation strategies. Some of the important adaptation practices in the State are as follows:

- Replenishing fish ponds with fresh cold water drawn from reservoirs, earthen ponds and lakes; and
- Switch to aquaculture in areas experiencing a drop in fish and water resources

Table 3 presents a detailed breakdown of climate change hazards, impacts, sources of vulnerability as well as adaptation practiced in the fisheries sub-sector, in matrix form.

**Table 1. Hazards- Impact-Vulnerability-Adaptation Matrix in the Crop Sub-Sector**

| <b>Subsector: Crop</b>                    |   |  |  |
|---|---|--|--|
| <b>Climate change Hazards/stressors</b>   | <b>Climate change Impact</b>  | <b>Determinants of vulnerability</b>   | <b>Climate change adaptation options correctly practice</b>  |
| Increasing temperature                    | <ul style="list-style-type: none"> <li>• Higher moisture demand by crops</li> <li>• Higher costs of irrigation and irrigation water</li> <li>• Decrease in crop yield</li> <li>• Crop loss due to high heat conditions especially for sensitive crops</li> <li>• Upsurge in pest and disease incidence</li> <li>• Reduced seed sprouting</li> <li>• Higher evapotranspiration</li> <li>• Shrinking/withering</li> <li>• Change in fruit colour/architecture of crops</li> </ul> | <ul style="list-style-type: none"> <li>• Poverty</li> <li>• Reliance on crop production for livelihoods</li> </ul>   | <ul style="list-style-type: none"> <li>• Selection and growing of temperature-, drought-tolerant crops</li> <li>• Growing of crops in midst of alley crops or trees to provide shade/tendrils</li> <li>• Irrigation farming</li> <li>• Growing disease-resistant crops</li> <li>• Low/minimum tillage</li> </ul> |
| Extreme rainfall events-storms and floods | <ul style="list-style-type: none"> <li>• Loss of farmland</li> <li>• High flood incidences in lower lying terrains eg., swamp, sometimes eroding crops</li> </ul>   | <ul style="list-style-type: none"> <li>• High incidence of poverty</li> <li>• High cost of drainage and irrigation High cost of leaving fallow areas prone to river surges</li> </ul>  | <ul style="list-style-type: none"> <li>• Planting of early maturing crops</li> <li>• Early harvesting before flood season</li> <li>• Cultivating cover crops to check erosion</li> </ul>   |
| Increasing rainfall variability           | <ul style="list-style-type: none"> <li>• Upsurge in pest and disease incidence</li> <li>• Leaching and loss of soil fertility</li> </ul>  | <ul style="list-style-type: none"> <li>• High incidence of poverty</li> <li>• Reliance on crop production for livelihoods Low penetration of modern weather forecasting</li> <li>• Major crops are unable to protect the soil from intense rainfall effects</li> </ul> | <ul style="list-style-type: none"> <li>• Making higher mounds</li> <li>• Cultivating water-tolerant varieties</li> <li>• Making ridges along farm boundary</li> <li>• Outward migration</li> <li>• Farmlands/river shore protection</li> </ul>   |
| Increasing/decreasing-rainfall volume     | <ul style="list-style-type: none"> <li>• Increased variability in crop yield and production</li> <li>• Causes spills of rivers and streams to farm lands leading to flooding and submerging of</li> </ul>   | <ul style="list-style-type: none"> <li>• High incidence of poverty</li> <li>• Crop production on low-lying plains</li> <li>• Reliance on rain-</li> </ul>  | <ul style="list-style-type: none"> <li>• Conversion of watersheds and riverine farm belts to flood tolerant crops like rice</li> <li>• Shoreline protection using sand bags</li> <li>• Outward migration</li> </ul>  |

**Table 2. Hazards- Impact-Vulnerability-Adaptation Matrix in the Livestock Sub-Sector**

| <b>Subsector: Crop</b>                    |  |  |   |
|---|--|--|---|
| <b>Climate change Hazards/stressors</b>   | <b>Climate change Impact</b>   | <b>Determinants of vulnerability</b>   | <b>Climate change adaptation options correctly practice</b>   |
| Increasing temperature                    | <ul style="list-style-type: none"> <li>• Higher rate of respiration by animals</li> <li>• Lower productivity and reproductive capability</li> <li>• High risk of stress and death of animals, leading to loss of sources of food and income by farmers</li> <li>• Increased cost of animal housing and cooling requirements</li> </ul> | <ul style="list-style-type: none"> <li>• Poverty</li> <li>• Limited alternative sources of livelihood</li> </ul>                                 | <ul style="list-style-type: none"> <li>• Breeding of livestock in pens and paddocks under shade</li> <li>• Breeding of temperature tolerant livestock species like muturu (local breeds)</li> <li>• Rainwater harvesting</li> <li>• Digging of boreholes</li> <li>• Intensive livestock management</li> </ul> |
| Extreme rainfall events-storms and floods | <ul style="list-style-type: none"> <li>• Extreme temperature events cause loss of pasture/rangeland through scorching of odder crops</li> <li>• Floods result in loss of cattle and other livestock tethered near river banks or which are under free range</li> <li>• Loss of income</li> </ul>                                       | <ul style="list-style-type: none"> <li>• High incidence of poverty</li> <li>• Large dependence on livestock production for livelihood</li> </ul> | <ul style="list-style-type: none"> <li>• Keeping livestock in pens and paddocks lowers losses and deaths due to floods</li> <li>• Outward migration</li> </ul>  |
| Increasing rainfall variability           | <ul style="list-style-type: none"> <li>• Higher disease and pest attack on animals (e.g. by tse-tse flies; ticks, fleas, which breed profusely under intense rainfall)</li> <li>• High loss of food and income by farmers due to high livestock mortality from disease and pests attack</li> </ul>                                     | <ul style="list-style-type: none"> <li>• Poverty</li> <li>• Large dependence on livestock production for livelihood</li> </ul>                   | <ul style="list-style-type: none"> <li>• Mass vaccination of livestock</li> <li>• Outward migration</li> <li>• Quarantine of sick animals</li> <li>• Treating sick animals with traditional medicine</li> </ul>   |
| Increasing/decreasing-rainfall volume     | <ul style="list-style-type: none"> <li>• Agro-ecological changes and ecosystem shifts which lead to:</li> <li>• Alteration of fodder quality and availability</li> <li>• Increased incidence of emerging diseases</li> <li>• Increased resource prices (e.g._feed)</li> </ul>  | <ul style="list-style-type: none"> <li>• Poverty</li> <li>• Large dependence on livestock production for livelihood</li> </ul>                   |   |

