Federal Government of Nigeria

United Nations Development Programme

ASSESSMENT OF INVESTMENT AND FINANCIAL FLOWS

IN THE

AGRICULTURAL SECTOR

Prepared for

UNDP/Federal Ministry of Environment

MAY, 2020

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The author(s) gratefully acknowledge the technical comments received from the UNDP Support Programme and Department of Climate Change, the focal point for this project.

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Abbreviations And Acronyms

AFOLU	Agriculture, Forestry and Other Land Uses
ATA	Agriculture Transformation Agenda
APP	Agriculture Promotion Policy
AU	African Union
BAU	Business –As- Usual
BOA	Bank of Agriculture
BUR	Biennial Update Report
CAADP	Comprehensive African Agriculture Development Policy
CBN	Central Bank of Nigeria
COVID -19	Coronavirus Disease -2019
CO_2-eq	Carbon Dioxide Equivalent
DCC	Department of Climate Change
ERGP	Economic Recovery and Growth Plan
FAO	Food and Agriculture Organization
FME	Federal Ministry of Environment
FMARD	Federal Ministry of agriculture and Rural Development
GDP	Gross Development Product
GESS	Growth Enhancement Support Scheme
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH or GIZ – a German Agency for international development cooperation
GWP	Global Warming Potential
Gg	Gigagram
ICEED	International Centre for Energy Environment and Development
I&FF	Investment and Financial Flow
IFEM	Inter-bank Foreign Exchange
IITA	International Institute for Tropical Agriculture
LCD	Low Carbon Development
NACCIMA	Nigeria Association of Chambers of Commerce, Industry, Mines and Agriculture
NAMA	Nationally Appropriate Mitigation Action
NAIC	Nigeria Agricultural Insurance Corporation
NAIP	National Agriculture Investment Plan
NASPA-CCN	National Adaptation Strategy and Plan of Action for Climate Change Nigeria
NBS	National Bureau of Statistics
NCCPRS	National Climate Change Policy Response Strategy
NDC	Nationally Determined Contribution
NEST	Nigerian Environmental Study/Action Team
NGO	Non-Governmental Organization
NIMET	Nigerian Meteorological Agency
NISRAL	Nigerian Incentive-Based Risk Sharing System for Agricultural Lending
MT	Metric tonnes

O&M	Operation and Maintenance
PFI	Presidential Fertilizer Initiative
SEC	Securities and Exchange Commission
SDGs	Sustainable Development Goals
UNFCCC	United Nations Framework Convention on Climate Change

Executive Summary

Agricultural sector is critical to Nigeria's economic growth; employing about 70% of its economically active population and contributed 24.4% to its 2016 GDP. Nigeria's agricultural sector is highly vulnerable to climate change thereby making the task of attaining food security difficult. With enormous food demand, which is expected to grow correspondingly with the population, the agricultural production system is recognized as a heavy contributor to total GHG emissions in Nigeria. These are significant considerations for recognizing the agricultural sector by the Nationally Determined Contribution (NDC) of Nigeria as one of the 5 key sectors in its plan to support Paris Agreement.

The I&FF assessment is to determine the specific activities needed by Nigeria to address climate change in the Agricultural sub-sector, and the level of financial contributions and sources required to achieve this objective. The scope of the I&FF assessment was narrowed to crop production, livestock and fisheries subsectors which were also to be impacted by climate change in the TNC. The assessment of three subsectors focused on Infrastructure & Services, Equipment & Machinery, and Irrigation/Dam/Drainage as Investment types. A historical perspective was built within the 2010 to 2014 period while the Base year was 2015. Also, the Baseline and Climate Scenario periods were between 2015 and 2030. In the Climate Scenario period, climate actions were introduced which are activities which Nigeria needs to do differently to avoid being cut up with the projection by the Third National Communication that emissions may grow to about 900 million tonnes in 2030 with the economy operating under Business-as-Usual approach.

It was determined that the Incremental Cumulative Discounted total cost of Investments required in the agriculture sector is US$ 27.209 billion, which are in the areas of Infrastructure and Services, Equipment and Machinery, Irrigation/Drainages in a ratio of 57.59%: 4.66%: 37.75% respectively. The discounted incremental IF, FF, O&M and subsidy costs for Mitigation are US$ 756.5793mn, US$ 9.436bn, US$ 159.982m and US$ 45.08165m, respectively. Whilst the discounted incremental IF, FF, O&M and subsidy costs for Adaptation are US$ 9.3879bn, US$ 5.5357bn, US$ 1.8986bn and US$ 101.2443m, respectively. The climate actions in the Crop Production subsector will require an estimated investment cost of US$ 25.289bn while livestock and fishery subsectors will require US$ 1.301bn and US$ 638.342m, respectively.

Some of the mitigation actions and associated Investment costs are: Developing integrated crop/livestock systems (US$ 533.09m); Production of improved fodder and forage seeds for livestock productivity (US$ 533.05m); Improved manure Management (US$ 925.9m); Crop rotation (fertilizer for Maize-Soybean and other legumes rotation) (US$ 5.23bn); soil management practices that reduce fertilizer use and increase crop diversification (US$ 3.8289m); Improved rice seed (early maturing and with low exudation rate) (US$ 898.83m); Sustainable/efficient water resources management (US$ 220.22m).

For adaptation actions among the list activities and associated costs are: Construction of embankment (dikes) (US$ 110.14m); Provision of potable water for livestock (US$ 177.68m); Establishment of grazing reserves (US$ 735.72m); Establishment of fattening schemes (US$ 402.48M); Establishment And development of feedlots (US$ 340.35m); Soil testing equipment for determining crop needs (US$ 49.8m); Mechanization/Tractor (US$ 205.215m); Improved rice milling machines (US$ 19.019m); Support to Research Institute to breed improved rice varieties (US$ 73.07m); and Agroforestry and capacity building (US$ 1.113bn).

Accessing data for the Agricultural Sector IFF assessment was challenging because of bureaucratic processes in public ministries and agencies, therefore the expectation of having this assessment concluded within the given timeframe was problematic. The lockdown following the global outbreak of COVID-19 pandemic and the inability of relevant officers to be in their duty posts at Federal and State

levels in Nigeria added to the challenge of obtaining data. This is particularly so with gathering of data between 2010 and 2015 to support developing the historic Investment and Financial Flow analysis. In order to address the challenge of missing data, estimates were derived from assumptions earlier established by the Federal Ministry of Agriculture (FMARD) and Central Bank of Nigeria. For example, some of the data collected were not disaggregated into crop production, livestock, and fisheries sectors or in terms of sources of the funds which made the analysis to fall back to an existing assumption that the ratio of the Agricultural Activity Mix is Crop production (85%), Livestock (10%) and Fisheries and others (5%) (FMARD, 2016). Similarly, data on State level investments are mostly lacking and estimates were derived based on the projection reported in the Nigerian Agricultural Sector Performance Review (2018) which was also validated during this assessment.

In estimating the cost of mitigation and adaptation actions, the assessment used the 5% economic growth rate projection made in the FMARD (2016) and FME (2020) to forecast IF&FF up to 2030. The assessment in some places relied on expert judgment which might have led to over or understatement of the values in each subsector. There may be few differences between the released NDC Action Plan and the recommendations arising from this assessment, which is attributable to the times of reporting and the need to reflect current prevailing national circumstances.

It is anticipated that as the assumptions change over the years, the estimates arrived at for the mitigation and adaptation plans will consequentially change.

CHAPTER ONE

1.0 INTRODUCTION

Agriculture is a critical sector in the economy of Nigeria comprising of crop production, livestock rearing, forestry and fishing. Agricultural practice in Nigeria is mainly rain-fed and therefore very sensitive to climate change. Although Nigeria depends heavily on the oil sector for much of its revenue, the country is predominantly an agricultural society with nearly 70% of the economically active population employed in it. There is a high correlation between aggregate GDP growth rate and agriculture GDP growth rate (Eboh *et al* 2009). Besides contributing to the overall gross domestic product of the economy, agriculture also provides fiscal revenues, industrial development, and export trade in the sub-region of West Africa development. Therefore, the socioeconomic security of the agricultural sector can be rightly considered a major issue in Nigeria.

The importance of agriculture sector cannot be separated from the critical challenge of food security in Nigeria. A huge pressure coming from the country's population of over 193 million individuals (according to estimated growth rate of 3.2% annually NBS, 2018) is correspondingly impacting on food demand and the agricultural system. Interestingly, Nigeria's agricultural sector is highly vulnerable to climate change thereby making the task of attaining food security difficult. Equally significant is the fact that the agricultural production system contributes to total emissions in Nigeria.

It is not surprising that agriculture is one of the 5 key sectors recognized by the Nationally Determined Contribution (NDC) of Nigeria in its plan to support Paris Agreement. Similarly, the Federal Ministry of Agriculture and Rural Development (FMARD) developed the National Agricultural Policy in 2016 which determined that the agricultural sector needs to be steered towards Green Growth. Adoption of Climate Smart Agriculture in Nigeria can reduce emission from agriculture by 74 million tonnes by 2030. This is part of the mitigation measures that could reduce emissions by around 45% by 2030 compared to Business-As-Usual (NDC, 2018). Agriculture is therefore of huge significance that deserves consideration as a priority sector in assessing Investment and Financial Flows for Nigeria.

1.1 OBJECTIVES

The overall objective of the I&FF assessment is to determine the extent and sources of funds needed to address climate change in the agricultural sub-sector at the national level and build directly on national government strategies, plans and programs. The assessment seeks to determine the specific activities needed by Nigeria to address climate change in the Agricultural sub-sector, and the level of financial contributions required to achieve this objective.

The assessment in the Agriculture subsector seeks to:

i. Analyze past and current national efforts to address climate change.
ii. Determine the main adaptation/mitigation measures for the selected sectors in the next 25 years.
iii. Determine the I&FF changes/increase needed in the sectors.
iv. Ascertain the additional I&FF needed to address climatechange.

v. Determine the various entities responsible for those investments and the sources of their investment funds; and
vi. Provide information needed by policymakers to address the issues of climate change.

1.2 Background

In 2015, Nigeria renewed its commitment to tackling climate change at the United Nations Framework Convention on Climate Change (UNFCCC) COP 21 in Paris with the submission of the country's Nationally Determined Contribution (NDC) that sets out the country's intended contributions and strategies on climate actions from 2015 to 2030. The subsequent signing and ratification of the Paris Agreement further reinforces the country's commitment towards the global quest to GHG emission reduction and strengthens several domestic efforts to address climate change. In 2018, Nigeria received support from UNDP's NDC Support Programme to advance the implementation of its NDC. As one of UNDP's flagship programs, the NDC Support Programme helps countries integrate climate and development solutions through the implementation of the Paris Agreement on climate change.

1.2.1 Previous Analyses Utilized

The current agricultural policy in Nigeria is situated within the framework of the Economic Recovery and Growth Plan (ERGP). The present Federal Government of Nigeria adopted ERGP as the broad policy priority for implementing economic reforms and development programs in the country. The Federal Government is building on the benefits derived from its earlier policy of Agricultural Transformation Agenda (ATA) which focused on import substitution, export orientation, value-addition through processing and backward integration linkages with emphasis on the involvement of the private sector (FMARD, 2016). With economic growth of 5% per year, emissions are expected to grow to about 900 million tonnes per year in 2030 using Business as Usual approach. Through the completion of the IFF assessment, the government of Nigeria will have the required footing to engage in the international climate change negotiations regarding the costs of climate change action, and to identify the most appropriate policy responses.

1.2.2 Institutional Arrangements and Collaborations

The conduct of the I&FF assessment was led by the Department of Climate Change (DCC), Federal Ministry of Environment, being Nigeria's focal point to the UNFCCC. During the I&FF assessment for the agriculture sector, relevant public and private sector entities were involved. The two tiers of government (Federal and State) have concurrent authority as regards to agriculture and they collaborate to bring about growth in this important sector through the National Council on Agriculture. At the national level, the Federal Ministry of Agriculture and Rural Development (FMARD) is primarily responsible for the implementation of agricultural activities in Nigeria; but many federal institutions outside FMARD participated in supporting growth in the sector. This situation is similar at the state level.

The I&FF Agriculture sector assessment draws on several disciplines and inputs from a broad group of stakeholders (Ministries, Departments and Agencies, NGOs, Private Sector, etc.). In the context of this arrangement, many institutions participated through consultations and interviews to supply useful data.

References and resource materials were also sourced from the official websites of these institutions. They include: Federal Ministry of Agriculture and Rural Development (including Departments, Agencies and Research Institutes under the ministry, National Centre for Agricultural Mechanization, National Agricultural Extension and Research Liaison (NAELRS), NISRAL, Federal Ministry of Water Resources (including Agencies and institutes under the ministry), Federal Ministry of Environment (including Agencies and institutes under the ministry), State Government Ministries, Central Bank of Nigeria, Food and Agriculture Organization, IITA, Agricultural Research Council of Nigeria, Biennial Update Report, Nigerian Agricultural Insurance Corporation, Commercial banks, Insurance companies, Ministry of National Planning and Budget/Budget Office, Universities and Colleges of Agriculture, NIMET, BOA, Commodity Associations, Local Non-Governmental Organizations (ICEED, NEST, etc.). Nigeria Association of Chambers of Commerce, Industry, Mines and Agriculture [NACCIMA], National Bureau of Statistics (NBS), Customs, SEC, Relevant Equipment Manufacturers, Fertilizer Companies -Indorama, Notore, and some private/public fertilizer blending plants in Nigeria (about 18 in number), Development Banks and Partners (e.g., AfDB, World Bank, ECOWAS, AU, GIZ, OXFAM etc.)

The role of the Agriculture sector team leader is essentially to oversee the work of the experts and relate with institutions supplying inputs for the sector, and to ensure that the sectoral I&FF assessment is completed according to agreed guidelines and methodology.

The exercise required coordination from sourcing and compilation of information on key sub-sectors of agriculture as well as connecting with relevant institutions. Other specialists that worked with in Agricultural Sectoral team are:

- The Economic expert
- The financial Expert
- Agricultural value chain expert

Desk officers were drawn from key institutions such as NISRAL AND FMARD who directly supported the assessment.

1.2.3 Basic Methodology and Key Terminology

After the sub-sectoral assessments have been completed, the results were compiled and compared across sub-sectors; and a synthesis report was prepared. The eight steps include:

i.Establish key parameters of the assessment.

- Define in detail the scope of the sector.
- Specify the assessment period and the reference year.
- Identify preliminary adaptation measures.
- Choose the analytical approach.

ii.**Compile historical I&FF data and operation and maintenance costs (O&M), subsidies and other input data for scenarios**

- Compile historical annual I&FF, broken down by entity and source of investment.
- Compile historical annual O&M costs, broken down by entity and source of investment.
- Compile historical annual subsidy costs if subsidies are explicitly included in the assessment.

- Compile other input data for the scenarios.

iii. **Defining the baseline**

- Describe the socio-economic and technological change, national and sectoral plans, and expected investments, given the current national and sectoral plans.

iv. **Derive annual IF, FF and O&M costs and subsidies if included explicitly for the baseline**.

