Agriculture has been the backbone of the economy in Nigeria providing employment and source of livelihood for the increasing population and accounting for over half of the GDP of the Nigeria economy at independence in 1960. However, the role it plays in the regional and economic development of the country has diminished over the years due to the dominant role of the crude oil sector in the economy. With the increasing food demand in Nigeria, the country has available input natural resources and potential for increasing the volume of crop production towards meeting the food and nutritional requirement of the rapidly increasing population and guarantee food security in the country. The study was undertaken to analyse the effect of different factors and policies on the changes in trend of crop production and investigate the possible effect of water resources development on increased volume of agricultural crop production in Nigeria.

The study revealed that there are opportunities for water resources development in the country through irrigation to supplement the water requirements and needs of farmers for agricultural production activities in many areas in the semi-arid and arid regions. Available data shows that there are available land and water resources that could be developed to support the production of food and agricultural development with opportunity for increased productivity.

However, while the water resources are unevenly distributed in the country, there is need for the efficient use and management of the available water resources and increasing the productive use especially in the northern region of the country where there is increasing incidence of drought and competing need for water among the different sectors of the economy. The study also made possible recommendations for policy formulation to address the current problems facing the agricultural sector in conjunction with the requirement for the development of the water resources.

**Keywords**

agriculture, biotechnology, crude oil, fadama, GDP, irrigation, productivity, population, water resources
Water resources development: opportunities for increased agricultural production in Nigeria

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Masters Thesis

Master of Water Resources and Livelihood Security
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Abstract

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GLOSSARY

**Agricultural Intensification**: is defined as increased average inputs of labour or capital on an area of land, either cultivated land alone, or on cultivated and grazing land, for the purpose of increasing the value of the output.

**Fadama**: refers to swumpy and flooded areas along river banks used for crop production in Nigeria

**Irrigation**: refers to the practise of applying water to the soil to supplement the natural rainfall and provide moisture for plant growth

**Sub-Irrigation**: this is a method of irrigation in which watering of plans is carried out by allowing water to soak up into a plant by introducing water from bottom

**Water Productivity**: refers to increasing crop yield per unit of water consumed

**Farm Labour Productivity**: this refers to the real output per hour of work on the farm

**Land Productivity**: this refers to the capacity of agricultural lands to produce biomass or average output per unit area used

ACRONYMS

**CBN**: Central bank of Nigeria

**CGIAR**: Consultative Group on International Agricultural Research

**GM Crops**: Genetically modified organism
**FAO:** Food and Agricultural Organisation

**FMWR:** Federal Ministry of Water Resources

**FOS:** Federal Office of Statistics

**IITA:** International Institute of Tropical Agriculture

**IFPRI:** International Food Policy Research Institute

**IFAD:** International Fund for Agricultural Development

**RBDA:** River Basin Development Authority
Chapter 1 Introduction

1.1 Background
Agriculture has been the mainstay of the economy in Nigeria and many of the African countries, providing employment and source of livelihood for their increasing population. The history of agriculture in Nigeria is intertwined with the political history of the country and can be assessed from the pre-colonial, colonial and post-colonial periods. The pre-colonial society in the country strived on agriculture as the main stay of the traditional economy and the period of the colonial administration brought a great impact on agricultural development with emphasis placed on research and extension services (Nwa, 2003). In the colonial era, agriculture was regarded as the backbone of the economy with most the foreign exchanged earnings at the time derived from export of agricultural products. At independence in 1960, it accounted for over half of the GDP of the country’s economy and was the main source of export earnings and public revenue before the emergence of the oil sector and exploration of crude oil began in the country. With agriculture as an occupation accounting for more than 60 percent of the total labour force of Nigeria’s working population providing both formal and informal employment in which about 38 percent are females (Balogun, 2000), its role in the economic and regional development of the country is of significant importance. The total cultivable land in the country is estimated at 61 million hectares, which represent about 66 percent of the total area of the country (Aquasat, 2005), relating to adequate availability of land resources for agricultural production coupled wit the availability of human labour resources.

However, the agricultural sector has suffered a relative decline in the preceding years after independence due to the dominance of oil sector in the economy and in the GDP aggregate share but the sector still accounts for about 33 percent of the GDP (Aigbokhan, 2001). While agriculture holds immense potential for enhancing and stabilising the country’s foreign exchange earnings and guaranteeing food security in the country, the past three decades have witnessed a steady decline in this role. Nigeria, which was once a large net agricultural produce exporter now imports food and attempts to revive the agricultural sector as a dominant sector, have been unsuccessful. With the increasing human population in the country and increase in demand for food, there are challenges for the development of the sector by boosting and increasing the volume of food production towards meeting the increase in food demand and guarantee food security in the country without reliance on external food imports. This can come through the development of the water and land resources which are major inputs in the agricultural production process and annexing the surplus and under-utilised human labour resources from the increasing population growth, available in the country. However, these steps must be taken without compromising the sustainability of the industry and environmental resources including water and land resources which are vital inputs in the production process.