**Table 3. Hazards- Impact-Vulnerability-Adaptation Matrix in the Fisheries Sub-Sector**

| <b>Subsector: Crop</b>                      |   |  |  |
|---|---|--|--|
| <b>Climate change Hazards/stressors</b>     | <b>Climate change Impact</b>  | <b>Determinants of vulnerability</b>   | <b>Climate change adaptation options correctly practice</b>  |
| Increasing temperature                      | <ul style="list-style-type: none"> <li>• Loss in fish population due to high oxygen demand</li> <li>• Loss of food and income to farmers</li> <li>• Loss of sources of livelihood</li> <li>• Lower water level in reservoirs</li> <li>• Reduced groundwater available for fish culture</li> <li>• Reduction of fisheries resources due to habitat loss</li> </ul> | <ul style="list-style-type: none"> <li>• High poverty levels</li> <li>• Limited contacts with Fish Extension Officers</li> <li>• Limited capacity/knowledge to employ traditional technologies to manage fish resources</li> </ul> | <ul style="list-style-type: none"> <li>• Replenishing fish ponds with fresh cold water drawn from reservoirs, earthen ponds and lakes</li> <li>• Switch to aquaculture in areas experiencing drop in fish and water resources</li> </ul> |
| Extreme rainfall events - storms and floods | <ul style="list-style-type: none"> <li>• High incidence of fish mortality from flood or droughts</li> </ul>   |  | <ul style="list-style-type: none"> <li>• Use of earthen ponds, concrete ponds in fish rearing and harvesting</li> </ul>  |
| Increasing rainfall variability             | <ul style="list-style-type: none"> <li>• Loss in fish population due to over-flooding of rivers and streams</li> </ul>  |  | <ul style="list-style-type: none"> <li>• Drainage and replacement of fish ponds with fresh water routinely to safe guard lives of fish</li> <li>• Fishing downstream during occasions of intense rainfall</li> </ul>                     |
| Increasing/decreasing-rainfall volume       | <ul style="list-style-type: none"> <li>• Lower harvestable fish and fish resources due to flood or drought</li> </ul>   |  | <ul style="list-style-type: none"> <li>• Use of earthen ponds and concrete platforms in fish production to control flood and drought</li> </ul>  |

## **2.6. Gender considerations and interactions in the sector**

Food nutrition and security outcomes are worsened by climate change. The impact is felt more by vulnerable groups including women and children. It also increases the likelihood of outward migration by men and youths. The implication of this outward migration is that there is an equivalent loss of family supplied farm labour and potential food shortages. Like the rest of Nigeria, women in Ebonyi State are comparatively more vulnerable to climate change than men due to lower adaptive capacity. Relatively lower adaptive capacity among women is linked to factors such as their limited ownership and access to land use in communities and restricting traditional roles of home care responsibilities assigned to women than economic responsibilities.

## **2.7. Recommended Adaptation Strategies, Policies, Programmes and Measures in the Various Sub-Sectors in Ebonyi State**

### **2.7.1. Crop Sector**

Recommended roles for the State and Local government

- Facilitate the development and implementation of new agronomical interventions
- Provide technical assistance/support for investors through extension services;
- Facilitate the introduction of buy-back programme to smallholder/commercial farmers;
- Develop infrastructure such as road, water and other basic amenities within the farm estates/settlements as a panacea to attract youth and other investors;
- Strengthen extension services to effectively promote primary production of crop produce;
- Develop effective and acceptable legal framework land matters to ensure easy access to lands for crop production;
- Promotion of appropriate farm mechanisation;
- Provision of enterprise-specific rural infrastructure;
- Collaborate with the Nigerian Meteorological Agency to improve the dissemination of early warning information and climate-based advisory services to farmers.
- Recommended roles for the NGOs, CSOs, academics and private sector
- Facilitate linkages to secure financial support for promoting climate-resilient agriculture;
- Actively promoting research on all areas of crops production; and
- Agricultural mechanisation
- Pilot the use of small
- Recommended roles for the communities
- Mobilizing crop farmers into cooperative associations;
- Collaboration on data gathering at the community level.

An overview of the recommended policies, programmes, adaptation measures discussed and the implementing organization is given in Table 4. Similarly, an evaluation of the proposed programmes relating to the crop sub-sector is presented in Table 5.



**Table 4. Recommended Policies, Programmes, Adaptation and Mitigation Strategies to be Addressed and Actor/Stakeholder to be responsible for implementation in the Crop Sub-sector**

| Recommended/Suggested Policy/<br>Action/Programme   | Climate Change Adaptation Options to be addressed by Proposed Policy/Action/Programme  | Climate Change Mitigation Options to be addressed by Proposed Policy/Programme/Action   | Actor/Stakeholder to be responsible for implementation   |
|---|--|---|--|
| Create State programme on large-scale adoption of climate-smart agriculture (CSA)   | <ul style="list-style-type: none"> <li>• CSA pilot demonstration farm project at AEFUNAI, CSA village (upon success of the pilot project)</li> </ul>   | <ul style="list-style-type: none"> <li>• CSA pilot demonstration farm project at AEFUNAI, CSA village (upon success of the pilot project)</li> </ul>  | <ul style="list-style-type: none"> <li>• Donor agencies (i.e., Feed the Future Agriculture Project, ActionAid, USAID, etc.)</li> <li>• MANR</li> <li>• MEnv</li> <li>• NGO</li> <li>• Communities</li> </ul> |
| <ul style="list-style-type: none"> <li>• Promote initiatives/actions on reduction of methane from rice paddies</li> </ul> | <ul style="list-style-type: none"> <li>• Alternate wet and dry rice management system</li> <li>• Adjusting the timing of organic residue additions</li> </ul>  | <ul style="list-style-type: none"> <li>• Alternate wet and dry rice management system</li> <li>• Rice cultivars with low exudation rates</li> <li>• Keeping the soil dry and avoiding waterlogging during off-season</li> <li>• Adjusting the timing of organic residue additions</li> </ul>  | <ul style="list-style-type: none"> <li>• Donor agencies (i.e., Feed the Future Agriculture Project, ActionAid, USAID, etc.)</li> <li>• MANR</li> <li>• MEnv</li> <li>• NGO</li> <li>• Communities</li> </ul> |
| <ul style="list-style-type: none"> <li>• Create programme on soil nutrient management for farmers</li> </ul>              | <ul style="list-style-type: none"> <li>• Precision application of inorganic fertilizers to crops; placing the fertilizer more precisely into the soil to make it more accessible to crops roots</li> <li>• Support farmers with soil testing equipment</li> <li>• Carry out soil fertility mapping of the state</li> </ul> | <ul style="list-style-type: none"> <li>• Precision application of inorganic fertilizers to crops; placing the fertilizer more precisely into the soil to make it more accessible to crops roots</li> <li>• Using slow-release fertilizer forms or nitrification inhibitors</li> <li>• Avoiding excess fertilizer applications</li> <li>• Non-use of nitrogen</li> </ul> | <ul style="list-style-type: none"> <li>• MANR</li> <li>• Donor agencies</li> <li>• Faculty of Agriculture,</li> <li>• AE-FUNAI</li> <li>• NGOs</li> </ul>  |