- Derive the annual I&FF for each type of investment broken down by investment entity and source of funding.
- The annual O&M costs broken down by investment entity and source of funding.
- The annual cost of subsidies for each type of investment and for I&FF and O&M costs if subsidies are explicitly included in the assessment.

v. Defining potential mitigation scenario. This involved identifying the mitigating interventions for each sub-sector of the energy sector and listing them for each type of asset.

vi. Deriving detailed annual I&FF estimates for the mitigation scenario. This required:

- Estimating annual changes, I&FF and EM required to implement mitigation scenarios.
- Estimating the annual IF, FF, and O&M costs, and subsidy costs, if included, explicitly, for mitigation scenario.
- Estimating the annual IF and FF for each investment type, disaggregated by investment entity and funding source.
- Estimating the annual O&M costs for each IF, disaggregated by investment entity and funding source; and
- Estimating annual subsidy costs for each relevant investment type and for IF, FF, and O&M costs, if subsidies are included explicitly in the assessment.

vii. Calculate the changes in IF, FF, and O&M costs, and in subsidy costs if included explicitly, needed to implement mitigation.

- Calculate changes in cumulative IF, FF, and O&M costs for all investment types.
- Calculate changes in annual IF, FF, and O&M costs for individual investment types, for individual sources of funds,
- and for all investment types and funding sources
- If subsidies are included explicitly, consider calculating changes in cumulative and/or in annual subsidies for IF, FF and O&M for each investment type and all investment types.

viii. Assessing policy implications. These highlight the need to:

- Based on the required changes in IF, FF and O&M costs identified in step vii, what are the necessary policies and incentives to induce this change.
- Integrate climate change in regional projects, regional and national strategy,
- Strengthen the capacities of all stakeholders.
- Integrating these options in national reference
- Involve local entities proactively; give responsibility/empowerment to the people.
- Develop activities that support the generation of income/revenue.

It is expected that this national assessment of I&FF will increase greater awareness and understanding of future investments that address climate change as well as development priorities.

1.2.4 Key Terminologies

The following key terms are used in this report:

Investment Flow (IF) - the capital cost of an active material with a lifespan of more than a year.

Financial flows (FF) - the ongoing expense for programmatic measures, the FF covers expenses other than those for the expansion or installation of new physical assets.

Material goods purchased with investment flows (IF) have operation and maintenance (O&M) costs shareholders (that is to say, permanent fixed costs and variable costs such as wages and raw materials).

Entity- connotes a person of legal age or institution/business that has a legal and separately identifiable existence that is capable to address issues affecting the agricultural sector as they relate to climate change.

Sources- refer to the type of economic - instruments that I&FF mechanism uses to generate revenue. Source criterion mainly connotes non-market mechanism such as the writing of proposal for a donation like tax on sovereign wealth funds. It could also be the carbon market where revenue could be generated.

Scenario- is a characterization of consistent and plausible conditions over a specified period. There are two different scenarios. The baseline scenario describes the conditions of the status quo, i.e., a description of what will probably happen if no new policy measures to cope with climate change are set in place during the assessment period (2005-2030). The adaptation scenario includes new measures to address the potential impacts of climate change.

Assessment period- the time horizon for assessment, i.e., the number of years covered by the baseline and the adaptation scenarios and associated annual I&FF and O&M costs. The assessment period to assess I&FF should cover at least 25 years and not more than 30 years.

Reference year- the first year of the assessment period, the first year of the baseline. The base year should be a recent year for which information on I&FF and O&M costs are available.

Chapter 2

2.1 SCOPE

Nigeria's Green Alternative outlined six (6) key sub-sectors of developmental focus to achieve a diversified economy, food security, poverty reduction and job creation (FMARD, 2016). These are: Industrial Commodities; Consumer Commodities; Export Commodities; Fresh fruits and Vegetables; Livestock; and Aquaculture- Fisheries and Cold Storage. In addition, the three (3) pillars recognized in the policy thrust for growth of Nigeria's agricultural sector include promotion and financing of agricultural investment in infrastructure, adoption of improved varieties and breeds of crops and livestock; building capacities and research for agricultural innovation which will enhance productivity and efficiency.

However, the National Policy on Climate Change of 2015 further contracted national key focus to Crop production, Livestock, and Fisheries as three (3) agricultural sub-sectors that will be majorly impacted by climate change. Drawing from the National Policy, the I&FF assessment narrowed its sectoral scope to:

- Crop production
- Livestock
- Fisheries

The assessment also considered investments in agroforestry because of the usefulness of this production systems in supporting mitigation and adaptation actions in agriculture. Though the sectoral scope focuses on the three subsectors above, it mainly relied on the issues identified in the policy thrusts of FMARD (2016) and FME (2020) to address mitigation and adaptation actions in the 3 agricultural subsectors. These were investment costs to support: Infrastructure and Services, Equipment and Machinery; and Irrigation. Research capacity building (Table 1).

Table 1: Cost items to be addressed under Infrastructure and Services, Equipment and Machinery; and Irrigation. Research capacity building

Investment	Crop Production	Livestock	Fisheries/Aquaculture
Infrastructure and Services	• Improved post-harvest handling, pests, and disease control, • use of fertilizer for increased yield, • Improved varieties of other crops (not rice), • Crop Insurance, Crop rotation, manure, • water harvesting, and local erosion control practices	• Construction of embankment, • Provision of potable water for livestock, • Establishment of grazing reserves, • Establishment of fattening schemes, - • Establishment & development of feedlots, • Construction of standard model abattoirs with complimentary facilities such as biogas systems, • Developing improved livestock breeds, • Culling of animals, • Establishment of livestock services centers. • Production of improved fodder and forage seeds for livestock productivity, - Extension services	• Production of improved fingerlings • Extension services • Provision of Early Warning Systems Equipment • Provision of facilities for Improved water management • Establishment of breeding and multiplication centre • Improved feed production and management • Improved vessel & gear Management
Equipment & machinery	• Mechanization, • soil testing, • processing machines	• Provision of water harvesting facilities, • Establish model cottage dairy processing facilities in grazing reserves. • Provision of Early Warning Systems Equipment, • Provision of facilities for Improved manure Management, • Training and capacity building on manure management, - • Establishment of livestock breeding and multiplication centre.	• Improved Vessel & gear Management
Irrigation	• Irrigation, drainages, and dams, • pests and disease control, • extension & training, • support to research institutes for research for improved		

	varieties, • Improved and early maturing rice varieties, • fertilizer management in rice farming/production, • efficient water resources management		

2.2 Data Input and Scenarios

2.2.1 Assessment Period and Cost Accounting Parameters

The data used in building up the historical scenario began from 2010 which essentially was the beginning year of the first Implementation Plan of Nigerian Vision 20: 2020 (NV20: 2020) that gave rise to Agricultural Transformation Agenda (ATA). ATA came on stream in 2011 and lasted till 2015 (Olomola and Nwafor, 2018). The baseline year of the assessment is 2015, and it was adopted because the Nationally Determined Contribution (NDC) was approved and submitted in that year. The choice of 2015 was also in appreciation of the period when data in the agricultural subsector are readily available**.**

The period for the assessment spanned between 2015 and 2030. The assessments are denominated in US$ and the Central Bank of Nigeria (CBN) exchange rate for Naira against the US$ in 2015 was used in making all monetary conversions.

2.2.2 Analytical Approach

All costs in the I&FF assessment are in US$ and have been assembled from relevant data sources through the agriculture budget expenditures obtained officially or from existing documentation on projects funded and implemented in the sector. Agriculture expenditure in this sense refers to budgetary and investment provisions related to the value chain of crops, livestock, and fishery resources. To derive the GDP at constant price (that is at 2015 price), the GDP at current price of each year was divided by the corresponding harmonized index of consumer price. The O&M per year was calculated using the 20 percent of each sub-sector total value of the I& FF considering the standards set by CBN regarding the agriculture sector. The base year data were provided by NBS and projections were made by using the annual growth rate of investment estimated at 5 percent.

The data obtained from Households, Corporation and Government agencies were compiled in excel spreadsheets as provided in the UNDP reporting guidelines. During the compilation of historical data, there were difficulties encountered. These include but not limited to:

- unavailability of relevant historical data.
- the lockdown due the covid-19 which kept all offices closed for a significant period of the assessment; and
- confidentiality attached to some data sets.

Regarding missing data, some generally documented (official) assumptions were adopted to fill them in with moderance in assumptions using the least value of the series of entity flows. Household and Corporation entities particularly lacked sufficient information, therefore the assessment process depended on common practices observed in the financing of agricultural projects. However, the ATA and APP documents made clear remarks about the agribusiness approach to agricultural development in Nigeria. Thus, the assessment determined the share of government, corporations and households for investments and financial flows of climate change scenario cost line options/practices using a ratio of 40% for government and 60% for private (corporations and households). For the 60% share private bodies, it was broken down further using the ratio of 35% for corporations and 65% for households as applicable also in the historical data. The cost of cultivating 1ha of cassava in Nigeria according to ATA is USD 37.99

with a projected yield of 25tons/ha. Furthermore, Abila (2012) reported that the production cost components (in %) for cultivating a hectare of cassava farm included: pesticides/herbicides = 0.15%, tractor = 1%, fertilizer = 0.41% and planting materials = 14.84%.

For ODAs, where partial investment figures were obtained, a total value of the investment (100%) was calculated on the assumption that the ratio of contributions for most counterpart funded projects is 10%:90% for government and the Donor agencies.

ASSUMPTIONS

2.2.3 Historical IF, FF, and O&M Data, and Subsidies

Assessment of Historical Data was between 2010 and 2014. Three Investment types were used in the assessment: namely,

1. Infrastructure and Services.
2. Equipment/machinery; and
3. Irrigation/Dam.

The assets contained in Investment type 1 (Infrastructure & Services) include Farm roads, buildings, storage houses etc., while that of Equipment/machinery include tractors and accessories, vehicles, and processing plants. Assets that make up Investment Type 3 (irrigation) include: construction of dams, drainages, waterways etc.

Table 2: Annual historical IF, FF, and O&M Cost in million 2015 USD (2010 -2014)

Year	Infrastructure				Equipment and Machinery				Dam, Irrigation and Drainage			
	IF	FF	O%M	Subsidy	IF	FF	O%M	Subsidy	IF	FF	O%M	Subsidy
2010	504.1209	168.5764	102.875	63.06	102.697	2.4648	20.2314		219.957	2.833954	43.99	0
2011	374.6966	122.0933	76.05072	1.03995	19.961	1.761	3.6224	2.7062	180.869	8.3	36.17	0
2012	438.196	163.715	87.832	16.35	34.83	0.74	6.366		180.869	8.3	36.17	0
2013	422.0438	174.857	85.239	0.628836	9.443	1.952	1.6904		152.26	8.92	30.324	0
2014	452.761	204.0158	90.5244	0.658	11.589	1.5	1.938	3.097	170.39	13.16	33.852	0
Total	2191.818	833.2575	442.5271	81.74	178.52	8.4178	33.8482	5.8	904.345	41.51395	180.506	0

The investment entities are the Household, Corporations, and the Government. The bulk of the funding between 2010 and 2014 is by the Government particularly from domestic funds, followed by that of the Corporations whose major source of funds is also domestic. The Operation and Maintenance (O&M) cost applied in the assessment is 20%. Within the period, between 80% and 85% of the Investment and Financial Flow went into crop production. This subsector also contributes heavily to the GDP. In crop production, the make-up of the Financial Flow includes fertilizer procurement, purchase of improved seedling, training/capacity building and extension activities. In the assessment, subsidy data are available only to fertilizer under crop production through the Nigeria's Growth Enhancement Support Scheme (GESS) program between 2010 and 2014; data on other subsidy regimes were not available.

It is assumed that 65% of the farmers are smallholders while 35% of them are the commercial (Large scale) farmers, and this ratio pattern was used to determine the quantity of fertilizer consumed by large-scale commercial agricultural farms/firms as well as the cost and the credit (agricultural credit guarantee scheme) to small farmers and large-scale agriculture farmers and further subjected to determine the actual amount of credit utilized in agriculture.

2.2.4 Baseline Scenario

The baseline scenario describes the conditions under Business-As-Usual. Furthermore, it reflects the continuation of the historical trends of achieving the investment and financial flows from 2010 – 2014. As at 2006, the population of Nigeria was 140.43 million (NPC, 2006), and according to the NDC, the current population of Nigeria is estimated to be 200 million using the growth rate of 3%. The 2015 Human Development Report showed that about 62% of Nigerians live below the poverty line (UNDP, 2015). The demand for food crops is expected to increase due to the expected population growth over a short period of time. Nigeria is known to have about 98.3 million hectares of land area out which 74 million hectares are good for farming. The country is yet to make significant use of its irrigation potential estimated at about 3.14 million ha. The area under irrigation is officially estimated at about 40,000 ha, which is less than 1 percent of irrigable land in use. The potential contribution of irrigated agriculture to total crop production is therefore enormous. This why the government targets to expand irrigation, from 1% of cultivated area in 2010 to 25% in 2020, which will be grown further to 50% in 2035. Hence in 2025, it is anticipated that 15.8% of the crop land will be irrigated (World Bank, 2012). About 42 % of the population is employed in agriculture and further investments in the sector could create more employment. In 2007, the contribution of agriculture to economy totaled about $132.2 billion (Economist, Sept. 2008), however the contribution to GDP averaged about 22% between 2010 and 2014 and went up to 24.4% in 2016.

The country's landscape is diverse in terms of agro-climatic conditions which allow a wide range of crops and animals to be grown and reared, respectively. The most important subsistence crops are maize, cassava, sorghum, yam, beans, rice, groundnut and to a lesser extent millet, soyabean and cocoyam. In general, the average arable crop yield in Nigeria is 4 tonnes of agricultural product per hectare compared to 13-14 tonnes per hectare in other countries of similar climatic pattern. Crop production is by far the most important component of the agriculture sector, contributing 89.7% to the total GDP of the sector (FME, 2018). The main cash crops are palm oil, cotton seed, cocoa, cashew, and sugarcane. The area of wet rice cultivation within annual cropland is projected to double to 2.625 million ha by 2025 from 1.313 in 2010, meeting the Government's 2018 target from the National Rice Development Strategy (World Bank, 2012). Agriculture is characterized by subsistence production system with limited mechanization and low productivity. According to FMARD (2016), Nigeria needs to add over 100,000 - 120,000 tractors and related equipment over the coming 5 to 8 years to achieve its production target.

Agriculture's share of Nigeria's budget is approximately 2% (specifically it was an average of 4.6% between 2008 and 2014) which failed to achieve the targets in the Maputo Declaration that prescribes a minimum of 10% budgetary allocation to the agricultural sector. State level spending are broadly similar, ranging from 2.0 - 9%). Agricultural sector historical growth was between 3% - 6% per annum in 2011 – 2015 while the Agriculture Activity Mix is 85% Crop Production and 15% Livestock and Others (FMARD,

2016). There is limited lending to agricultural value chain actors due to high perceived risks in the sector (AGRA, 2017). The Federal Government established the Nigeria Agricultural Insurance Corporation (NAIC) to assist farmers to lower risks by administering approved premium rates for subsidized crops. NAIC in 2015 approved premium rates for subsidized crops as 4% of the sum insured and 5% for livestock (https://www.naic.gov.ng/news_inside/how-to-insure-your-agricultural-projects-with-naic).This assessment used the 4% of the premium to calculate the investment of the farmers and project into the future using the same growth rate (5%).