1.2 Impact of crude oil boom and the state of agriculture in Nigeria
Oil exploration activities began in the country in the early 1960’s but were fully developed in the 1970’s. With an estimated oil reserve of 35.2 billion barrels and an average production of 2.5 million barrels per day, the modern economy segment is highly dependent on oil earnings accounting for about 90 percent of the foreign exchange earnings for the country and about 70 percent of government revenues (Aigbokhan, 2001). With the advent of the oil sector in the country and the oil boom in the 1970s, combined with the high oil prices at the time, there
was increased revenue and foreign exchange earning for the country and attracting mass drift of people from the agricultural based sector into the oil sector for higher pay and better standard of living (ibid).

The oil boom in the country also brought a significant impact on the economy of Nigeria with a shift from the agricultural based economy to higher dependency on oil earnings, resulting in a reduction in local agricultural food production and increased food import into the country. Thus, there has been a dramatic restructuring of the Nigerian economy since the 1960s as a booming economy resulting from the growth of the petroleum industry with the rapid transformation having major consequences on pattern of food production and food consumption (Andrea and Beckman, 1985).

Before the discovery of crude oil and before independence, Nigeria was an important exporter of agricultural produce including cocoa, groundnuts, palm produce and cotton which were produced by independent small holders and having a significant impact on their individual agrarian economy. However, by mid-1960s, the export of crude oil has increased significantly resulting in an increased foreign exchange earning from the export and the decline in world market price of the main agricultural exports in the mid-1960s also had a negative impact on the production of the commodities locally in the rural areas (Aigbokhan, 2001). With the export of crude oil reaching an average of one million barrels per day around 1970 and growing to two million barrels by 1973, and stabilising around that level for the rest of the decade, coupled with a major increase in the world market price of crude oil around this period from the OPEC price hike, the revenue from oil accounted for about 93 percent of the total export earning for the country through the 1980s period (Andrea and Beckman, 1985).

Thus the boom in the economy and increased foreign exchange earning increased the rate of public investments in public services such as roads, airports, education, health and defence with the construction industry becoming the most dynamic sector of the economy. This served as an attractive centre for the informal sector of small producers of goods and services, traders and contractors with a combination of the sector’s activities, education and paid wage employments pulling a massive flow of labour from the agricultural sector with a significant rise in the number of non-agricultural employment (Andrea and Beckman, 1985; Aigbokhan, 2001). In the rural areas, there was also a shift from agricultural to non-agricultural activities such as trading, transport and construction (ibid).

The oil-induced shift of the population from agriculture to other sectors had a great impact on the agricultural sector and industry in the country with the domestic food producers facing a shortage of labour in the farm sector and the country unable to feed itself (Andrea and Beckman, 1985). The cost of labour also increased simultaneously along with the outflow of farm labour increasing the cost of local production of food with major drop in production output of food crops over the period 1969 to 1981 (ibid).

Due to the subsistence level of production in the country, the household of the producers consumes most of the food they produced, with not much evidence of accelerated commercialization of food production (Andrea and Beckman, 1985). The prices of domestic food also increased dramatically with the shortfall in local supply thus necessitating the need for imports of grains with massive import of food items in the 1970s and 1980s due to the failure of the local producers in meeting with the increasing demand for food crops (Akande, 2006). The prices of food crops produced locally were also higher than the prices of the
imported ones with unrestricted importation of food contributing as a major factor to the
sharp increase in the non-agricultural population (Andrea and Beckman, 1985; Aigbokhan,
2001). Andrea and Beckman (1985) however opined that if the imports had been controlled
and restricted, the prices of the domestic food would have helped to regulate and stabilise the
flow of people and resources between the sectors of the economy.

The country’s oil sector has continued to receive boast with the development of more oil
blocks and natural liquefied gas coupled with the incessant increases in the crude oil prices in
the world oil market (Akande, 2006, Okolo, 2004). The increasing dependency on the oil
revenue however has brought a significant negative impact on the agricultural sector and its
development in the country resulting in neglect and low productivity in the agricultural
sector.

1.3 Challenges of population growths and the rural – urban mass drift
With the population in Nigeria increasing at an alarming rate, meeting the food need and
nutritional requirements of the population internally requires adequate attention paid to the
development of the agricultural sector in the country towards increasing volume of
production and productivity in the sector. With a statistical figure of 88.6 million people in
1991, and a current population figure of 140 million people in 2006 (Guardian, 2007),
Nigeria represents about 25 percent of the total population of sub-Saharan African. The
annual population growth rate in the country is estimated at 2.2 percent with the growth rate
increasing from the 1950s to most of the 1980s (Nwa, 2003).