|   |   |   |  |
|---|---|---|--|
| <ul style="list-style-type: none"> <li>Regular workshops and media disseminations at the LGA and community levels to encourage adoption of crop development and improved farming practices</li> </ul> | <ul style="list-style-type: none"> <li>Using improved crop varieties</li> <li>Extending crop rotations with perennial crops</li> <li>Reducing use of unplanted fallow</li> <li>Crop rotation with legume crops</li> <li>Cultivating vegetative cover crops</li> </ul>   | <ul style="list-style-type: none"> <li>Using improved crop varieties</li> <li>Extending crop rotations with perennial crops</li> <li>Reducing use of unplanted fallow</li> <li>Crop rotation with legume crops</li> <li>Cultivating vegetative cover crops</li> </ul> | <ul style="list-style-type: none"> <li>MANR</li> <li>Research institutions</li> <li>Media</li> <li>NGOs</li> </ul>                           |
| <ul style="list-style-type: none"> <li>Development of active crop insurance and other risk management programmes for farmers at the grassroots</li> </ul>   | <ul style="list-style-type: none"> <li>Diversify, source of household income</li> <li>Strengthen self-help groups</li> <li>Establish weather/meteorological stations</li> <li>Develop private insurance to reduce climate-related risks</li> <li>Participate in income stabilization programs</li> <li>Planting on higher and larger mounds and ridges</li> </ul> |   | <ul style="list-style-type: none"> <li>NIMET</li> <li>MANR</li> <li>Insurance corporations</li> <li>Civil Society Groups</li> </ul>          |
| <ul style="list-style-type: none"> <li>Provision of early warning information systems</li> </ul>  | <ul style="list-style-type: none"> <li>Provide early warning systems for climate change related variables of rainfall, drought, floods, and disease outbreaks</li> <li>Planting more water-efficient or drought-tolerant crop varieties</li> <li>Promote the dissemination of improved weather forecasts</li> </ul>   |   | <ul style="list-style-type: none"> <li>NIMET</li> <li>MANRJADP</li> <li>Menv</li> <li>NGOs</li> <li>Radio and Television Stations</li> </ul> |
| <ul style="list-style-type: none"> <li>Introduce programme to scale up conservation agriculture</li> </ul>  | <ul style="list-style-type: none"> <li>Encourage crop rotations, preferably with perennial crops</li> <li>Promote rotations or inter-cropping with</li> </ul>   | <ul style="list-style-type: none"> <li>Encourage crop rotations, preferably with perennial crops</li> <li>Promote</li> </ul>  | <ul style="list-style-type: none"> <li>MANR</li> <li>NCOS</li> <li>Research Institute</li> </ul>   |
| <ul style="list-style-type: none"> <li>Promote water management, irrigation and rainwater harvesting initiatives</li> </ul>   | <ul style="list-style-type: none"> <li>Building small dams for irrigation</li> <li>Planting cover crops</li> <li>Land reclamation</li> </ul>  | <ul style="list-style-type: none"> <li>Develop local watershed planning through community participation planning</li> </ul>   | <ul style="list-style-type: none"> <li>MEnv</li> <li>MANR</li> <li>NGOs</li> <li>MWR</li> <li>Donor agencies</li> </ul>                      |
| <ul style="list-style-type: none"> <li>Agroforestry</li> </ul>  | <ul style="list-style-type: none"> <li>Intercropping crops and trees</li> </ul>   | <ul style="list-style-type: none"> <li>Intercropping crops and trees</li> </ul>   | <ul style="list-style-type: none"> <li>MANR</li> <li>MEnv</li> </ul>   |

|   |  |   |  |
|---|--|---|--|
| <ul style="list-style-type: none"> <li>• Support agricultural research and initiatives especially in the areas of storage, processing, agribusiness and rural enterprise growth</li> </ul>  | <ul style="list-style-type: none"> <li>• Encourage cultivation of improved crop varieties such as water, heat and drought tolerant crops</li> <li>• Foster cultivation of early maturing crop varieties</li> <li>• Set up climate resilient crop processing, storage and marketing facilities</li> </ul> | <ul style="list-style-type: none"> <li>• Encourage the use of renewable energies to power processing mills and storage facilities in the state</li> </ul> | <ul style="list-style-type: none"> <li>• Research institutions/tertiary institutions</li> <li>• Private sector</li> <li>• NGOs</li> <li>• Donor agencies</li> </ul>                            |
| <ul style="list-style-type: none"> <li>• Promote active involvement of the private sector in extension programs and addressing the gender dimension</li> </ul>                              | <ul style="list-style-type: none"> <li>• Improve capacity and coverage of extension activities to include climate change adaptation and mitigation, with a focus on gender equity</li> </ul>   |   | <ul style="list-style-type: none"> <li>• MANR</li> <li>• Private sector</li> <li>• NGOs</li> <li>• Local government departments of agriculture</li> <li>• Universities in the State</li> </ul> |
| <ul style="list-style-type: none"> <li>• Promote climate change adaptation and mitigation insurance based on public-private partnership</li> </ul>  | <ul style="list-style-type: none"> <li>• Introduction insurance products targeting farmers dealing with climate change impacts</li> </ul>  |   | <ul style="list-style-type: none"> <li>• Insurance corporate</li> <li>• MANR</li> </ul>  |
| <ul style="list-style-type: none"> <li>• Support research for improved climate resilient crop varieties</li> </ul>  | <ul style="list-style-type: none"> <li>• Breeding improved crop varieties that are climate resilient</li> <li>• Regularly conduct vulnerability assessment of the</li> </ul>   | <ul style="list-style-type: none"> <li>• Development improved crop varieties that are climate resilient</li> </ul>  | <ul style="list-style-type: none"> <li>• Donor organizations</li> <li>• Research Institute</li> <li>• MANR</li> </ul>  |
| <p>Notes: Menv (State Ministry of Environment); MANR (State Ministry of Agriculture and Natural Resources); NGO (Non-Governmental Organization); NIMET (Nigerian Meteorological Agency)</p> |  |   |  |