Although there are numerous challenges faced by Nigeria's economy, the agriculture sector has shown resilience and was able to grow by 4.3% between 2010 and 2016 (FME, 2018). The key driver of agricultural growth is mainly from increases in crop production subsector e.g., between 2011 to 2014 food production grew by 21 MT which led to a reduction of the food import bill by almost 400% over that period. ATA projected that the growth rate of the production/demand for rice and cassava will grow by 5% till 2050, and production/demand for other crops will likely have the same growth rate. This estimation by ATA was one of the bases for making projections in this assessment for future growth in agricultural sector. Input supply in the sector is in deficit. Average fertilizer usage in Nigeria is at 13 kg/ha compared to world average of 50 kg/ha in Africa and 150 kg/ha for Asia (AGRA, 2017). There are areas where land and water resources are currently underutilized, and production can be expanded in an environmentally sustainable manner using a climate smart approach which could reduce GHG emissions compared to traditional agriculture (FME 2020).

In fisheries and aquaculture, Nigeria has a huge domestic fishery economy but still relies heavily on imported fish and specialized feed for its protein consumption as the country imports between $400 and $600 million worth of fish and fish products each year (FMARD, 2016). Post-harvest loss rates are high in Nigeria with about 60% for perishable crops. The Federal Government of Nigeria, between 2012 and 2014 invested ₦66 billion to establish 33 silo complexes made of 25 grain aggregation centers and 9 units of Blumberg warehouses (FMARD, 2016).

Policy Environment

There have been various policies and legislation that focused directly on agriculture or are developed for other sectors but have strong impact on the growth of agriculture sector. Despite these policies, challenges remained in the sector including low productivity, underinvestment by the private sector, land ownership and tenure rigidities, weak research-extension linkage, poor infrastructure, restricted access to credit, ageing farming population and low return to investment; persistent rural-urban population drift and unsustainable development paradigm due to short planning horizons. A key springboard that enabled the evidential growth in the agricultural sector is the Nigerian Vision 20: 2020 (NV20: 2020) of 2009. The first implementation Plan of Nigerian Vision 20: 2020 (NV20: 2020) was 2010-2013; and among the overall goals and targets of the vision 2020 were: to increase domestic agricultural productivity by 6-fold in 2020; to a substantially mechanize system by 2020; expand dairy production and milk yield from the current state of less than 2000 kg to 5,000 kg per cow per lactation by 2015; grow farm gate storage by 20% farm-gate, achieve 75% commercial storage and 5% strategic reserves by 2020; increase the size of irrigated land from current 1% of cultivable land to 10% of cultivable land by 2015 and to 25% by 2020; and grow adoption of improved varieties/species of seed and brood stock by 75% in 2020. This National

Vision 20: 2020 was further strengthened with the institution of Agricultural Transformation Agenda (ATA) in 2011. The GESS which was designed to improve farmers' access to modern agricultural inputs at subsidized prices was the most successful of the Six components of ATA. Through the GESS an innovative input subsidy scheme was designed and implemented to increase farmers' income, productivity, and access to modern inputs. The National Climate Change Policy Response and Strategy (NCCPRS) was adopted in 2012 to provide a better framework and implementation of the GHG reduction options with the goals of fostering low-carbon, high economic growth and to build a climate resilient society. Also, to make national ATA program achievable and strengthen national capacity to respond effectively to the challenges of climate change, the FMARD in 2015 developed the National Agricultural Resilience Framework (NARF), an output of Advisory Committee on Agricultural Resilience in Nigeria (ACARN) that was launched an initiative in 2013 to provide a roadmap for implementing climate-resilient agriculture. NARF provided policy recommendations to support Climate Smart agricultural practices and strengthen the capacity of agricultural producers to increase productivity and thrive in the face of growing challenges from multiple environmental stressors and changing climate (FMARD, 2015). Some of NARF policy recommendations focus on affordable inputs, water management, enhanced capacity for predicting shocks and managing risks and social safety nets.

In June 2016, the Agriculture Promotion Policy (otherwise known as the Green Alternative) was launched and has since continued to guide the development initiatives in the sector. Also, the Presidential Fertilizer Initiative (PFI) commenced in 2016 which enabled rehabilitation of 12 of the 28 abandoned fertilizer blending plants in various locations in the country. The Economic Recovery and Growth Plan (ERGP), a medium-term economic development Plan (2017 – 2020) was developed for the purpose of restoring economic growth while leveraging the ingenuity and resilience of the Nigerian people. The ERGP has 5 key execution priorities targeted to achieve its objectives; one of the priorities being "to achieve agriculture and food security". Also, the National Agriculture Investment Plan (NAIP) was implemented between 2011 and 2014. The NAIP places emphasis on intra-sectoral diversification which made it possible for the crop, livestock, and fisheries sub-sectors to receive their fair share of investment in accordance with the AU's 2014 Malabo Declaration, which seeks to cut poverty rates by half by 2025 through agriculture-led economic growth. Therefore, this assessment also recognizes the Comprehensive Africa Agriculture Development Program (CAADP) process, the ECOWAS Agriculture Policy (ECOWAP), and Malabo declaration which are regional and sub-regional agricultural sector initiatives aimed at fostering peer review and knowledge sharing in the transformation of agriculture, achieve food security and global competitiveness. In 2014, Nigeria's president and other African Heads of State and Government assented to the Malabo declaration on accelerated agricultural growth and transformation for shared prosperity and improved livelihoods.

Adaptation in Agriculture Sector

According to (FME, 2011) in the absence of adaptation, climate change could result in a loss of between 2% and 11% of Nigeria's GDP by 2020, and which may rise to between 6% and 30% by the year 2050. For Nigeria to respond to climate change appropriately will mean doing certain things differently and allocating resources differently. It will require investments beyond the resources of a developing country

such as Nigeria. But the cost of not taking any action is significantly higher. The expected loss could be in the range of N15 trillion (US$100 billion) and N69 trillion (US$460 billion) by 2050. Agricultural sector will bear a huge share of this loss with the adverse impacts occurring in the forms of rise in temperature, change in pattern of rainfall, sea level rise, and extreme weather events. Separate models have projected lower yields in the longer term (2050) with rice production appearing to have the greatest vulnerability with yields falling as much as 7 % in the short term and 25 % in the longer term (FME, 2020). Climate impact on agriculture varies considerably by agro-ecological sub-zone (AESZ) and crop type. Most vulnerable is the north-eastern region followed by the north-west while the south-west is the least vulnerable followed by the south-east (Adesina and Odekunle, 2011). The zones most vulnerable happen to be the major food producing zones in Nigeria.

An increase in total annual rainfall could have a beneficial effect on the productivity of cassava and ginger and adversely affect the productivity of yam, maize, tomato, and melon but extreme temperatures will have negative association with cassava, sweet potato, onion, and okra yields (FME, 2020). According to the National Policy on Climate Change, agricultural productivity may decline by between 10 and 25% in 2080 under Business-as-Usual scenario and for some parts of the country the decline could be up to 50% under rain-fed agriculture. Whilst the World Bank recently predicted an up to 30% drop in the country's crop output due to erratic rainfall and higher temperatures. Thus, food security will be in jeopardy and it will render most developmental initiatives (such as ERGP, SDGs) aimed at reducing poverty ineffective.

Table 3: NASPA STRATEGIES FOR AGRICULTURE (CROPS AND LIVESTOCK)

S/N	Sub-Sector	Adaption Options
1	Livestock	Diversify livestock and improve range management; increase access to drought resistant forage crops and livestock feeds; and provide early warning/meteorological forecasts and related information, intensify livestock production in place of slash and burn, agricultural insurance
2	Crop Production	Expansion and optimization of irrigation systems; increase rainwater & sustainable ground water harvesting for use in agriculture; adopt better soil management practices; increase planting of native vegetation cover & promotion of re-greening efforts; intensify crop production in place of slash and burn, Increasing and upgrading crop storage facilities, Growing more cover crops, increased access to forecasting of weather, effective pest control for insects and birds; provision of agricultural insurance

Adapted from (FME, 2011)

Adaptation measures related to climate change in the agricultural sector are numerous and varied, and therefore require huge financial resources for human and technical capacity building, which is one of the imperatives of this I&FF assessment.

Mitigation in the Agricultural Sector and Land Use

The agricultural sector is a significant contributor of anthropogenic GHGs. Among others, the sector plays an important role in the oxidation of biomass, organic matter, and the combustion of fossil fuels in the automation of agricultural activities. N_2O is produced by the denitrification of nitrogen compounds in soils, fertilizer, and manure, and by biomass burning (Lal *et al*., 1998). CH_4 is a by-product of ruminant animal digestion, manure storage systems, rice cultivation, biomass burning, and the anaerobic

breakdown of soil organic matter. Both CH_4 and N_2O are far more potent as GHGs than CO_2 based on their Global Warming Potentials (GWP).

Soils contain high levels of soil organic matter (soil carbon) and agricultural practices release CO_2 from the breakdown of the soil organic matter. Thus, with suitable agricultural management practices such as zero- or minimum-tillage, improved fallows, crop rotation and retention of residues on the soil surface, soils can be enhanced to replenish their lost organic matter. That is, they can be managed to become effective CO_2, sinks. Oladele and Braimoh (2013) in a review and analysis of soils across Africa have shown that differences in soil management practices produce large differentials in carbon sequestration. For instance, improved fallows are shown to be able to sequester 2,413 Kg C ha^{-1} compared with the use of residues which can only sequesters on the average about half of this (1,266 Kg C ha^{-1}). In view of the foregoing, using appropriate agricultural management practices is a good mitigation option in the agricultural sector.

Agriculture sector gave a net emissions of 366,734 Gg CO2-eq with a removal of 4,288 Gg CO2-eq under HWP which is the highest emissions for the period considered in the First Biennial Update Review (FME, 2018). According to Table 4 and 5 below, in 2015 the net emissions from the AFOLU sector were 476, 948 Gg CO2-eq while in the year 2000 the emissions from the same sector was 376861 Gg CO2-eq representing an increase of about 27%. Among the factors attributed for the increase were: the increase in livestock populations and (b) increased consumption of nitrogen based synthetic fertilizers (FME, 2018).

Emissions from livestock are generated through enteric fermentation and poor manure management from domestic animals such as cattle, sheep, goats, horses, swine, donkeys (asses and mules), camels and poultry. Total emissions from livestock increased from 21877 Gg CO2-eq in 2000. Enteric fermentation constituted an overall average of about 90% of the total emissions from livestock and manure management contributed the remaining 10%. CH4 emissions from rice cultivation was 7356 Gg CO2-eq in 2015 but in 2009 it was 4225 Gg CO2-eq. Emissions from rice cultivation constituted about 2.6% of the total emissions from aggregated source and non-CO_2 emission from land in 2015 (FME 2018).

According to NDC, if climate actions are implemented unconditionally using national resources, emission are expected to reduce by 20% from the Business as Usual (BAU) scenario. This reduction may further be increased with external support to 45% of the BAU scenario.

Table 4: Emissions and removals (GgCO2-eq) by source categories of the AFOLU sector with Aggregated sources and non-CO2 emissions Gg CO2-eq from land

Emissions and removals (GgCO2-eq) by source categories of the AFOLU sector						Aggregated sources and non-CO2 emissions Gg CO2-eq from land					
year	livestock	land	Aggregated sources % non co_2 emission on land	Others	Net Emission	Year	Rice cultivation	Agricultural soils savanna burning		Crops residues burning	Total
2009	24063	389791	21939	-3012	432780	2009	4225	17713	1.513	0.345	21939
2010	25401	395807	24526	-2897	442837	2010	5595	18929	1.513	0.439	24526
2011	28005	398926	25618	-3007	449542	2011	5219	20397	1.296	0.539	25618
2012	29424	404533	27747	-2661	459043	2012	6586	21158	1.296	0.573	27747
2013	29039	410153	29693	-2758	466128	2013	6742	22950	1.036	0.577	29693
2014	29200	452701	29301	-2702	508500	2014	7120	22179	1.182	0.588	29301
2015	29375	421434	28762	-2623	476948	2015	7356	21404	1.30	0.640	28762

Source FME, 2018

Nigeria developed NAMA which is strategic framework that allows the country to develop long-term measures and programs supporting a low carbon, climate-resilient, pro-growth, and gender-sensitive sustainable development path. There are opportunities for mitigation actions in the agricultural sector.

Some of specific mitigation options in the agricultural sector include:

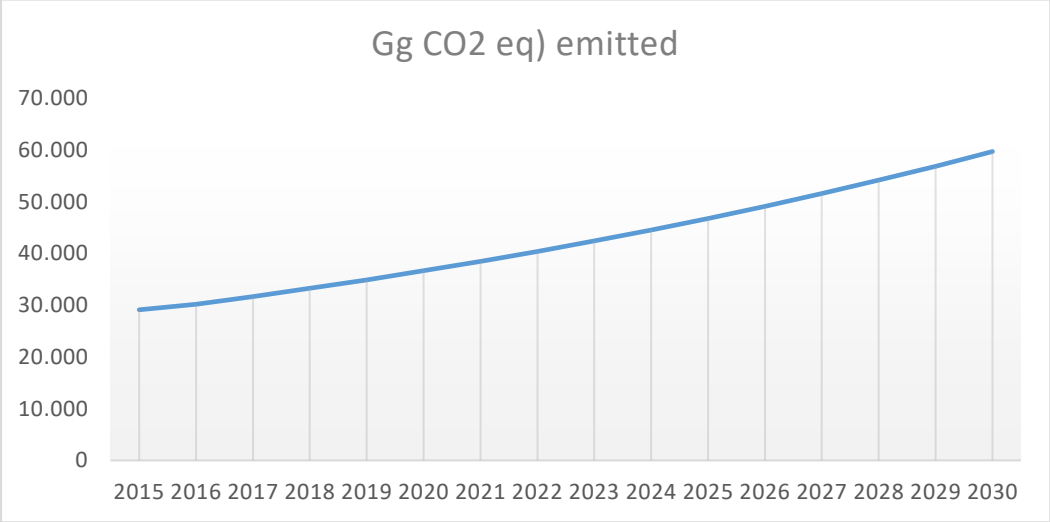
- Rice production through adoption of improved varieties of upland rice, with retention of crop residue, better water management for irrigation and use of organic fertilizers.
- Control of emission in livestock production through: improved production efficiency, provision of modern hygienic abattoir, and promotion of non-meat protein sources like fish and snails with high protein but less emission.
- Sustainable management of savanna and rangelands by promoting policies that discourages bush burning through awareness and designate grazing zones thereby improving potentials for sequestration.
- Reduce the use of biomass from forestland to ensure carbon sequestration is sustained.
- Climate Smart Agriculture through efficient use of agricultural land for multiple production.

The NDC had outlined six measures which included Climate Smart Agriculture (CSA) and Reforestation which if Nigeria implements unconditionally using national resources are expected to reduce emissions by 20 % from the Business-As-Usual (BAU) scenario. But this reduction may further be increased with external support to 45% of the BAU scenario. Under Business-As-Usual without climate actions in the agricultural sector then current projected rate of 2 tonnes CO2 eq per capita in 2030 may be exceeded to

reach 3 tonnes CO2 eq per capita (FME, 2018). This is because agricultural gas emissions in the coming decades are expected to increase because of increased demand in agricultural products and change in diet.

The Third national communication (TNC) projected that GHG coming from rice cultivation and managed agricultural soils will be growing by 5% (FME, 2020). This assessment consistently used this growth rate to make some projections regarding emission up to 2030 (Figure 1) and about the costs of adaptation and mitigation actions.

Figure 1: Projected GHG emissions from Rice cultivation and other Managed Agricultural soil at 5% growth from 2015 to 2030 with part of the data adapted from FME (2020)



Under the Business-as-Usual Scenario, the total IF, FF and O&M that will be needed in the agricultural sector for all three (3) investment types (Infrastructure & Services, Equipment/Machinery, and Irrigation/Dams) are US$ 2035.87m, US$ 2148.29, US$ 410.60 respectively with a subsidy cost of US$ 27.22m as shown in Table 6. These investment costs are further disaggregated into entities in Table 7. The Government shoulders almost half of the investment costs. Table 8 shows the annual investment cost discounted with 12.5% which was the obtainable rate in 2015 as the twelve-month average of the inter-bank call rate (interest rate) from the CBN records in 2015. The logistic total investment cost (US$) for IF, FF and O&M are 930.33, 982.65 and 187.57 respectively.

However, it is noteworthy that under the Business-As-Usual scenario there is still a huge gap in terms of deliberate actions to reduce GHG emissions from the agricultural sector. While actions related to climate adaptation and very rarely mitigation were observed in the historical expenditures in the crop production, livestock, and fisheries subsectors, what was largely missing are deliberate actions clearly delineated as adaptation or mitigation approaches to curb and ensure reduction in GHG emissions. A large portion of government expenditures in the agricultural sector are directed to recurrent expenditures with less on capital expenditures which is needed to promote climate actions. The emissions under BAU may exceed 60,000 $GgCO_2$ eq year-1 by the year 2030 (Figure 1).

Table 5: Baseline Scenario: Annual IF, FF, and O&M by Investment Types (Mitigation/Adaptation) for Agriculture for 2015-2030

	Infrastructure				Equipment and Machinery				Irrigation/Dam/Drainage				Cumulative Total for All Investment Types			
Year	**IF**	**FF**	**O&M**	**Subsidy**	**IF**	**FF**	**O&M**	**Subsidy**	**IF**	**FF**	**O&M**	**Subsidy**	**IF**	**FF**	**O&M**	**Subsidy**
2015	66.06	107.98	13.49	0.38	2.46	1.39	0.39	0.93	36.53	1.48	7.31	0	105.05	110.85	21.18	1.30
2016	67.71	110.68	13.83	0.39	2.53	1.43	0.40	0.97	37.44	1.51	7.49	0	107.68	113.62	21.71	1.35
2017	69.40	113.45	14.17	0.40	2.59	1.46	0.41	1.00	38.38	1.55	7.68	0	110.37	116.46	22.26	1.40
2018	71.14	116.28	14.53	0.41	2.65	1.50	0.42	1.04	39.34	1.59	7.87	0	113.13	119.37	22.81	1.45
2019	72.92	119.19	14.89	0.42	2.72	1.54	0.43	1.06	40.32	1.63	8.06	0	115.96	122.36	23.38	1.47
2020	74.74	122.17	15.27	0.43	2.79	1.57	0.44	1.10	41.33	1.67	8.27	0	118.85	125.42	23.97	1.53
2021	76.61	125.23	15.65	0.44	2.86	1.61	0.45	1.15	42.36	1.71	8.47	0	121.82	128.55	24.57	1.58
2022	78.52	128.36	16.04	0.45	2.93	1.65	0.46	1.19	43.42	1.76	8.68	0	124.87	131.77	25.19	1.64
2023	80.49	131.57	16.44	0.46	3.00	1.70	0.47	1.24	44.51	1.80	8.90	0	127.99	135.06	25.81	1.70
2024	82.50	134.85	16.85	0.47	3.07	1.74	0.48	1.29	45.62	1.84	9.12	0	131.19	138.44	26.46	1.76
2025	84.56	138.23	17.21	0.48	3.15	1.78	0.49	1.34	46.76	1.89	9.35	0	134.47	141.90	27.05	1.83
2026	86.68	141.68	17.71	0.49	3.23	1.83	0.51	1.40	47.93	1.94	9.59	0	137.83	145.45	27.80	1.89
2027	88.84	145.22	18.15	0.51	3.31	1.87	0.52	1.46	49.13	1.99	9.83	0	141.28	149.08	28.50	1.96
2028	91.06	148.85	18.60	0.52	3.39	1.92	0.53	1.52	50.35	2.04	10.07	0	144.81	152.81	29.21	2.04
2029	93.34	152.57	19.07	0.53	3.48	1.97	0.55	1.58	51.61	2.09	10.32	0	148.43	156.63	29.94	2.11
2030	95.67	156.39	19.55	0.55	3.56	2.01	0.56	1.65	52.90	2.14	10.58	0	152.14	160.54	30.69	2.19
Total	**1280.25**	**2092.70**	**261.46**	**7.29**	**47.70**	**26.97**	**7.49**	**19.93**	**707.92**	**28.62**	**141.58**	**0.00**	**2035.87**	**2148.29**	**410.53**	**27.22**

Table 6: **Baseline Scenario: Total IF, FF, and O&M by Investment Type and Funding Sources in million 2015 USD**

Investment entity category / source of funds	Infrastructure				Equipment and Machinery				Irrigation/Dam/Drainage				Cumulative Total for All Investment Entities			
	IF	FF	O&M	subsidies	IF	FF	O&M	subsidies	IF	FF	O&M	Subsidies	IF	FF	O&M	Subsidies
Households	244.39	1235.40	50.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	244.39	1235.40	50.47	0.00
Corporations	131.71	665.20	27.20	0.00	0.00	0.00	0.00	12.63	0.00	0.00	0.00	0.00	131.71	665.20	27.20	12.63
Governments	904.02	191.65	183.83	7.29	47.70	26.70	7.49	9.04	707.92	28.62	141.58	0.00	1659.64	247.25	332.90	16.33
Total funds	1280.24	2092.12	261.12	7.29	47.70	26.70	7.49	19.92	707.92	28.62	141.58	0.00	2035.85	2147.95	410.19	27.21

Table 7: **Baseline Scenario: Discounted IF, FF, and O&M Estimates (mitigation & adaptation) by Investment (2015-2030)**

Year	IF	FF	O&M	subsidy	IF	FF	O&M	Subsidy	IF	FF	O&M	Subsidy	IF	FF	O&M	Subsidy
2015	66.06	107.98	13.49	0.38	2.46	1.39	0.39	0.93	36.53	1.48	7.31	0.00	105.05	110.85	21.18	1.30
2016	60.36	98.69	12.33	0.34	2.25	1.27	0.35	0.86	33.38	1.35	6.68	0.00	95.99	101.31	19.36	1.20
2017	55.15	90.20	11.26	0.31	2.05	1.16	0.32	0.80	30.51	1.23	6.10	0.00	87.71	92.59	17.69	1.11
2018	50.39	82.43	10.29	0.29	1.87	1.05	0.29	0.74	27.89	1.13	5.58	0.00	80.15	84.62	16.16	1.02
2019	46.04	75.34	9.40	0.26	1.71	0.96	0.27	0.66	25.49	1.03	5.10	0.00	73.24	77.33	14.77	0.93
2020	42.07	68.86	8.59	0.24	1.56	0.88	0.24	0.62	23.29	0.94	4.66	0.00	66.92	70.67	13.49	0.86
2021	38.44	62.93	7.85	0.22	1.42	0.80	0.22	0.57	21.29	0.86	4.26	0.00	61.15	64.59	12.33	0.79
2022	35.12	57.52	7.17	0.20	1.30	0.73	0.20	0.53	19.46	0.79	3.89	0.00	55.88	59.03	11.27	0.73
2023	32.09	52.57	6.55	0.18	1.18	0.66	0.18	0.49	17.78	0.72	3.56	0.00	51.06	53.95	10.29	0.67
2024	29.06	48.02	5.92	0.17	1.02	0.55	0.15	0.45	16.25	0.66	3.25	0.00	46.33	49.23	9.33	0.62
2025	26.80	43.91	5.47	0.15	0.99	0.55	0.15	0.42	14.85	0.60	2.97	0.00	42.64	45.06	8.60	0.57
2026	24.48	40.13	5.00	0.14	0.90	0.50	0.14	0.39	13.58	0.55	2.72	0.00	38.96	41.18	7.85	0.53
2027	22.37	36.68	4.57	0.13	0.82	0.46	0.13	0.36	12.41	0.50	2.48	0.00	35.60	37.64	7.18	0.49
2028	20.44	33.52	4.17	0.12	0.75	0.42	0.12	0.33	11.34	0.46	2.27	0.00	32.53	34.40	6.56	0.45
2029	18.68	30.63	3.81	0.11	0.68	0.38	0.11	0.31	10.37	0.42	2.07	0.00	29.73	31.43	5.99	0.42
2030	17.24	28.01	3.53	0.10	0.66	0.38	0.11	0.29	9.47	0.38	1.89	0.00	27.37	28.78	5.53	0.38
Total	**584.80**	**957.41**	**119.41**	**3.34**	**21.63**	**12.14**	**3.38**	**8.73**	**323.90**	**13.10**	**64.78**	**0.00**	**930.33**	**982.65**	**187.57**	**12.07**

2.2.5 Climate Change Scenario

Nigeria has a challenge of food insecurity coupled with high rate of population growth (3% per annum); it will be expected that Nigeria will drive towards meeting the required food demand over a short period of time. This trend is consequentially expected to increase the agricultural greenhouse gas emissions. The Federal and some State governments have taken measures to combat GHG emissions which include instituting policy actions. The National Climate Change Policy Response and Strategy (NCCPRS) of 2012 gave guidance to implementation of GHG reduction options. The goal of the NCCPRS is to foster low-carbon high economic growth and build a climate resilient society, through the following main objectives:

- Implement mitigation to promote low carbon sustainable high economic growth.
- Enhance national capacity to adapt to climate change. Increase public awareness.
- Involve the private sector to address climate change challenges.
- Strengthen national institutions and mechanisms for a suitable and functional climate change governance framework.

The implementation of the strategies of NCCPRS is expected to be backed with governments' willingness through improved budgetary allocation to the sector. Agriculture being the major contributor to the total GHG emissions in Nigeria (with net total emission of 366,730 Gg-CO2-eq in 2016) has been a victim of rather dwindling government investment to the sector.

The TNC suggested a Low Carbon Development (LCD) Scenario from the selected Base-year in the period of the study (2016 – 2035), which if implemented will promote GHG emission reductions in GHG emitting sectors of the economy like agriculture. Some of the recommendations for the LCD pathway may have been in use before 2015 without primarily targeting GHG emissions reduction, but which have some potential reduction benefits. According to World Bank (2012), some of the Low Carbon Development Actions suggested in Agriculture sector are shown in Table 9 below.

Sub-sector	Low Carbon Growth Activities	Specific Actions	Benefits	Net Reduction
Crop Production	Sustainable Land Management (SLM)	Minimum or no-tillage, Mulching Crop rotation, integrating leguminous	Yields can be more than 60% higher than under conventional tillage	Conservation tillage can sequester between 0.1 and 1.3 t C/ha/yr globally
		Agroforestry	Crop yield response is uncertain, Studies show an increase by 50 to 200%, others no effect	From 0.86 to 3.75 t C/ha/yr
		Rotational and intermittent irrigation in Rice system	Increased crop yield	
		improved seeds that are transplanted instead of broadcasted in Rice system	Increased crop yield	reduced emission
		Application of organic fertilizers	Increased crop yield	Reduced emission
Livestock	Sustainable grazing management	Restoration of degraded pastures with inputs such as mineral fertilizers, manure application	Increase varies depending on the type and quantity of improvements	Can eliminate between 0.2 to 0.4 t C/ha/yr
			Increase in meat and milk production per animal	Methane production can be reduced by 10% - 40
	Sustainable Livestock Management	Use of improved Breeds	Increase in meat and milk production per animal	Possible decreases in GHG production per unit of livestock product about 1% per year
		Limitation of the number of livestock	Provide safety, speed, hold capacity and weight	Reduce vessel emissions by 10% to 30% can be achieved
		Better feeding practice	Reduce trawl resistance and improved harvest	Reduce energy use and emission
Fisheries & Aquaculture	Capture Fisheries	Vessel Management (efficient engines & larger propellers, better vessel shape & hull modifications, & speed reductions)	Increased quality & yield;	Reduce emission from mill, and
		Gear Management: (multi-rig gear, efficient otter boards, off-bottom fishing, high-strength materials, and large mesh sizes) & Gear using fuel for traditional fishing	Increase productivity, reduce risk	Reduced emission
	Aquaculture	Feed mill & Feed Management		
		Integrated Management		

Table 8: Recommended Low Carbon Actions in Crop Production, Livestock and Fisheries
Source: World Bank (2012)

The estimates for climate actions for each type of activity during the periods of 2015 and 2030 are shown in Tables 11, 12, 13 and 14 respectively. These climate actions are the activities which Nigeria needs to undertake differently to avoid being cut up with the projection by the Third National Communication that emissions may grow to about 900 million tonnes in 2030 with the economy operating under Business-as-Usual approach.

The total investment cost to implement climate actions targeted at achieving the NDC goals in the agricultural sector for all the Investment types between 2015 and 2030 are US$25.29bn, 38.11bn and 5.176bn representing IF, FF and O&M respectively (Table 11). The above values took cognizance of recommendations of the NDC, TNC, APP, NARF, NAIP, CAADP and other relevant policy frameworks locally and offshore. Further assessment shows that the percentage cost of Investment flow in agricultural sector is 36.7% while that of Financial Flow and Operation and Maintenance costs are 55.3% and 7.5% respectively. The higher cost of Financial Flow cost is attributable to the expected greater number and cost of activities which it consists of such as fertilizer and manure use and management, supply of improved seeds and breeds, etc.

The highest investment cost over the period of assessment is in Infrastructure and Services (57.59%). The percentage costs of the other 2 Investment types are 4.66% for Equipment & Machinery and 37.75% for Irrigation, Dam & Drainage. According to Figure 2, the bulk of the estimated funds (56.25%) is to come from Government while 25.8% and 16.89% are coming from Households and Corporations, respectively. The Investment costs were further disaggregated into those required for mitigation action and adaptation actions. The annual cumulative Investment costs estimated for implementing mitigation actions between 2015 and 2030 are US$ 1767.537, US$ 22769.4, US$ 388.3405 for IF, FF and O&M respectively with a subsidy cost of US$80.8139 (Table 13). On the other hand, the investment costs to implement adaptation actions over the same period are US$ 23522.96, US$ 15338.93, and US$ 4787.747 representing IF, FF and O&M respectively (Table 14).

2.2.5.1 Emission Reductions under the Climate Change Scenario

According to Smith *et al*. (2007) there are three broad mitigation potentials in agriculture. These include avoiding emissions, reducing emissions, and enhancing removals. They further provided a guide on how to calculate the mitigation potentials for different climate zones (cool-dry, cool-moist, warm-dry and warm-moist) for each practice in agriculture. Nigeria is considered to have two of these climate zones – warm-dry and warm-moist. The average mitigation potential for each agricultural mitigation option was calculated and used for the country in this assessment.