**Table 5. Evaluation of Proposed Policies/Programmes/Actions in the Crop Sub-Sector**

| Climate Change Adaptation Options to be Addressed by Proposed Policies/Programmes /Actions  | Measurement criteria for the effectiveness of Proposed Policies/Programmes/ Actions  | Measurement criteria for the effectiveness of Proposed Policies/Programmes/Actions   |  | Impacts If Policy/Programme/Action is NOT Implemented |  |
|---|--|--|--|---|--|
|   |  | Positive Impacts   | Negative Impacts                                     | Positive Impacts                                      | Negative Impacts   |
| <ul style="list-style-type: none"> <li>Create State programme climate-smart agriculture (CSA); CSA pilot project at AEFUNAI, CSA village (upon success of the pilot project)</li> </ul>               | <ul style="list-style-type: none"> <li>Number of farmers/farms reporting increased crop productivity</li> <li>Number of farmers/farms reporting decreased greenhouse gas emissions from crop production</li> <li>Increased farmers income</li> </ul> | <ul style="list-style-type: none"> <li>Increased crop productivity, improved adaptation and reduced emissions</li> </ul>   | <ul style="list-style-type: none"> <li>NA</li> </ul> | <ul style="list-style-type: none"> <li>NA</li> </ul>  | <ul style="list-style-type: none"> <li>Decreased crop productivity, low adaptation and increased emissions</li> </ul>  |
| <ul style="list-style-type: none"> <li>Promote initiatives/actions on reduction of machine from rice paddies</li> </ul>   | <ul style="list-style-type: none"> <li>Rice paddy areas with evidence of methane emission avoided, reduced and removed</li> </ul>  | <ul style="list-style-type: none"> <li>Lower methane emission</li> </ul>   | <ul style="list-style-type: none"> <li>NA</li> </ul> | <ul style="list-style-type: none"> <li>NA</li> </ul>  | <ul style="list-style-type: none"> <li>Continuous methane emission</li> </ul>  |
| <ul style="list-style-type: none"> <li>Create programme on nutrient management for farmers</li> </ul>   | <ul style="list-style-type: none"> <li>Numbers of farmers taking part in the training and adopting improved new practices on nutrient management</li> </ul>  | <ul style="list-style-type: none"> <li>Increased productivity and lower emissions</li> </ul>   | <ul style="list-style-type: none"> <li>NA</li> </ul> | <ul style="list-style-type: none"> <li>NA</li> </ul>  | <ul style="list-style-type: none"> <li>Decreased productivity and higher emission</li> </ul>   |
| <ul style="list-style-type: none"> <li>Regular workshops and media disseminations at the LGA and community levels to encourage adoption of crop development and improved farming practices</li> </ul> | <ul style="list-style-type: none"> <li>Numbers of farmers taking part in the training and adopting improved practices</li> </ul>   | <ul style="list-style-type: none"> <li>Increased productivity</li> <li>Increased income</li> </ul>   | <ul style="list-style-type: none"> <li>NA</li> </ul> | <ul style="list-style-type: none"> <li>NA</li> </ul>  | <ul style="list-style-type: none"> <li>Decreased productivity</li> <li>Decreased income</li> </ul>   |
| <ul style="list-style-type: none"> <li>Development of active crop insurance and other risk management programmes for farmers at the grassroots</li> </ul>   | <ul style="list-style-type: none"> <li>Numbers of farmers taking up insurance</li> </ul>   | <ul style="list-style-type: none"> <li>Increased productivity, income and livelihood</li> </ul>  | <ul style="list-style-type: none"> <li>NA</li> </ul> | <ul style="list-style-type: none"> <li>NA</li> </ul>  | <ul style="list-style-type: none"> <li>Increased productivity, income and livelihood</li> </ul>  |
| <ul style="list-style-type: none"> <li>Provision of early warning information systems</li> </ul>  | <ul style="list-style-type: none"> <li>Numbers of farmers reporting crop and income loss</li> </ul>  | <ul style="list-style-type: none"> <li>Reduction in the risk of loss of crops</li> </ul>   | <ul style="list-style-type: none"> <li>NA</li> </ul> | <ul style="list-style-type: none"> <li>NA</li> </ul>  | <ul style="list-style-type: none"> <li>Increase in the risk of loss of crops</li> </ul>  |
| <ul style="list-style-type: none"> <li>Introduce programme to scale up conservation agriculture</li> </ul>  | <ul style="list-style-type: none"> <li>Numbers of farmers adopting conservation agriculture practices</li> </ul>   | <ul style="list-style-type: none"> <li>Increased productivity and lower emissions</li> </ul>   | <ul style="list-style-type: none"> <li>NA</li> </ul> | <ul style="list-style-type: none"> <li>NA</li> </ul>  | <ul style="list-style-type: none"> <li>Decreased productivity and higher emissions</li> </ul>  |
| <ul style="list-style-type: none"> <li>Promote water management, irrigation and rainwater harvesting initiatives</li> </ul>   | <ul style="list-style-type: none"> <li>Numbers of initiatives on water management, irrigation and rain water harvesting</li> </ul>   | <ul style="list-style-type: none"> <li>Higher crop productivity</li> <li>Decreased flood and drought incidence</li> </ul>  | <ul style="list-style-type: none"> <li>NA</li> </ul> | <ul style="list-style-type: none"> <li>NA</li> </ul>  | <ul style="list-style-type: none"> <li>Lower crop productivity</li> <li>Increased flood and drought incidence</li> </ul>   |
| <ul style="list-style-type: none"> <li>Agroforestry</li> </ul>  | <ul style="list-style-type: none"> <li>Numbers of hectares cultivating crops and trees together</li> </ul>   | <ul style="list-style-type: none"> <li>Increased soil fertility</li> <li>Increased crop productivity</li> <li>Carbon mitigation</li> <li>Increased resilience</li> </ul> | <ul style="list-style-type: none"> <li>NA</li> </ul> | <ul style="list-style-type: none"> <li>NA</li> </ul>  | <ul style="list-style-type: none"> <li>Decreased soil fertility</li> <li>Decreased crop productivity</li> <li>Increased greenhouse gas emission</li> <li>Decreased resilience</li> </ul> |

|  |  |  |  |  |  |
|--|--|--|--|--|--|
| <ul style="list-style-type: none"> <li>Support agricultural research and initiatives especially in the area of storage, processing, agribusiness and rural enterprise growth.</li> </ul> | <ul style="list-style-type: none"> <li>Number of commissioned agricultural researches focusing on the resilience of agribusinesses in the State.</li> <li>Number of commissioned agricultural researches focusing on storage, processing, agribusiness and rural enterprise growth</li> <li>The number of improved crop varieties produced</li> <li>The number of seed banks set up</li> </ul> | <ul style="list-style-type: none"> <li>High crop productivity</li> <li>Reduction of post-harvest loss due to climate hazards</li> </ul>  | <ul style="list-style-type: none"> <li>NA</li> </ul>   | <ul style="list-style-type: none"> <li>NA</li> </ul>   | <ul style="list-style-type: none"> <li>Lower crop productivity</li> <li>Increase in post-harvest loss due to climate hazards</li> </ul>  |
| <ul style="list-style-type: none"> <li>Promote active involvement of the private sector in extension programs and addressing the gender dimensions</li> </ul>                            | <ul style="list-style-type: none"> <li>Increased number of private agricultural extension outfits in the State</li> </ul>  | <ul style="list-style-type: none"> <li>Increased Knowledge of climate change among farmers</li> <li>Increased diffusion of technologies from research institutes to rural farmers</li> <li>Increased crop productivity</li> <li>Decreased susceptibility to the impacts of climate change</li> </ul> | <ul style="list-style-type: none"> <li>NA</li> </ul>   | <ul style="list-style-type: none"> <li>NA</li> </ul>   | <ul style="list-style-type: none"> <li>Decreased knowledge of climate change among farmers</li> <li>Decreased diffusion of technologies from research institutes to rural farmers</li> <li>Decreased crop productivity</li> <li>Increased susceptibility to impacts of climate change</li> </ul> |
| <ul style="list-style-type: none"> <li><b>Long Term Needs</b></li> </ul>   |  |  |  |  |  |
| <ul style="list-style-type: none"> <li>Promote climate change adaptation and mitigation insurance based on public-private partnership</li> </ul>   | <ul style="list-style-type: none"> <li>Increased budgetary allocations for climate-based insurance</li> <li>Availability and adoption of insurance products by farmers</li> </ul>  | <ul style="list-style-type: none"> <li>Compensation for farmers in the event of climate-induced loss</li> <li>Increased scale of crop production</li> </ul>  | <ul style="list-style-type: none"> <li>Increased likelihood of dis-adopting local adaptive measures</li> </ul> | <ul style="list-style-type: none"> <li>Increased likelihood of adopting local adaptive measures</li> </ul> | <ul style="list-style-type: none"> <li>No compensation in the event of crop failure due to climate change</li> </ul>   |
| <p>Note: NA (Not Application)</p>  |  |  |  |  |  |

### 2.7.2. Livestock

The following adaptation and mitigation actions have been recommended for the livestock sub-sector are listed below.

#### Sectoral Adaptation Strategies

- 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
- Support research for livestock improvement and vulnerability assessment of the sector
- Create livestock safe haven in paddocks and pens in elevated areas and platforms
- Develop novel insurance products
- Promote involvement of the private sector, development partners and other relevant

- bodies in livestock production
- Promote the use of integrated crop and livestock pests and diseases control and management
- Diversify livestock farmers' livelihoods
- Sectoral Mitigation Strategies
- Improving feed resource use efficiencies
- Longer term management changes and animal breeding
- Improved manure management
- Climate smart livestock production strategies

An overview of the recommended policies, programmes, adaptation measures discussed and the implementing organization is given in Table 5. Similarly, an evaluation of the proposed programmes relating to the crop sub-sector is presented in Table 6.

**Table 6. Recommended Policies, Programmes, Adaptation and Mitigation Strategies to be Addressed and Actor/Stakeholder to be responsible for implementation in the Livestock Sub-Sector**

| <b>Recommended/Suggested Policy/Action/Programme</b>   | <b>Climate Change Adaptation Options to be addressed by Proposed Policy/Action/Programme</b>  | <b>Climate Change Mitigation Option to be addressed by Proposed Policy/Programme/Action</b>                                   | <b>Actor/Stakeholder to be responsible for implementation</b>  |
|--|---|---|--|
| Promotion of water management initiatives; construction of water boreholes; incorporate rainwater harvesting education in agricultural extension | <ul style="list-style-type: none"> <li>• Foster rainwater harvesting practices in livestock production</li> <li>• Provision of potable water for livestock</li> </ul>   |   | <ul style="list-style-type: none"> <li>• Communities</li> <li>• NGOs</li> <li>• MV/k</li> <li>• MANR</li> </ul>                          |
| Create a programme On climate smart livestock production   | <ul style="list-style-type: none"> <li>• Design and implement pilot projects on climate smart livestock production</li> </ul>   | <ul style="list-style-type: none"> <li>• Design and implement pilot projects on climate smart livestock production</li> </ul> | <ul style="list-style-type: none"> <li>• MANR</li> <li>• Research Institutions</li> <li>• Donor organizations</li> <li>• NGOs</li> </ul> |
| <ul style="list-style-type: none"> <li>• Promote animal breeding, pest and disease control</li> </ul>  | <ul style="list-style-type: none"> <li>• Intensive livestock keeping</li> <li>• Regular vaccination of livestock</li> <li>• Use of integrated crop and livestock pests and diseases control and management</li> </ul> | <ul style="list-style-type: none"> <li>• Selecting improved livestock breeds/species</li> </ul>                               | <ul style="list-style-type: none"> <li>• Farmers</li> <li>• Government agencies</li> <li>• Private sector</li> </ul>                     |