The identified agricultural mitigation option relevant to the assessment, and which data are available include:

- Promoting the use of improved/early maturing varieties (especially rice production),
- Encouraging improvement in soil management practices to reduce consumption of fertilizer.

- Increasing crop diversification and promoting climate smart agriculture.
- Promoting integrated crop/livestock systems to ensure circular utilization of resources.
- Introduction of low energy production systems using agricultural by-products to meet agricultural energy needs.

Avoiding water logging, draining wetland rice farms once or more times during the growing season and effective irrigation measures enhances carbon mitigation (Follett 2001; Lal 2004; Hasan, 2013). The average mitigation potential for this option calculated using data from Smith *et al*. (2007) for the warm-dry and warm-moist climate zones is 1.14 t CO2-eq. ha^{-1} yr^{-1} (Table 10).

These three options are important for rice farming; the average for the three mitigation options was further calculated and applied in estimating the mitigation potential for rice farming for this assessment.

Table 9: Average per-area annual mitigation potentials for the warm-dry and warm-moist climate regions for non-livestock mitigation options

Mitigation Option	**Average for the two regions (all GHG (t CO2-eq. ha^{-1} yr^{-1}))**
Nutrient management	0.475
Water management	1.14
Use of improved varieties	0.685
Average	**0.767**

Source: Estimates calculated from data provided by Smith et al (2007)

In situations where there are no data and no model was accessed for computing the annual CO_2 equivalent reduction relating to climate actions, the 20% reduction commitment pledged by Nigeria in the NDC document was assumed and multiplied against the annual GHG projections between 2015 to 2030; this particularly was used in the livestock subsector.

The total emission reduction between 2015 and 2030 was 495,653.8 Gg CO_2 eq yr-1 under the climate actions scenario.

Table 10: Climate Change/Target scenario: annual cumulative IF, FF and O&M estimates by investment types (mitigation/adaptation) for year 2015-2030

Year	Infrastructure					Equipment & Machinery					Irrigation					Cumulative Total for All Investment Types				
	IF	FF	O&M	subsidy	CO2/Yr	IF	FF	O&M	Subsidy	CO2/Yr	IF	FF	O&M	Subsidy	CO2/Yr	IF	FF	O&M	Subsidy	CO2/Yr
2015	452.60	817.48	90.03	2.95	17947	77.96	33.96	16.45	10.08	5749.20	789.51	156.44	157.90	1.06	2394	1320.08	1007.886	264.3842	14.0918	26090.2
2016	171.82	1013.80	33.73	4.11	18313	81.67	35.66	17.24	10.39	5848.20	829.38	163.27	165.88	1.11	2298	1082.88	1212.73	216.84	15.62	26459.20
2017	161.08	1339.06	31.55	3.93	18606	85.57	37.44	18.06	10.73	6140.61	870.35	170.45	174.07	1.17	2334	1117.00	1546.94	223.68	15.82	27080.61
2018	226.40	1358.29	44.58	5.28	18904	89.66	39.31	18.93	11.07	6447.64	914.42	177.98	182.88	1.23	2372	1230.48	1575.58	246.39	17.57	27723.64
2019	237.72	1734.84	46.81	5.54	19207	93.95	41.28	19.84	11.44	6770.02	959.59	185.88	191.92	1.29	2410	1291.26	1962.00	258.56	18.26	28387.02
2020	249.60	2375.23	49.15	5.81	19514	98.46	43.34	20.79	11.82	7108.49	1007.87	194.19	201.57	1.35	2448	1355.94	2612.76	271.51	18.99	29070.49
2021	262.08	2396.23	51.60	6.11	19826	103.19	45.51	21.79	12.22	7463.95	1058.27	202.90	211.65	1.42	2487	1423.54	2644.65	285.05	19.75	29776.95
2022	275.19	2418.28	54.18	6.41	20143	108.16	47.78	22.84	12.64	7837.15	1110.78	212.05	222.16	1.49	2527	1494.13	2678.12	299.18	20.55	30507.15
2023	288.95	2441.43	56.89	6.73	20466	113.38	50.17	23.95	13.09	8229.00	1166.42	221.67	233.28	1.57	2568	1568.75	2713.27	314.12	21.38	31263.00
2024	303.39	2465.74	73.40	7.07	20793	118.86	52.68	25.18	13.55	8640.45	1225.19	231.76	245.04	1.64	2609	1647.44	2750.18	343.62	22.27	32042.45
2025	318.56	2491.25	77.07	7.42	21126	124.61	55.32	26.40	14.04	9072.43	1286.10	242.35	257.22	1.73	2651	1729.28	2788.92	360.70	23.19	32849.43
2026	334.49	2518.06	80.93	7.80	21295	130.66	58.08	27.69	14.55	9526.10	1350.15	253.48	270.03	1.81	2672	1815.30	2829.62	378.64	24.16	33493.10
2027	351.21	2546.19	84.97	8.19	21465	137.00	60.99	29.03	15.09	10002.41	1418.36	265.16	283.67	1.90	2693	1906.57	2872.34	397.68	25.18	34160.41
2028	368.77	2579.19	89.22	8.60	21637	143.66	64.04	30.45	15.65	10502.53	1488.73	277.42	297.75	2.00	2715	2001.17	2920.65	417.41	26.25	34854.53
2029	387.21	2610.39	93.68	9.03	21810	150.65	67.24	31.93	16.25	11027.65	1563.27	290.30	312.65	2.10	2736	2101.14	2967.93	438.27	27.37	35573.65
2030	406.58	2650.34	98.37	9.48	21948	158.00	70.60	33.49	16.87	11578.98	1640.98	303.83	328.20	2.20	2758	2205.56	3024.77	460.05	28.55	36320.98
Total	**4795.67**	**33755.80**	**1056.16**	**104.46**	**323037**	**1815.45**	**803.39**	**384.05**	**209.48**	**131944.80**	**18679.38**	**3549.13**	**3735.88**	**25.08**	**40672**	**25290.49**	**38108.33**	**5176.09**	**339.01**	**495653.80**

Table 11contains annual IF, FF, & OM investment forecast in both mitigation and adaptation for the 3 investment types and the corresponding mitigation potential to be achieved.

Table 11: Target scenario: cumulative IF, FF and O&M estimates (mitigation/adaptation) by investment type and funding sources

Investment	Infrastructure Services												Equipment & Machinery												Irrigation/Dam/Drainage			
	Crop Production				Livestock				Fishery				Crop Production				Livestock				Fishery				Crop Production			
	IF	FF	O&M	sub	IF	FF	O&M	Sub	IF	FF	O&M	sub	IF	FF	O&M	Subs	IF	FF	O&M	subs	IF	FF	O&M	SubS	IF	FF	O&M	Subs
Households	1765.36	12932.58	353.07	0.00	23.28	0.00	5.83	0.0	103.55	58.06	20.71	0.00	328.65	77.79	65.73	0.00	183.56	71.54	36.71	0.00	77.22	45.42	15.44	0.00	344.87	1384.16	68.97	0.00
Corporations	950.58	6938.51	190.12	0.00	12.52	0.00	3.14	0.0	200.47	76.18	31.06	19.90	176.97	41.89	35.39	0.00	336.15	156.74	82.27	73.27	221.22	79.56	30.12	75.66	185.70	745.32	37.14	0.00
Government	584.79	13230.94	116.96	46.92	50.01	5.77	12.51	0.00	119.23	76.56	29.81	0.00	90.80	79.79	18.16	60.56	241.90	173.98	60.47	0.00	159.10	76.70	39.77	0.00	18145.95	1419.65	3629.19	25.08
Total funds	3300.72	33102.03	660.14	46.92	85.81	5.77	21.48	0.00	423.26	210.79	81.58	8.33	596.42	199.46	119.28	60.56	761.61	402.25	179.45	73.27	457.54	201.68	85.34	75.66	18676.53	3549.13	3735.31	25.08

Figure 2:Target Scenario: Cummulative IF, FF & O&M by Funding Sources

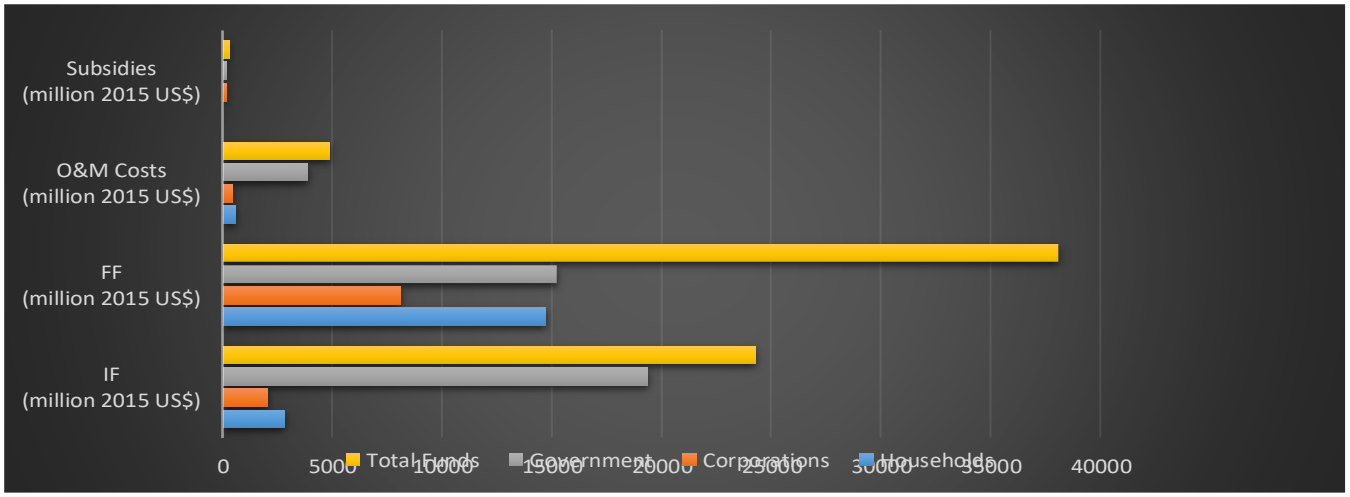


Table 12: Target Scenario: Annual Cumulative IF, FF and O&M Estimates (Mitigation) by Investment Type for Year 2015 – 2030

	Infrastructure					Equipment & Machinery					Irrigation					Cumulative Total for All Investment Types				
Year	IF	FF	O&M	Subsidy	CO2	IF	FF	O&M	Subsidy	CO2	IF	FF	O&M	subsidy	CO2	IF	FF	O&M	Subsidy	CO2

2015	23.17	378.00	4.50	1.22	17947.00	14.03	8.40	3.07	2.20	5749.20	37.51	118.96	7.50	1.06	2394.00	74.71	505.36	15.07	4.48	26090.20
2016	24.33	510.62	4.61	1.28	18313.00	14.73	8.82	8.82	2.31	5848.20	39.38	124.91	7.88	1.11	2298.00	78.45	644.35	15.71	4.70	26459.20
2017	25.55	745.85	4.84	1.34	18606.00	15.47	9.26	3.38	2.43	6140.61	41.35	131.15	8.68	1.17	2334.00	82.37	886.27	16.49	4.93	27723.61
2018	26.82	746.34	5.08	1.41	18904.00	16.24	9.73	3.55	2.55	6447.64	43.42	137.71	9.12	1.23	2372.00	86.49	893.78	17.32	5.18	27723.64
2019	28.16	1010.26	5.33	1.48	19207.00	17.06	10.21	3.73	2.67	6770.02	45.59	144.60	9.57	1.29	2410.00	90.81	1165.07	18.18	5.44	28387.02
2020	29.57	1483.90	5.60	1.55	19826.00	17.91	11.26	4.11	2.81	7108.49	47.87	151.83	10.05	1.35	2448.00	95.36	1646.45	19.09	6.00	29070.49
2021	31.05	1484.47	5.88	1.71	20143.00	18.81	12.41	4.32	2.95	7463.95	50.27	159.42	10.56	1.42	2487.00	100.12	1655.15	20.05	6.30	29776.95
2022	32.60	1485.07	6.17	1.80	20466.00	19.75	13.03	4.53	3.10	7837.15	52.78	167.39	11.08	1.49	2527.00	105.13	1664.28	22.10	6.94	3050.15
2023	34.23	1486.36	6.48	1.89	20793.00	20.73	13.69	4.85	3.25	8229.00	55.42	175.76	11.64	1.57	2527.00	110.39	1673.87	27.42	7.29	31263.00
2024	35.95	1487.06	10.94	1.98	21126.00	21.77	14.37	5.09	3.41	8640.45	58.19	184.55	12.22	1.64	2568.00	115.91	1683.94	28.80	7.66	32042.45
2025	37.74	1487.06	11.49	2.08	2126.00	22.86	15.09	5.09	3.58	9072.43	61.10	193.77	12.22	1.73	2651.00	121.70	1694.52	30.24	8.04	32849.10
2026	39.63	1487.78	12.06	2.18	21295.00	24.00	15.84	5.34	3.76	9526.10	64.15	203.46	12.83	1.81	2672.00	127.79	1705.62	31.75	8.44	31160.41
2027	41.61	1488.55	12.66	2.29	21465.00	25.20	16.64	5.61	3.95	10002.41	67.36	213.64	13.47	1.90	2693.00	134.18	1717.28	33.33	8.86	34854.53
2028	43.69	1490.34	13.30	2.29	21637.00	26.46	15.84	5.89	4.15	10502.53	70.73	224.32	14.15	2.00	2715.00	140.88	1730.51	35.00	9.31	35573.65
2029	45.88	1491.24	13.96	2.41	21637.00	27.78	16.64	6.19	4.36	11027.65	74.27	235.53	14.85	2.10	2736.00	147.93	1743.41	36.75	105.89	35573.65
2030	48.17	1494.76	14.66	2.53	21984.00	29.17	17.47	6.50	4.57	11578.98	77.98	247.31	15.60	2.20	2758.00	155.32	1759.54	36.75	9.31	36320.98
Total	548.17	19756.31	137.56	28.77	323037.00	331.99	198.77	73.30	52.05	131944.80	887.38	2814.32	177.48	25.08	40672.00	1767.54	22769.40	388.34	105.89	495653.80

Table 13: **Target Scenario: Annual Cumulative IF, FF and O&M Estimates (Adaptation) by Investment Type for Year 2015 – 2030**