|   |   |  |   |
|---|---|--|---|
| <ul style="list-style-type: none"> <li>• Incorporate climate change adaptation in livestock development and research programme</li> </ul>         | <ul style="list-style-type: none"> <li>• Develop improved livestock species</li> <li>• Sustainable production of breeds of endemic livestock</li> </ul>   |  | <ul style="list-style-type: none"> <li>• MANR</li> <li>• Research institutions</li> <li>• Donor agencies</li> </ul>   |
| <ul style="list-style-type: none"> <li>• Create awareness programmes to improve feed resource use efficiencies in livestock production</li> </ul> | <ul style="list-style-type: none"> <li>• Production and proper management of fodder</li> </ul>  | <ul style="list-style-type: none"> <li>• Replacing livestock fodder with more concentrate</li> <li>• Adding oils to livestock diet</li> <li>• Enhance protein intake to reduce N excretion and N<sub>2</sub>O emissions</li> </ul> | <ul style="list-style-type: none"> <li>• Research institutions</li> <li>• MANR</li> <li>• Menv</li> <li>• Mq4ia</li> <li>• NGOs</li> </ul>  |
| <ul style="list-style-type: none"> <li>• Create awareness programmes to improve manure management in livestock production</li> </ul>              |   | <ul style="list-style-type: none"> <li>• Storing and handling the manures in solid rather than liquid form reduces Ch4 emissions</li> </ul>  | <ul style="list-style-type: none"> <li>• MANR</li> <li>• Research institutions</li> <li>• NGOs</li> </ul>   |
| <ul style="list-style-type: none"> <li>• Support research for improvement climate-resilient livestock breeds</li> </ul>                           | <ul style="list-style-type: none"> <li>• Breeding improved livestock species that are climate-resilient</li> <li>• Regularly conduct vulnerability assessment of the livestock to climate change</li> </ul>   | <ul style="list-style-type: none"> <li>• Breeding improved livestock species that are climate- resilient</li> </ul>  | <ul style="list-style-type: none"> <li>• Donor organizations</li> <li>• Research Institutions</li> <li>• MANR</li> <li>• USAID, Feed the Future</li> <li>• ActionAid</li> </ul>   |
| <ul style="list-style-type: none"> <li>• Promote/Support livestock and income loss risk management initiatives</li> </ul>                         | <ul style="list-style-type: none"> <li>• Diversity source of household income</li> <li>• Strengthen self-help groups</li> <li>• Participate in income stabilization programs</li> <li>• Promote involvement of the private sector, development partners and other relevant bodies in livestock production</li> <li>• Introduce and intensify insurance products to encourage/incentivise livestock production and protect farmers from losses.</li> </ul> |  | <ul style="list-style-type: none"> <li>• NIMET</li> <li>• MANR</li> <li>• MANR</li> <li>• Development Partners (i.e., USAID, Feed the Future, ActionAid)</li> <li>• Private sector</li> <li>• Insurance corporations</li> </ul> |

|  |  |  |  |
|--|--|--|--|
| <ul style="list-style-type: none"> <li>• Promote/Support disaster risk management initiatives</li> </ul>   | <ul style="list-style-type: none"> <li>• Setup early warning systems for start of rainfall, drought, floods, and disease outbreaks</li> <li>• Maintaining &amp; drainage outlets</li> <li>• Raising heat-tolerant livestock varieties</li> <li>• Create livestock safe-haven in paddocks and pens in elevated areas and platforms</li> </ul> |  | <ul style="list-style-type: none"> <li>• NIMET</li> <li>• MANR</li> <li>• State Emergency Management Agency</li> <li>• Development Partners (i.e., USAID, Feed the Future, ActionAid)</li> <li>• Private sector</li> </ul> |
| <p>Notes: MEnv (State Ministry of Environment); MANR (State Ministry of Agriculture and Natural Resources); NGO (Non-Government Organisation); NIMET (Nigerian Meteorology Agency); ADP (Agricultural development programme)</p> |  |  |  |

#### Recommended roles for the State and Local government

- Facilitate genetic improvement of indigenous livestock breeds
- Promote livestock production through the adoption of improved technology and management techniques
- Facilitate the establishment of ranches and pasture development across the State
- Promote and encourage livestock production intensification
- Facilitate effective extension and veterinary services
- Provide regulatory oversight to ensure compliance with international standard in livestock feed milling

#### Recommended roles for the NGOs, CSOs, academics and private sector

- Improve the capacity of key actors in the livestock value chains
- Establishment of feed mills and regulate feed manufacturing practices
- Promote and support effective livestock activities in schools
- Recommended roles for the private communities
- Promote and encourage micro livestock production and utilization of livestock waste
- Formation of livestock farmer & cooperative organizations