Year	Infrastructure				Equipment & Machinery				Irrigation				Cumulative Total for All Investment Types			
	IF	FF	O&M	Subsidy	IF	FF	O&M	Subsidy	IF	FF	O&M	Subsidy	IF	FF	O&M	Subsidy
2015	429.43	439.48	85.53	1.74	63.93	25.56	13.38	7.88	752.00	37.48	150.40	0.00	1245.36	502.53	249.32	9.62
2016	147.49	503.18	29.12	2.84	66.94	26.84	14.02	8.08	790.00	38.37	158.00	0.00	1004.43	568.38	201.13	10.92
2017	135.54	593.21	26.71	2.59	70.10	28.18	14.68	8.30	829.00	39.29	165.80	0.00	1034.63	660.68	207.19	10.89
2018	199.58	611.95	39.50	3.87	73.41	29.59	15.37	8.53	871.00	40.26	174.20	0.00	1043.99	681.80	229.07	12.39
2019	209.55	724.58	41.47	4.06	76.89	31.07	16.11	8.76	914.00	41.29	182.80	0.00	1200.45	796.93	240.38	12.82
2020	220.03	891.33	43.55	4.26	80.55	32.62	16.87	9.01	960.00	42.36	192.00	0.00	1260.58	966.31	252.42	13.27
2021	231.03	911.76	45.72	4.48	84.39	34.25	17.68	9.27	1008.00	43.48	201.60	0.00	1323.41	989.49	265.00	13.75
2022	242.58	933.21	48.01	4.70	88.42	35.96	18.52	9.55	1058.00	44.66	211.60	0.00	1389.00	1013.83	278.13	14.25
2023	254.71	955.73	50.41	4.94	92.65	37.76	19.41	9.83	1111.00	45.91	222.20	0.00	1458.36	1039.39	292.02	14.77
2024	267.44	979.38	62.46	5.19	97.09	39.65	20.34	10.14	1167.00	47.21	233.40	0.00	1531.54	1066.23	331.90	15.32
2025	280.82	1004.20	65.59	5.44	101.76	41.63	21.31	10.46	1225.00	48.58	245.00	0.00	1607.58	1094.41	348.41	15.90
2026	294.86	1030.28	68.87	5.72	106.66	43.71	22.34	10.79	1286.00	50.01	257.20	0.00	1687.52	1124.00	348.41	16.51
2027	309.60	1057.65	72.31	6.00	111.80	45.90	23.42	11.14	1351.00	51.52	270.20	0.00	1772.40	1155.07	365.93	17.14
2028	325.08	1088.85	75.92	6.30	117.20	48.19	24.55	11.51	1418.00	53.11	283.60	0.00	1860.28	1190.15	384.08	17.81
2029	341.34	1119.15	79.72	6.62	122.87	50.60	25.74	11.89	1489.00	54.77	297.80	0.00	1953.21	1224.52	403.27	18.51
2030	358.41	1155.58	83.71	6.95	128.82	53.13	26.99	12.30	1563.00	56.52	312.60	0.00	2050.23	1265.23	423.30	19.25
Total	**4247.49**	**13999.49**	**918.59**	**75.69**	**1483.46**	**604.62**	**310.75**	**157.43**	**17792.00**	**734.82**	**3558.40**	**0.00**	**23522.96**	**15338.93**	**4787.75**	**233.12**

Table 14: **Target Scenario: Discounted IF, FF and O&M Estimates (Mitigation/Adaptation) For 2015-2030**

Year	Infrastructure & Services				Equipment & Machinery				Irrigation/Dam/Drainage				Cumulative Total for All Investment Types			
	IF	FF	O&M	subsidy	IF	FF	O&M	subsidy	IF	FF	O&M	subsidy	IF	FF	O&M	subsidy
2015	452.60	817.48	90.03	3.62	77.96	33.96	16.45	10.08	789.51	156.44	157.90	1.06	1320.08	1007.89	264.38	14.76
2016	153.02	903.89	30.04	4.28	72.67	31.72	15.34	9.25	739.53	145.59	147.91	0.99	965.23	1081.19	193.29	14.52
2017	127.73	1064.49	25.02	3.69	67.75	29.63	14.30	8.49	691.99	135.52	138.34	0.93	887.46	1229.63	177.66	13.11
2018	160.02	962.72	31.51	4.26	63.17	27.67	13.33	7.80	648.26	126.17	129.65	0.86	871.44	1116.57	174.49	12.92
2019	149.67	1096.38	29.47	3.98	58.90	25.85	12.43	7.17	606.58	117.50	121.35	0.81	815.15	1239.73	163.26	11.96
2020	139.99	1338.48	27.57	3.72	54.92	24.15	11.59	6.59	568.08	109.45	113.65	0.76	762.99	1472.08	152.81	11.07
2021	130.93	1203.96	25.78	3.48	51.22	22.55	10.81	6.06	531.86	101.97	106.37	0.71	714.01	1328.49	142.97	10.25
2022	122.46	1083.34	24.12	3.25	47.77	21.07	10.08	5.58	497.77	95.03	99.55	0.66	668.00	1199.44	133.75	9.49
2023	114.54	975.16	22.56	3.04	44.56	19.68	9.41	5.14	466.08	88.57	93.21	0.62	625.18	1083.41	125.18	8.80
2024	107.13	878.11	25.83	2.84	41.56	18.38	8.80	4.73	436.53	82.57	87.35	0.58	585.22	979.06	121.98	8.15
2025	100.20	791.03	24.15	2.65	38.77	17.17	8.21	4.36	408.58	76.99	81.71	0.54	547.56	885.19	114.07	7.55
2026	93.72	712.87	22.58	2.48	36.17	16.04	7.66	4.02	382.46	71.80	76.45	0.51	512.36	800.70	106.69	7.01
2027	87.99	642.69	21.12	2.32	33.75	14.98	7.15	3.71	358.26	66.97	71.65	0.48	479.99	724.64	99.91	6.50
2028	81.99	580.41	19.74	2.17	31.49	13.99	6.67	3.42	335.29	62.45	67.05	0.45	448.77	656.85	93.46	6.04
2029	76.69	523.74	18.46	2.02	29.38	13.07	6.22	3.16	313.94	58.23	62.78	0.42	420.01	595.04	87.46	5.60
2030	71.73	474.04	17.26	1.89	27.42	12.21	5.81	2.91	293.84	54.40	58.76	0.39	392.99	540.65	81.83	5.20
Total	2170.07	14048.80	455.25	49.70	777.45	342.11	164.27	92.47	8068.57	1549.77	1613.71	10.83	11016.10	15940.68	2233.22	153.00

Table 15 contains discounted IF, FF, & OM investment forecast in both mitigation and adaptation measures for the 3 investment types. The discount rate is 12.15% which was the twelve-month average of the inter-bank call rate (interest rate) from the CBN records in 2015.

Table 15: **Target Scenario: Discounted IF, FF and O&M Estimates (Mitigation) for 2015-2030**

Year	Infrastructure & Services				Equipment & Machinery				Irrigation/Dam/Drainage				Cumulative Total for All Investment Types			
	IF	FF	O&M	subsidy	IF	FF	O&M	subsidy	IF	FF	O&M	subsidy	IF	FF	O&M	subsidy
2015	23.17	378.00	4.49	1.22	14.03	8.40	3.07	2.20	37.51	118.96	7.50	1.06	74.71	505.36	15.06	4.48
2016	21.63	455.28	4.10	1.13	13.10	7.84	2.86	2.05	35.12	111.37	7.02	0.99	69.85	574.49	13.98	4.18
2017	20.19	592.95	3.82	1.06	12.22	7.32	2.67	1.92	32.88	104.27	6.58	0.93	65.30	704.54	13.07	3.90
2018	18.85	529.04	3.57	0.99	11.41	6.83	2.50	1.79	30.78	97.67	6.16	0.87	61.04	633.54	12.22	3.65
2019	17.60	638.53	3.33	0.92	10.65	6.38	2.33	1.67	28.82	91.40	5.76	0.81	57.07	736.31	11.43	3.41
2020	16.43	836.30	3.11	0.86	9.94	5.95	2.17	1.56	26.98	85.57	5.40	0.76	53.35	927.82	10.68	3.18
2021	15.33	745.96	2.90	0.80	9.28	5.55	2.03	1.45	25.26	80.12	5.05	0.71	49.87	831.63	9.99	2.97
2022	14.31	665.39	2.71	0.75	8.66	5.18	1.89	1.36	23.65	75.01	4.73	0.66	46.62	745.59	9.33	2.77
2023	13.36	593.54	2.53	0.70	8.08	4.84	1.77	1.27	22.14	70.23	4.43	0.63	43.59	668.61	8.73	2.59
2024	12.47	529.45	3.79	0.65	7.54	4.52	1.68	1.18	20.73	65.75	4.15	0.59	40.75	599.72	9.62	2.42
2025	11.65	472.30	3.54	0.61	7.04	4.21	1.57	1.10	19.41	61.56	3.88	0.55	38.09	538.07	8.99	2.26
2026	10.87	421.32	3.31	0.57	6.57	3.93	1.46	1.03	18.17	57.63	3.63	0.51	35.61	482.88	8.40	2.11
2027	10.15	375.85	3.09	0.53	6.13	3.67	1.37	0.96	17.01	53.96	3.40	0.48	33.29	433.48	7.85	1.97
2028	9.47	335.51	2.88	0.50	5.72	3.43	1.27	0.90	15.93	50.52	3.19	0.45	31.13	389.45	7.34	1.84
2029	8.84	299.32	2.69	0.47	5.34	3.20	1.19	0.84	14.91	47.30	2.98	0.42	29.10	349.82	6.86	1.73
2030	8.26	267.49	2.51	0.43	4.99	2.98	1.11	0.78	13.96	44.28	2.79	0.39	27.20	314.76	6.41	1.61
Total	232.59	8136.22	52.38	12.19	140.70	84.24	30.94	22.06	383.29	1215.60	76.66	10.83	756.58	9436.06	159.98	45.08

Table 16: **Target Scenario: Discounted IF, FF and O&M Estimates (Adaptation) for 2015-2030**

Year	Infrastructure & Services				Equipment & Machineries				Irrigation/Dam/Drainage				Cumulative Total for All Investment Types			
	IF	FF	O&M	subsidy	IF	FF	O&M	Subsidy	IF	FF	O&M	Subsidy	IF	FF	O&M	Subsidy
2015	429.43	439.48	85.53	2.40	63.93	25.56	13.38	7.88	752.00	37.48	150.40	0.00	1245.36	502.53	249.32	10.28
2016	131.39	448.61	25.94	3.15	59.58	23.88	12.47	7.20	704.41	34.21	140.88	0.00	895.38	506.70	179.30	10.34
2017	107.53	471.54	21.19	2.63	55.53	22.31	11.63	6.58	659.11	31.24	131.82	0.00	822.17	525.09	164.64	9.21
2018	141.17	433.69	27.94	3.27	51.76	20.84	10.84	6.01	617.48	28.54	123.50	0.00	810.40	483.07	162.27	9.29
2019	132.07	457.85	26.14	3.06	48.25	19.47	10.10	5.50	577.76	26.10	115.55	0.00	758.08	503.42	151.80	8.56
2020	123.56	502.19	24.46	2.86	44.98	18.19	9.42	5.03	541.10	23.87	108.22	0.00	709.64	544.26	142.10	7.89
2021	115.59	458.00	22.88	2.68	41.94	17.00	8.78	4.61	506.60	21.85	101.32	0.00	664.14	496.86	132.98	7.28
2022	108.15	417.95	21.41	2.50	39.11	15.88	8.19	4.22	474.12	20.02	94.82	0.00	621.38	453.85	124.42	6.72
2023	101.18	381.62	20.03	2.34	36.48	14.84	7.64	3.87	443.94	18.34	88.79	0.00	581.59	414.81	116.45	6.21
2024	94.66	348.66	22.04	2.19	34.02	13.86	7.12	3.55	415.79	16.82	83.16	0.00	544.47	379.35	112.32	5.74
2025	88.56	318.74	20.61	2.04	31.73	12.95	6.64	3.26	389.17	15.43	77.83	0.00	509.46	347.12	105.09	5.30
2026	82.85	291.55	19.28	1.91	29.60	12.10	6.20	2.99	364.29	14.17	72.86	0.00	476.74	317.82	98.33	4.90
2027	77.51	266.84	18.03	1.79	27.61	11.31	5.78	2.75	341.24	13.01	68.25	0.00	446.37	291.16	92.06	4.53
2028	72.52	244.90	16.86	1.67	25.04	10.57	5.39	2.52	319.36	11.96	63.83	0.00	416.92	267.43	86.08	4.19
2029	67.85	224.42	15.77	1.56	24.04	9.87	5.03	2.32	299.02	11.00	59.80	0.00	390.91	245.29	80.61	3.88
2030	63.47	206.55	14.75	1.46	22.43	9.22	4.70	2.13	279.88	10.12	55.98	0.00	365.78	225.89	75.42	3.59
Total	1937.48	5912.59	402.86	37.50	636.75	257.87	133.33	70.41	7685.28	334.18	1537.06	0.00	10259.52	6504.63	2073.24	107.92

Chapter 3

3.0 RESULTS

3.1 Incremental Changes in IF, FF, O&M Costs, and Subsidy Costs

The incremental changes for Investment costs are derived by subtracting BAU costs from the costs for Climate Scenario. The estimates obtained provide perspective on the additional cost of investment required above the Business-as-Usual approach.

According to table 18, the Incremental IF, FF, O&M and subsidy values are US$ 23.2546bn, US$ 35.96bn, US$ 4.7654bn and US$ 327.52m respectively with an overall value of US$64.31bn over a period of 2015 and 2030. When discounted**,** the Incremental IF, FF, O&M and subsidy are US$ 10.07bn, US$ 14.956bn, US$ 2.042bn and US$ 133.696m respectively with an overall value of US$ 27.209 bn over a period of 2015 to 2030 (Table 20). When segregated in terms of Mitigation and Adaptation, the discounted incremental IF, FF, O&M and subsidy costs for Mitigation are US$ 756.5793mn, US$ 9.436bn, US$ 159.982m and US$ 45.08165m, respectively. The discounted incremental IF, FF, O&M and subsidy costs for Adaptation are US$ 9.3879bn, US$ 5.5357bn, US$ 1.8986bn and US$ 101.2443m respectively (Tables 22 and 23). During the period 2015-2030, agricultural sector will require an estimated US27.209 billion of investments with 57.59%, 4.66% and 37.75% in Infrastructure & Services, Equipment & Machinery, Irrigation/Drainages, respectively. According to Figure 3, the climate actions in the Crop Production subsector will require an investment cost estimate of US$ 25.289bn (or 92.87% of the total Agriculture Investment Cost) while Livestock and Fishery subsectors require US$ 1.301bn (4.77%) and US$ 638.342m (2.36%).

As shown in Table 19, some of the mitigation actions and associated Investment costs are: Developing improved livestock breeds (US$ 533.09m); Production of improved fodder and forage seeds for livestock productivity (US$ 533.05m); Provision of facilities for Improved manure Management (US$ 925.9m); Crop rotation (fertilizer for Maize-Soybean and other legumes rotation) (US$ 5.23bn); Fertilizer quality control (US$ 3.8289m); Improved rice seed (early maturing and with low exudation rate) (US$ 898.83m); Sustainable/efficient water resources management (US$ 220.22m). For adaptation actions among the list activities and associated costs are: Construction of embankment (dikes) (US$ 110.14m); Provision of potable water for livestock (US$ 177.68m); Establishment of grazing reserves (US$ 735.72m); Establishment of fattening schemes (US$ 402.48M); Establishment And development of feedlots (US$ 340.35m); Soil testing equipment for determining crop needs (US$ 49.8m); Mechanization/Tractor (US$ 205.215m); Improved rice milling machines (US$ 19.019m); Support to Research Institute to breed improved rice varieties (US$ 73.07m); and Agroforestry and capacity building (US$ 1.113bn).

This assessment observed that there was continuous decline in Foreign Direct Investment (FDI) into the country over the past five years which also affected investments in the agricultural sector. To realizing the climate actions, it will be important to intensify international collaboration to gain the support needed to achieve the NDC goals particularly under the prevailing economic downturn occasioned by COVID-19 pandemic.