**Table 7. Evaluation of Proposed Policies/Programs/Actions in the Livestock Sub-Sector**

| Climate Change Adaptation Options to be Addressed by Proposed Policies/Programmes /Actions   | Measurement criteria for the effectiveness of Proposed Policies/Programmes/ Actions   | Impacts If Policy/Programme/Action is Implemented   |   | Impacts If Policy/Programme/Action is NOT Implemented                                       |   |
|--|---|---|---|---|---|
|  |   | Positive Impacts  | Negative Impacts  | Positive Impacts  | Negative Impacts  |
| <ul style="list-style-type: none"> <li>Promotion of water management initiatives; construction of water boreholes; incorporate rainwater harvesting education in agricultural extension</li> </ul> | <ul style="list-style-type: none"> <li>Number of rain water collection structures constructed</li> <li>Increased number of boreholes constructed</li> <li>Rainwater harvesting incorporated in the list of agricultural technologies/practices disseminated to farmers by extension agents</li> </ul> | <ul style="list-style-type: none"> <li>Increased livestock production</li> <li>Increased resilience</li> </ul>  | <ul style="list-style-type: none"> <li>NA</li> </ul>  | <ul style="list-style-type: none"> <li>NA</li> </ul>  | <ul style="list-style-type: none"> <li>Decreased livestock</li> <li>Decreased resilience</li> </ul>   |
| <ul style="list-style-type: none"> <li>Create a programme on climate smart livestock production</li> </ul>   | <ul style="list-style-type: none"> <li>Number of climate smart livestock production pilot projects</li> </ul>   | <ul style="list-style-type: none"> <li>Increased productivity and resilience</li> <li>Decreased greenhouse gas emissions</li> </ul>   | <ul style="list-style-type: none"> <li>NA</li> </ul>  | <ul style="list-style-type: none"> <li>NA</li> </ul>  | <ul style="list-style-type: none"> <li>Decreased productivity and resilience</li> <li>Increased greenhouse gas emissions</li> </ul>   |
| <ul style="list-style-type: none"> <li>Promote animal breeding, pest and disease control</li> </ul>  | <ul style="list-style-type: none"> <li>Number of improved livestock species reared by farmers</li> <li>Increased number of pest and disease control strategies in place</li> </ul>  | <ul style="list-style-type: none"> <li>Lower incidence of animal diseases</li> <li>Increased livestock productivity</li> </ul>  | <ul style="list-style-type: none"> <li>Higher cost of production</li> </ul>                       | <ul style="list-style-type: none"> <li>Lower cost of production</li> </ul>                  | <ul style="list-style-type: none"> <li>Higher incidence of animal diseases</li> <li>Decreased livestock productivity</li> </ul>   |
| <ul style="list-style-type: none"> <li>Incorporate climate change adaptation in livestock development and research programmes</li> </ul>   | <ul style="list-style-type: none"> <li>Number of improved livestock species by farmer</li> </ul>  | <ul style="list-style-type: none"> <li>Lower incidence of animal diseases</li> <li>Increased livestock productivity</li> </ul>  | <ul style="list-style-type: none"> <li>Higher cost of production</li> </ul>                       | <ul style="list-style-type: none"> <li>Lower cost of production</li> </ul>                  | <ul style="list-style-type: none"> <li>Higher incidence of animal diseases</li> <li>Decreased livestock productivity</li> </ul>   |
| <ul style="list-style-type: none"> <li>Create awareness programmes to improve feed resource use efficiencies in livestock production</li> </ul>  | <ul style="list-style-type: none"> <li>Number of awareness raising campaigns carried out in mass media and local language</li> </ul>  | <ul style="list-style-type: none"> <li>Higher productivity of livestock</li> <li>Lower GHG emissions</li> </ul>   | <ul style="list-style-type: none"> <li>NA</li> </ul>  | <ul style="list-style-type: none"> <li>NA</li> </ul>  | <ul style="list-style-type: none"> <li>Lower productivity of livestock</li> <li>Higher GHG emissions</li> </ul>   |
| <ul style="list-style-type: none"> <li>Create awareness programme to improve manure management in livestock production</li> </ul>  | <ul style="list-style-type: none"> <li>Number of awareness raising campaigns carried out in mass media and local language</li> </ul>  | <ul style="list-style-type: none"> <li>Higher productivity of livestock</li> <li>Lower GHG emissions</li> </ul>   | <ul style="list-style-type: none"> <li>NA</li> </ul>  | <ul style="list-style-type: none"> <li>NA</li> </ul>  | <ul style="list-style-type: none"> <li>Lower productivity of livestock</li> <li>Higher GHG emissions</li> </ul>   |
| <ul style="list-style-type: none"> <li>Promote/Support livestock and income loss risk management initiatives</li> </ul>  | <ul style="list-style-type: none"> <li>Increases number of livestock and income loss risk management initiatives addressing climate change</li> <li>Budget size for livestock insurance</li> <li>Periodic new subscriptions of livestock insurance products</li> </ul>                                | <ul style="list-style-type: none"> <li>Improvement in household livelihood</li> <li>Reduced risk of livestock operation</li> <li>Decline of financial risks faced by livestock farmers</li> </ul> | <ul style="list-style-type: none"> <li>Dis-adoption of traditional adaptive strategies</li> </ul> | <ul style="list-style-type: none"> <li>Resort of traditional adaptive strategies</li> </ul> | <ul style="list-style-type: none"> <li>Disruption of household livelihood</li> <li>Increased risk of livestock operation</li> <li>Limited scale of operations</li> <li>Increased risk of loss of livelihoods</li> </ul> |

### **2.7.3. Fisheries**

The following adaptation and mitigation actions have been recommended for the fisheries sub-sector are listed below.

#### **Sectoral Adaptation Strategies**

Implementation of climate change aware for the fisheries sector;

- Improved risk and disaster management: Use new diseases and preventive treatment; pests and diseases
- Conduct quality research to encourage climate change adaptation for fisheries and aquaculture;
- Use of improved and sustainable feeds;
- Install weather and climate forecast stations and set up programmes to disseminate information thereof with fish farmers. For example, rainfall, flood and drought prediction; and
- Introduce innovative climate-referenced insurance products among fish producers and aquaculturists.
- Promote/support herbivorous species aquaculture and culturing aquatic plants helps remove wastes from polluted waters.
- Sectoral Mitigation Strategies
- Develop initiatives for using renewable energy sources for fish breeding and processing.

An overview of the recommended policies, programmes, adaptation measures discussed and the implementing organization is given in Table 8. Similarly, an evaluation of the proposed programmes relating to the crop sub-sector is presented in Table 9.

**Table 8. Recommended Policies, Programmes, Adaptation and Mitigation Strategies to be Addressed and Actor/Stakeholder to be responsible for implementation in the Fisheries Sub-Sector**

| <b>Recommended/Suggested Policy/Action/Programme</b>  | <b>Climate Change Adaptation Options to be addressed by Proposed Policy/Action/Programme</b>   | <b>Climate Change Mitigation Options to be addressed by Proposed Policy/Programme/Action</b> | <b>Actor/Stakeholder to be responsible for implementation</b>   |
|---|--|--|---|
| <ul style="list-style-type: none"> <li>• Climate change awareness and education initiatives for fisheries sub-sector</li> </ul>                 | <ul style="list-style-type: none"> <li>• Switch to aquaculture in areas experiencing drop in fish and water resources</li> <li>• Establishments of fish farmers cooperatives</li> <li>• Carry out awareness to educate fish farmers on potential adaptation options</li> <li>• Conduct quality research to encourage climate change adaptation for fisheries and aquaculture</li> <li>• Use of improved and sustainable and where possible non-conventional fish feeds to reduce wastage</li> <li>• Introduce new diseases and preventive treatment</li> </ul> |  | <ul style="list-style-type: none"> <li>• MANR</li> <li>• Menv</li> <li>• NGOs</li> <li>• Research Institutions</li> </ul>   |
| <ul style="list-style-type: none"> <li>• Climate change disaster and risk management actions/initiatives in the fisheries sub-sector</li> </ul> | <ul style="list-style-type: none"> <li>• Deployment of early warning and monitoring systems to improve fish resource management</li> <li>• Use new diseases and preventive treatment</li> <li>• Install weather and climate forecast stations and set up programmes to disseminate information thereof with fish farmers. For example, rainfall, flood and drought prediction</li> <li>• Introduce innovative climate-referenced insurance products among fish producers and aquaculturists</li> </ul>   |  | <ul style="list-style-type: none"> <li>• NIMET</li> <li>• Menv</li> <li>• MANR</li> <li>• NGOs</li> <li>• Research institutions</li> <li>• Insurance companies</li> </ul> |

|  |   |  |   |
|--|---|--|---|
| <ul style="list-style-type: none"> <li>• Climate change disaster and risk management actions/initiatives in the fisheries sub-sector</li> </ul>                            | <ul style="list-style-type: none"> <li>• Deployment of early warning and monitoring systems to improve fish resource management</li> <li>• Use new diseases and preventive treatment</li> <li>• Install weather and climate forecast stations and set up programmes to disseminate information thereof with fish farmers. For example, rainfall, flood and drought prediction</li> <li>• Introduce innovative climate- referenced insurance products among fish producers and aquaculturists</li> </ul> |  | <ul style="list-style-type: none"> <li>• NIMET</li> <li>• Menv</li> <li>• MANR</li> <li>• NGOs</li> <li>• Research institutions</li> <li>• Insurance companies</li> </ul> |
| <ul style="list-style-type: none"> <li>• Promote/support herbivorous species aquaculture and culturing aquatic plants helps remove wastes from polluted waters.</li> </ul> | <ul style="list-style-type: none"> <li>• Introduce and scale up herbivorous species aquaculture</li> <li>• Culturing aquatic plants helps remove wastes from polluted waters</li> </ul>   |  | <ul style="list-style-type: none"> <li>• IMET</li> <li>• Menv</li> <li>• MANR</li> <li>• Research institutes</li> <li>• MOE</li> </ul>                                    |
| <ul style="list-style-type: none"> <li>• Develop initiatives for using renewable energy sources for fish breeding and processing</li> </ul>                                | <ul style="list-style-type: none"> <li>• Design and pilot the use of renewable energy sources for fish breeding and processing</li> </ul>   | <ul style="list-style-type: none"> <li>• Promote the use of renewable energy sources for fish breeding and processing</li> </ul> | <ul style="list-style-type: none"> <li>• MANR</li> <li>• Research Institutions</li> <li>• Donor agencies</li> <li>• NOOs</li> </ul>                                       |
| <p>Notes: NIMET (Nigeria Meteorological Agency); MEnv (Ministry of Environment); MANR (Ministry of Agriculture and Natural Resources); MOE (Ministry of Education)</p>     |   |  |   |

### Recommended roles for the State and Local government

- Nutrients recycling from aquaculture recirculation systems
- Issuance of fishing permits to avoid overfishing
- Incorporation of local adaptation knowledge into development programs;
- Support rural areas with the procurement fishing production inputs through subsidies;
- Provide early warning systems for protection against natural threats.

### Recommended roles for the NGOs, CSOs, academics and private sector

- Private sector participants can get involved in the production of fish and introduce new and efficient water recirculation systems
- Recommended roles for the private communities

### Some recommended roles of community-based groups include:

- Communities should be encouraged to form associations or cooperatives for better development of climate change response strategies.

**Table 9. Evaluation of Proposed Policies/Programmes/Actions in the Fisheries Sub-Sector**

| Climate Change Adaptation Options to be Addressed by Proposed Policies/Programmes /Actions  | Measurement criteria for the effectiveness of Proposed Policies/Programmes/ Actions  | Impacts If Policy/Programme/Action is Implemented   |  | Impacts If Policy/Programme/Action is NOT Implemented |  |
|---|--|---|--|---|--|
|   |  | Positive Impacts  | Negative Impacts   | Positive Impacts                                      | Negative Impacts   |
| <ul style="list-style-type: none"> <li>Climate change awareness and education initiatives for fisheries sub-sector</li> </ul>                 | <ul style="list-style-type: none"> <li>Number of stakeholders who are aware of climate change impacts (including farmers and government agencies)</li> </ul>                               | <ul style="list-style-type: none"> <li>Climate knowledge acquisition and educated adoption of appropriate adaptation measures</li> </ul>  | <ul style="list-style-type: none"> <li>NA</li> </ul>   | <ul style="list-style-type: none"> <li>NA</li> </ul>  | <ul style="list-style-type: none"> <li>Dearth of awareness and Increased vulnerability of fisheries sub-sector and livelihoods</li> </ul>  |
| <ul style="list-style-type: none"> <li>Climate change disaster and risk management actions/initiatives in the fisheries sub-sector</li> </ul> | <ul style="list-style-type: none"> <li>Number of monitoring stations installed and operational</li> <li>Number of insurance products and share of farmers adopting the products</li> </ul> | <ul style="list-style-type: none"> <li>knowledge of future climate events and informed decision-making</li> <li>Increased scale of operations and security of livelihoods in the events of loss from climate hazards</li> </ul> | <ul style="list-style-type: none"> <li>Disincentive for farmers applying proved traditional adaptation measures</li> </ul> | <ul style="list-style-type: none"> <li>NA</li> </ul>  | <ul style="list-style-type: none"> <li>Increased vulnerability of the fisheries sector and livelihoods</li> <li>Worsening poverty situation without compensation for fish farmers</li> </ul> |
| <ul style="list-style-type: none"> <li>Develop initiatives for using renewable energy sources for fish breeding and processing</li> </ul>     | <ul style="list-style-type: none"> <li>Number of farms and fish processing firms using renewable energy devices for their operations</li> </ul>  | <ul style="list-style-type: none"> <li>Reduction in total GHG emissions from the sub-sector</li> </ul>  | <ul style="list-style-type: none"> <li>NA</li> </ul>   | <ul style="list-style-type: none"> <li>NA</li> </ul>  | <ul style="list-style-type: none"> <li>Sustained emissions of GHG which contributes to global warming</li> </ul>   |
| <ul style="list-style-type: none"> <li>Notes: NA (Not Applicable)</li> </ul>  |  |   |  |   |  |

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**CLIMATE CHANGE ADAPTATION ACTION  
PLAN FOR THE AGRICULTURE SECTOR IN EBONY STATE  
STAKEHOLDERS MEETING**