Table 17: **Incremental Annual IF, FF, O&M Estimates by Investment Types in million 2015 US$ for 2015- 2030**

INCREMENTAL ANNUAL IF, FF, O&M ESTIMATES BY INVESTMENT TYPES FOR 2015- 2030																
	INFRASTRUCTURE				**EQUIPMENT/MACHINES**				**IRRIGATION/DAM/DRAINAGE**				**Cumulative Total for All Investment Types**			
Year	IF	FF	O&M	Subsidy	IF	FF	O&M	Subsidy	IF	FF	O&M	Subsidy	IF	FF	O&M	Subsidy
2015	386.54	709.50	76.54	3.24	75.50	32.57	16.07	9.15	752.98	154.97	150.60	1.06	1215.02	897.04	243.20	13.45
2016	104.11	903.12	19.90	4.43	79.15	34.23	16.84	9.43	791.94	161.76	158.39	1.11	975.20	1099.11	195.13	14.97
2017	91.68	1225.61	17.37	4.27	82.98	35.98	17.66	9.72	831.98	168.89	166.40	1.17	1006.64	1430.48	201.42	15.16
2018	155.26	1242.00	30.05	5.64	87.00	37.81	18.51	10.03	875.08	176.39	175.02	1.23	1117.35	1456.20	223.58	16.89
2019	164.80	1615.65	31.91	5.93	91.23	39.74	19.41	10.38	919.27	184.25	183.85	1.29	1175.31	1839.64	235.18	17.59
2020	174.86	2253.06	33.88	6.24	95.67	41.77	20.35	10.72	966.54	192.51	193.31	1.35	1237.08	2487.34	247.54	18.31
2021	185.47	2271.01	35.95	6.56	100.34	43.89	21.34	11.07	1015.91	201.19	203.18	1.42	1301.71	2516.09	260.48	19.06
2022	196.66	2289.92	38.14	6.90	105.23	46.13	22.38	11.45	1067.36	210.30	213.47	1.49	1369.26	2546.35	274.00	19.84
2023	208.46	2309.86	40.45	7.26	110.39	48.48	23.48	11.84	1121.91	219.87	224.38	1.57	1440.76	2578.21	288.31	20.67
2024	220.89	2330.88	56.55	7.63	115.79	50.94	24.70	12.26	1179.57	229.91	235.91	1.64	1516.25	2611.74	317.16	21.54
2025	234.00	2353.03	59.80	8.02	121.47	53.53	25.91	12.69	1239.34	240.46	247.87	1.73	1594.81	2647.03	333.57	22.44
2026	247.81	2376.38	63.22	8.44	127.43	56.26	27.18	13.15	1302.23	251.54	260.45	1.81	1677.47	2684.17	350.84	23.41
2027	262.37	2400.97	66.82	8.88	133.69	59.11	28.51	13.63	1369.24	263.17	273.85	1.90	1765.30	2723.26	369.18	24.41
2028	277.71	2430.34	70.62	9.33	140.27	62.12	29.91	14.14	1438.38	275.39	287.68	2.00	1856.36	2767.85	388.20	25.47
2029	293.87	2457.81	74.61	9.81	147.18	65.27	31.38	14.67	1511.65	288.22	302.33	2.10	1952.71	2811.30	408.33	26.58
2030	310.91	2493.95	78.82	10.31	154.44	68.59	32.93	15.23	1588.08	301.69	317.62	2.20	2053.42	2864.23	429.36	27.74
Total	**3515.42**	**31663.11**	**794.63**	**112.89**	**1767.75**	**776.42**	**376.56**	**189.56**	**17971.46**	**3520.51**	**3594.29**	**25.08**	**23254.63**	**35960.04**	**4765.49**	**327.53**

Data contained in Table 18 are derived from the differences in the corresponding values in Table 11 and Table 6

Table 18: **Climate Actions, Investment types and Costs (US$) in Crop Production, Livestock and Fishery provided for within the Incremental Cost during 2015 -2030 period**

	LIVESTOCK and FISHERY				
	CLIMATE ACTION (ITEM)	**INVESTMENT**	**ACTION TYPE**	**COST (US$)**	**Percentage of Total Cost of Investment**
1	Construction of embankment (dikes)	Infrastructure	Adaptation	110.14m	0.44%
2	Provision of potable water for livestock	Infrastructure	Adaptation	177.68m	0.71%
3	Establishment of fattening schemes	Infrastructure	Adaptation	402.48M	1.42
4	Establishment & development of feedlots	Infrastructure	Adaptation	340.35m	1.36%
5	Establishment of grazing reserves	Infrastructure	Adaptation	735.72m	2.94%
6	Developing improved livestock breeds	Infrastructure	Mitigation	533.09m	2.13%
7	Construction of standard model abattoirs with complimentary facilities	Infrastructure	Mitigation	175.18m	0.70%
8	Culling of animals	Infrastructure	Mitigation	90.09m	0.36%
9	Vaccination of livestock and cross border diseases surveillance	Infrastructure	Adaptation	90.09m	0.36%
10	Establishment of livestock services centers.	Infrastructure	Adaptation	215.22m	0.86%
11	Production of improved fodder and forage seeds for livestock productivity	Infrastructure	Mitigation	533.05m	2.13%
12	Extension services	Infrastructure		735.76m	2.94%
13	Provision of water harvesting facilities	Equipment	Adaptation	445.46m	1.78%
14	Establish model cottage dairy processing facilities in grazing reserves.	Equipment	Adaptation	735.76m	2.94%
15	Provision of Early Warning Systems Equipment	Equipment	Mitigation	625.65m	2.50%
16	Provision of facilities for Improved manure management	Equipment	Mitigation	925.9m	3.70%
17	Training and capacity building on manure management	Equipment	Mitigation	265.27m	1.06%
18	Establishment of livestock breeding and multiplication centres	Equipment	Adaptation	735.76m	2.94%

	CROP PRODUCTION				
S/N	**COST LINE**	**INVESTMENT TYPE**	**MITIGATION OR ADAPTATION**	**COST US$**	**Percentage of Total cost of Investment**
19	Crop rotation (fertilizer for Maize-Soybean and other legumes rotation)	Infrastructure	Mitigation	5.23bn	20.9%
20	Fertilizer quality control	Infrastructure	Mitigation	3.8289m	0.0153%
21	Crop rotation (Improved maize	Infrastructure	Adaptation	1.018bn	4.07%

	and soybean seed)				
22	Pest/weed and disease control for crop rotation	Infrastructure	Adaptation	695.7m	2.78%
23	Improved rice seed (early maturing and with low exudation rate)	Irrigation	Mitigation	898.83m	3.59%
24	Soil fertility management in rice farms (fertilizer with attributes to suppress methane on rice fields such as ammonium sulphate)	Irrigation	Mitigation	7.007m	0.028%
25	Support to Research Institute to breed improved rice varieties	Irrigation	Adaptation	73.07m	0.292%
26	Sustainable/efficient water resources management	Irrigation	Mitigation	220.22m	0.88%
27	Dams and irrigation (new ones and making existing ones more effective and efficient)	Irrigation	Adaptation with some mitigation co-benefits	4.516bn	18.05%
28	Training and extension on improved/resilient farming techniques/practices (especially in managing rice farming)	Irrigation	Adaptation	152.65m	0.61%
29	Pest and disease control on rice farms	Irrigation	Adaptation	104.11m	0.416%
30	Soil testing equipment for determining crop needs	Equipment	Adaptation	49.8m	0.199%
31	Mechanization/Tractor	Equipment	Adaptation	205.215m	0.82%
32	Improved rice milling machines	Equipment	Adaptation	19.019m	0.076%
33	Storage facilities, silos, grain reserve	Infrastructure	Adaptation	82.583m	0.33%
34	Promotion of conservation Agriculture & reclamation of problem soils	Infrastructure	Mitigation	208.45m	0.833%
35	Insurance	Infrastructure	Adaptation	12.012m	0.048%
36	Milling accessories for other crops	Infrastructure	Adaptation	145.15m	0.58%
37	Adoption of other soil conservation practices, manure, water harvesting, local erosion control practices	Infrastructure	Adaptation	585.61m	2.34%
38	Improved cassava varieties	Infrastructure	Adaptation	1.714bn	6.85%
39	Soil fertility management in cassava farms	Infrastructure	Adaptation with mitigation co-benefits	46.55m	0.186%
40	Pests/weeds and disease control in rice cassava farming	Infrastructure	Adaptation	17.519m	0.070%
41	Agroforestry and capacity building	Infrastructure	Adaptation & mitigation	1.113bn	4.45%
		TOTAL (IF&FF Discounted Incremental Cost)		25.026bn	100%

Please note that items listed above are not individually regarded as climate adaptation or mitigation actions, but the focus will lead to the following climate actions:

- Promoting the use of improved/early maturing varieties (especially rice production),
- Encouraging improvement in soil management practices to reduce consumption of fertilizer.
- Increasing crop diversification and promoting climate smart agriculture.
- Promoting integrated crop/livestock systems to ensure circular utilization of resources.
- Introduction of low energy production systems using agricultural by-products to meet agricultural energy needs

Table 19: **Incremental Cumulative Discounted IF, FF, O&M Estimates by Investment Type for 2015-2030**

ANNUAL CUMULATIVE DISCOUNTED INCREMENTAL COST FOR IF, FF, O&M FOR 2015-2030																
Year	INFRASTRUCTURE/SERVICES				EQUIPMENT/MACHINERY				IRRIGATION/DAM/DRAINAGE				TOTAL			
	IF	FF	O&M	Subsidy	IF	FF	O&M	Subsidy	IF	FF	O&M	Subsidy	IF	FF	O&M	Subsidy
2015	386.54	709.50	76.54	3.24	75.50	32.57	16.07	9.15	752.98	154.97	150.60	1.06	1215.02	897.04	243.20	13.45
2016	92.66	805.20	17.71	3.94	70.29	30.32	14.95	8.33	706.15	144.24	141.23	0.99	869.10	979.76	173.89	13.26
2017	72.58	974.29	13.75	3.38	65.44	28.22	13.91	7.57	661.47	134.28	132.29	0.93	799.49	1136.80	159.96	11.88
2018	109.63	880.29	21.22	3.97	60.92	26.25	12.95	6.87	620.37	125.04	124.07	0.87	790.91	1031.59	158.24	11.72
2019	103.62	1021.04	20.07	3.72	56.70	24.41	12.04	6.26	581.10	116.47	116.22	0.81	741.42	1161.93	148.33	10.80
2020	97.91	1269.63	18.98	3.48	52.77	22.69	11.20	5.68	544.79	108.51	108.96	0.76	695.47	1400.83	139.14	9.92
2021	92.49	1141.03	17.93	3.26	49.11	21.08	10.42	5.13	510.57	101.11	102.11	0.71	652.16	1263.23	130.47	9.11
2022	87.34	1025.83	16.95	3.05	45.69	19.57	9.69	4.63	478.32	94.24	95.66	0.67	611.34	1139.64	122.29	8.35
2023	82.45	922.60	16.01	2.85	42.50	18.16	9.00	4.17	448.30	87.85	89.66	0.63	573.24	1028.61	114.67	7.65
2024	78.07	830.09	19.91	2.67	39.52	16.84	8.39	3.74	420.27	81.92	84.05	0.59	537.87	928.85	112.36	7.00
2025	73.41	747.12	18.68	2.50	36.75	15.60	7.80	3.34	393.73	76.39	78.75	0.55	503.88	839.12	105.23	6.39
2026	69.24	672.74	17.59	2.34	34.15	14.44	7.24	2.97	368.89	71.25	73.78	0.51	472.28	758.44	98.60	5.83
2027	65.29	606.01	16.55	2.19	31.73	13.36	6.72	2.63	345.85	66.47	69.17	0.48	442.87	685.84	92.44	5.30
2028	61.55	546.89	15.57	2.05	29.47	12.34	6.23	2.30	323.95	62.02	64.79	0.45	414.97	621.25	86.59	4.80
2029	58.01	493.10	14.65	1.92	27.36	11.38	5.78	2.00	303.57	57.88	60.71	0.42	388.94	562.36	81.14	4.34
2030	54.49	446.03	13.73	1.79	25.38	10.49	5.36	1.72	284.37	54.02	56.87	0.39	364.24	510.54	75.96	3.90
Total	**1585.27**	**13091.40**	**335.84**	**46.36**	**743.29**	**317.73**	**157.75**	**76.51**	**7744.67**	**1536.68**	**1548.93**	**10.83**	**10073.23**	**14945.81**	**2042.53**	**133.70**

Data contained in Table 20 are derived from the differences in the corresponding values in Table 15 and Table 8

Figure 3: Discounted Incremental Cumulative Investment Costs By Subsectors and Investment Types

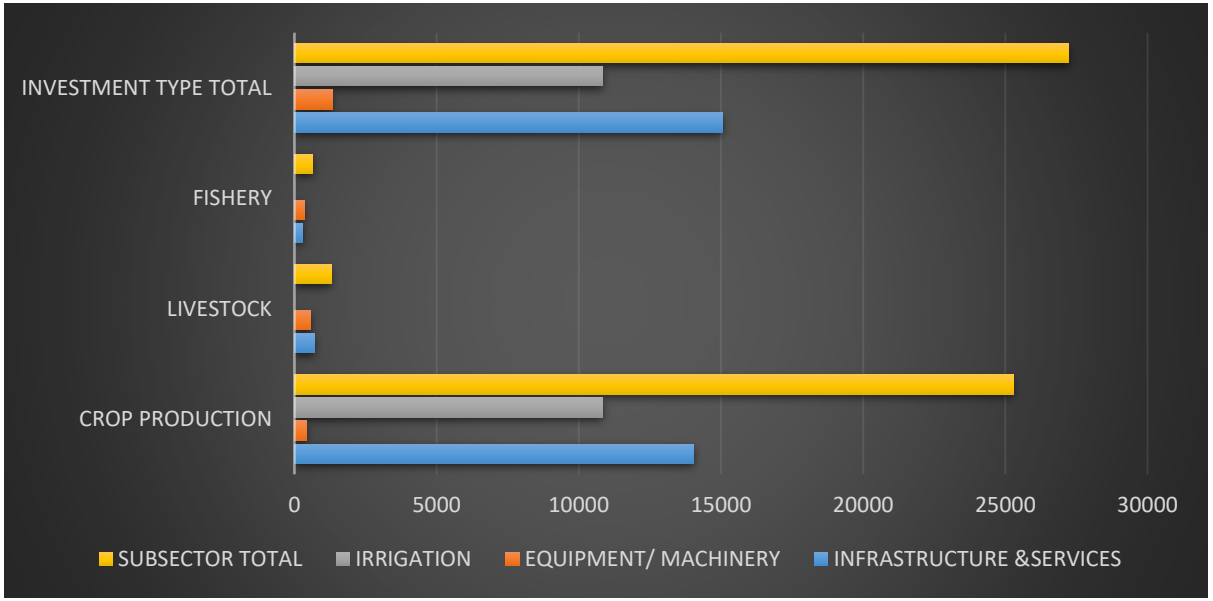


Table 20: Incremental Cumulative Discounted IF, FF, & O&M Estimates by Investment Type and Funding Sources for 2015 – 2030

INCREMENTAL CUMULATIVE DISCOUNTED IF, FF, & O&M ESTIMATES BY INVESTMENT TYPE/ENTITIES FOR 2015 – 2030 (2015 Million USD)																
Investment Entity Category/Source of Funds	**INFRASTRUCTURE & SERVICES**				**EQUIPMENT/MACHINERY**				**IRRIGATION/DAM/DRAINAGE**				**TOTAL**			
	IF	FF	O&M	Subsidy	IF	FF	O&M	Subsidy	IF	FF	O&M	Subsidy	IF	FF	O&M Costs	Subsidy
Households	619.10	4866.34	127.04	22.62	212.22	83.17	42.44	0.00	1573.37	604.41	314.67	0.00	2404.69	5553.92	484.16	22.62
Corporations	574.59	2709.48	110.71	8.43	290.98	118.24	58.47	63.12	847.20	325.45	169.44	0.00	1712.77	3153.17	338.62	71.55
Government	391.55	5515.79	98.08	15.31	252.60	128.54	59.97	26.02	5324.10	606.82	1064.82	10.83	5968.25	6251.14	1222.86	52.16
Total Funds	1585.24	13091.61	335.83	46.36	755.80	329.94	160.88	89.14	**7744.67**	**1536.68**	**1548.93**	**10.83**	10085.71	14958.24	2045.64	146.33

Table 21: **Incremental Cumulative Discounted IF, FF, O&M Estimates by Investment Type (Mitigation) for 2015-2030**

Year	Infrastructure				Equipment/Machinery				Irrigation/Dam/Drainage				Total for All Investment Types			
	IF	FF	O&M	subsidy	IF	FF	O&M	subsidy	IF	FF	O&M	subsidy	IF	FF	O&M	Subsidy
2015	23.17	378.00	4.50	1.22	14.03	8.40	3.07	2.20	37.51	118.96	7.50	1.06	74.71	505.36	15.07	4.48
2016	21.63	455.28	4.10	1.13	13.10	7.84	2.86	2.05	35.12	111.38	7.02	0.99	69.85	574.50	13.98	4.18
2017	20.19	592.95	3.82	1.06	12.22	7.32	2.67	1.92	32.88	104.28	6.58	0.93	65.30	704.55	13.07	3.90
2018	18.85	529.04	3.57	0.99	11.41	6.83	2.50	1.79	30.78	97.63	6.16	0.87	61.04	633.50	12.22	3.65
2019	17.60	638.53	3.33	0.92	10.65	6.38	2.33	1.67	28.82	91.40	5.76	0.81	57.07	739.31	11.43	3.41
2020	16.43	836.30	3.11	0.86	9.94	5.95	2.17	1.56	26.98	85.58	5.40	0.76	53.35	927.82	10.68	3.18
2021	15.33	745.96	2.90	0.80	9.28	5.55	2.03	1.45	25.26	80.12	5.05	0.71	49.87	831.64	9.99	2.97
2022	14.31	665.39	2.71	0.75	8.66	5.18	1.89	1.36	23.65	75.01	4.73	0.67	46.62	745.59	9.33	2.78
2023	13.36	593.54	2.53	0.70	8.08	4.84	1.77	1.27	22.14	70.23	4.43	0.63	43.59	668.61	8.73	2.59
2024	12.47	529.45	3.79	0.65	7.54	4.52	1.68	1.18	20.73	65.75	4.15	0.59	40.75	599.72	9.62	2.42
2025	11.65	472.30	3.54	0.61	7.04	4.21	1.57	1.10	19.41	61.56	3.88	0.55	38.09	538.07	8.99	2.26
2026	10.87	421.32	3.31	0.57	6.57	3.93	1.46	1.03	18.17	57.64	3.63	0.51	35.61	482.89	8.40	2.11
2027	10.15	375.85	3.09	0.53	6.13	3.67	1.37	0.96	17.01	53.96	3.40	0.48	33.29	433.48	7.85	1.97
2028	9.47	335.51	2.88	0.50	5.72	3.43	1.27	0.90	15.93	50.52	3.19	0.45	31.13	389.46	7.34	1.84
2029	8.84	299.32	2.69	0.46	5.34	3.20	1.19	0.84	14.91	47.30	2.98	0.42	29.10	349.82	6.86	1.72
2030	8.26	267.49	2.51	0.43	4.99	2.98	1.11	0.78	13.96	44.28	2.79	0.39	27.20	314.76	6.41	1.61
Total	**232.59**	**8136.22**	**52.38**	**12.19**	**140.70**	**84.24**	**30.94**	**22.06**	**383.29**	**1215.60**	**76.66**	**10.83**	**756.58**	**9436.06**	**159.98**	**45.08**

Data contained in Table 22 are like values of the corresponding year in Table 8. It is assumed that before the NDC no significant mitigation measures were adopted in the agricultural sector.

Table 22: **Incremental Cumulative Discounted IF, FF, O&M Estimates by Investment Type (Adaptation) for 2015-2030**

Year	Incremental Cumulative Discounted IF, FF and O&M estimates by Investment Types (Adaption) for 2015 - 2030 (Million 2015USD)															
	Infrastructure & Services				Equipment & Machinery				Irrigation/ Dam/Drainage				Cummulative Total for All Investment Types			
	IF	FF	O&M	subsidy	IF	FF	O&M	subsidy	IF	FF	O&M	subsidy	IF	FF	O&M	Subsidy
2015	368.96	331.93	73.44	2.02	62.64	25.31	13.13	7.50	715.47	36.01	143.09	0.00	1147.07	393.25	229.66	9.53
2016	76.12	350.31	14.89	2.80	58.40	23.65	12.24	6.85	671.03	32.86	134.21	0.00	805.55	406.83	161.33	9.66
2017	57.02	381.70	11.09	2.32	54.45	22.10	11.41	6.26	628.59	30.01	125.72	0.00	740.07	433.81	148.21	8.58
2018	95.00	351.58	18.71	2.99	50.77	20.66	10.63	5.73	589.59	27.42	117.92	0.00	735.36	399.65	147.26	8.71
2019	89.87	382.81	17.70	2.80	47.35	19.30	9.91	5.24	552.27	25.07	110.45	0.00	689.50	427.18	138.07	8.03
2020	84.99	433.60	16.74	2.62	44.16	18.04	9.24	4.79	517.80	22.93	103.56	0.00	649.96	474.57	129.54	7.41
2021	80.35	395.32	15.83	2.46	41.19	16.86	8.61	4.39	485.31	20.99	97.06	0.00	606.85	433.17	121.51	6.85
2022	75.93	360.66	14.96	2.30	38.43	15.75	8.03	4.02	454.66	19.23	90.93	0.00	569.02	395.64	113.93	6.32
2023	71.74	329.26	14.14	2.15	35.85	14.72	7.49	3.69	426.15	17.62	85.23	0.00	533.74	361.61	106.86	5.84
2024	67.75	300.81	16.66	2.02	33.45	13.75	6.98	3.38	399.54	16.16	79.91	0.00	500.73	330.73	103.55	5.40
2025	63.96	275.00	15.69	1.89	31.21	12.85	6.51	3.10	374.32	14.83	74.86	0.00	469.49	302.68	97.07	4.99
2026	60.37	251.58	14.78	1.77	29.12	12.01	6.08	2.85	350.71	13.62	70.14	0.00	440.21	277.21	91.00	4.62
2027	56.97	230.31	13.92	1.66	27.18	11.22	5.67	2.62	328.83	12.51	65.77	0.00	412.98	254.04	85.36	4.28
2028	53.74	211.51	13.11	1.55	25.36	10.49	5.29	2.41	308.02	11.50	61.60	0.00	387.13	233.50	80.00	3.96
2029	50.69	193.90	12.34	1.45	23.67	9.80	4.93	2.21	288.66	10.58	57.73	0.00	363.02	214.28	75.00	3.67
2030	47.79	178.66	11.61	1.36	22.10	9.16	4.60	2.03	270.41	9.74	54.08	0.00	340.29	197.56	70.30	3.40
Total	**1401.25**	**4958.93**	**295.61**	**34.17**	**625.34**	**255.68**	**130.75**	**67.08**	**7361.38**	**321.08**	**1472.28**	**0.00**	**9387.97**	**5535.69**	**1898.64**	**101.24**

Data contained in Table 23 are derived from the differences in the corresponding values in Table 17 and Table 8

3.2 Policy Implications

It is key that willingness is demonstrated by the Government, private sector, and donor agencies if the NDC actions are to be realized. There is need to develop policies and draw up action plans on the capacity, coordination and prioritization of government programs and activities to raise and enhance the effectiveness of climate action funds from different sources. The ERGP and the APP initiatives are medium term plans and are due for review. The review process provides a veritable window to mainstream the climate actions into the policy frameworks through the exercise coming up. Also, flexibility needs to be integrated in the policies and plans to accommodate shocks that could arise from global uncertainties like COVID-19.

The climate actions listed in Table 18 which are geared towards achieving emission reductions in crop production, livestock, fisheries, and aquaculture subsectors need to be rigorously integrated into national policy frameworks to create the enabling environment for realizing NDC targets. Also, reduction of vulnerability of the people and the agricultural system should be pushed simultaneously by mainstreaming the adaptation actions also contained in Table 18, to ensure that food security is not compromised as the population continues to grow.

The policy actions (thrust) should target to:

- Integration of NDC actions as it concerns development of agricultural value chains.
- Promote development of farm infrastructures to enhance low carbon such as utilization of waste for biogas, compost manure which will contribute to emission reduction in the agriculture sector as listed in Table 19; and in addition to specifically scale-up CSA practices including conservation farming, efficient resource management and modern plant/livestock/fish breeding technologies and conserving and managing local germplasm for future breeding programmes.
- Funding research and development in Climate Smart Agriculture, improved breed of crops and animal species, early warning systems and modeling for vulnerability of agricultural systems; and all these to meet the needs of the different agro-ecological zones.
- Promote rigorous development of improved feeds and manure management, backed up with training, with the aim of reducing GHG gas from enteric fermentation in the livestock subsector.
- Focus on research that engender frequent refinement of the strategies and agro-technologies for improved varieties in crop, livestock, and fishery industries.
- Implement policies that encourage and promote sedentary and intensive livestock production as against the Nomadic or semi-intensive livestock practices.

Since the development of the NDC Action Plan in 2015, there have been momentum in the Nigeria's polity such as the development of Biennial Update Report and the Third National Communications and these account for some of the observed differences in the recommendations of this report and the existing NDC Action Plan. It is expected that the results of this Investment and Financial Flow assessment will be mainstreamed into the on-going NDC Update.

3.3 Key Uncertainties and Limitations of the methodology

The assessment of the Agricultural Sector IFF was challenging on account of difficulty encountered in accessing data. The bureaucratic process in public ministries and agencies most cases made collection of data within the timeframe of this exercise problematic. This was further worsened with the lockdown following the global outbreak of COVID-19 pandemic and the inability of relevant officers to be in their duty posts at federal and State levels in Nigeria. This is particularly so with gathering of data between 2010 and 2015 to support the construction of historic Investment and Financial Flow analysis. In order to address the challenge of missing data, estimates were derived from assumptions earlier established by the Federal Ministry of Agriculture (FMARD) and Central Bank of Nigeria. For example, some of the data collected were not disaggregated into crop production, livestock and fisheries sectors or in terms of sources of the funds which made the analysis to fall back to an assumption that the ratio of the Agricultural Activity Mix (Crop production (85%), Livestock (10%) and Fisheries and others (5%) (FMARD, 2016). Similarly, data on State level investments are mostly lacking and estimates were derived based on the projection made by the Nigerian Agricultural Sector Performance Review (2018) which was also validated during the analysis.

The calculation of the cost of mitigation and adaptation actions used the 5% economic growth rate projection made in the FMARD (2016) and FME (2020) to forecast I&FF up to 2030. The assessment in some places relied on expert judgment which might have led to over or understatement of the values in each subsector. It is anticipated that as the assumptions change over the years, the estimates arrived at for the mitigation and adaptation plans will consequentially change.

REFERENCES

1. Abila N. (2012). Labour Arrangements in Cassava Production in Oyo State, Nigeria. *Tropicultura*, 2012, 30, 1, 31-35.
2. AGRA (2017) AGRA NIGERIA Operational Plan pp34.
3. Eboh, E. C., O. C. Ujah and C. E. Nzeh. 2009. "Lessons of the Global Economic Crisis for Nigeria's Agricultural Sector Strategy." In print, African Institute for Applied Economics [AIAE], Enugu.
4. Economist. 2008. "Country Briefing, September." Accessed September 2020 and available **http://www.economist.com/Countries/Nigeria/profile.cfm?folder=Profile-Economic%20Structure.**
5. Cole, C.V. et al. (1997). Global estimates of potential mitigation of greenhouse gas emissions by agriculture. *Nutr. Cycl. Agroecosyst*. 49, 221–228.
6. Civil Society Coalition for Poverty Eradication – CISCOPE (2009) Agricultural Expenditures: Budget Tracking/Investment Analysis of Agricultural Sector in Nigeria (2000-2008). file:///F:/UNDP/IFF%20Literature%20Nigeria/pdf_Agricultural_Expenditures_VFS_Final_Draft_Nov_2009.pdf
7. FMARD (2010) ECOWAP/CAADP Process National Agricultural Investment Plan (NAIP) 2011-2014 pp82.
8. FMARD (2015) National Agricultural Resilience Framework (NARF). Federal Ministry of Agriculture and Rural Development. pp123.
9. FMARD (2016) The Agriculture Promotion Policy (2016 – 2020) Building on the Successes of the ATA, Closing Key Gaps Policy and Strategy Document pp59
10. FME (2011) National Adaptation Strategy and Plan of Action on Climate Change for Nigeria (NASPA-CCN). pp95
11. FME (2018) First Biennial Update Report (BUR1) of the Federal Republic of Nigeria under the United Nations Framework Convention on Climate Change (UNFCCC). pp205
12. FME (2020) Third National Communication (TNC) of the Federal Republic of Nigeria under the United Nations Framework Convention on Climate Change (UNFCCC) pp252
13. Follett, R. F. (2001). Organic carbon pools in grazing land soils. In The potential of U.S. grazing lands to sequester carbon and mitigate the greenhouse effect (eds R. F. Follett, J. M. Kimble & R. Lal), pp. 65–86. Boca Raton, FL: Lewis.
14. Hasan, E. (2013). Proposing mitigation strategies for reducing the impact of rice cultivation on climate change in Egypt, *Water Science*, 27, 69–77.
15. Lal, R. (2004). Soil carbon sequestration impacts on global climate change and food security. *Science* 304, 1623–1627.
16. **Olomola A,S and Nwafor M (2018)** Nigeria Agriculture Sector Performance Review pp80. http:///F:/UNDP/IFF%20Literature%20Nigeria/nigeria_agric_sector_review_report_august_2018.pdf.
17. Smith, P., D. Martino, et al. (2007). Greenhouse gas mitigation in agriculture. *Philosophical Transactions of the Royal Society B* **363**(1492): 789-813.
18. UNDP (2015): Human Development Report. Briefing note for countries on the 2015 Human Development Report. P7
19. World Bank (2012): Nigeria: Opportunities for low carbon development Volume 2, part A: Agriculture and Land Use pp 83