An estimation done by the World Bank shows that the country’s annual population growth
rate for the period between 1965 and 1973 was at 2.5 percent and increasing to 2.7 percent
between 1973 and 1983 (World Bank, 2005) and with a current growth rate of 3.2 percent
(Guardian, 2007). The projection is that the country’s population will increase to 200 million
probably within the next twenty-five years (World Bank, 2005). Thus, population growth
rate has been an issue of central concern in Nigeria in recent times and there is need for
agricultural production, industrial and other economic output as well as provision of health
and other social services to double within the twenty-five years period for the current per
capital level to be maintained. Migration from the rural to urban areas has also accelerated in
recent decades with the average urban population annual growth rate increasing at 5.54
percent and migration a major factor in the urban population growth (Onokerhoraye, 1995).
Research findings has indicated an increase in the rate of immigration of young persons from
the rural areas to the urban centres for white collar and non-farm jobs, educational purposes,
better social amenities and higher standard of living (Akande, 2006, Fadayomi, 1988).
Nevertheless, there are projections that the urban population is unlikely to be stable due to the
tendency for old migrants of rural origins to return to the villages at the end of their migration
career and for the contemporary migrants to consist predominantly of youths (ibid).
1.4 Population growth and distribution in Nigeria

The relationship between population growth and development has been an issue of great concern in many countries of the world with diverse opinions on whether rapid population growth is beneficial or not. Nigeria is regarded as the most populated country in sub-Saharan Africa relating to an ample supply of human resources that can be utilized in the productive activities of the country which depends on the knowledge of the size and composition of the population. The population growth rate in the country has witnessed a dramatic increase in the last few decades with the first population census in the country conducted in 1911 with a total population of approximately 16 million people (Onokerhoraye, 1995) and a current population statistics of 140 million people in 2006 census result (Guardian, 2007). The current population figures also show that the number of males in the country outnumbered the females relating to an increase in the amount of manpower available in the country due to the higher participation of males in production activities (ibid).

Table 1.1: Nigeria population statistics from 1911 -2006

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
<th>Growth Rate (%)</th>
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<tr>
<td>1911</td>
<td>15,974,670</td>
<td>1.6</td>
</tr>
<tr>
<td>1921</td>
<td>18,600,000</td>
<td>2.1</td>
</tr>
<tr>
<td>1952/53</td>
<td>30,400,000</td>
<td>5.6</td>
</tr>
<tr>
<td>1963</td>
<td>56,670,000</td>
<td>2.5</td>
</tr>
<tr>
<td>1991</td>
<td>88,992,220</td>
<td>2.83</td>
</tr>
<tr>
<td>1996</td>
<td>102,317,806</td>
<td>2.83</td>
</tr>
<tr>
<td>2001</td>
<td>117,638,749</td>
<td>2.83</td>
</tr>
<tr>
<td>2004</td>
<td>127,911,593</td>
<td>2.83</td>
</tr>
<tr>
<td>2006</td>
<td>140,003,542</td>
<td>3.2</td>
</tr>
</tbody>
</table>

Source: FOS, 2005; Guardian, 2007 and Onokerhoraye, 1995
Table 1.1 shows Nigeria population from the period 1911 to 2006. While the country witnessed a slight growth rate of 1.6 percent at the initial stage in 1911, the population increased rapidly from 18.6 million people in 1921 to 30.4 million in 1952/53 period with a growth rate of 5.6 percent per annum. However, from the 1952/53 period, the population had increased by double reaching 88.9 million people by 1991. The sharp increase in the population growth rate has been the trend from that period up to the present moment.

Nigeria did not have any rigid national population policy until 1988 despite the government realising as far back as the 1970s that the country is experiencing a rapidly growing population by world standard (Onokerhoraye, 1995). However, the political leaders did not consider the population growth a serious obstacle to domestic economic progress until recent times (ibid). The national population policy in the country thus has its background from the declining levels in the GDP of the country but continued growth in the population, with a projection for the GDP to decline more in the future while noting agriculture as the basis of life for most of the citizens particularly at the grassroots level (Nwa, 2003; Onokerhoraye, 1995).

The population in Nigeria is also unevenly distributed with extensive areas in the Chad basin, the middle Niger Valley, the grass plains of Oyo and Niger Delta among others sparsely populated while large areas of densely populated districts are found in parts of the south and north of the country (NPC, 1998). An important consequence of this uneven distribution is the great pressure on land resources in some of the densely concentrated districts with shortages of farmlands in those areas and surplus in other areas, coupled with the increasing volume of rural-rural and rural-urban migration (ibid).

The north east and north west occupy 43 percent of the total land area in Nigeria and accounts for 35 percent of the total population with many areas in the north having records of prolonged droughts and desert conditions prevailing along the northern borderlands which are sparsely populated (Nwa, 2003). The middle belt region has a land area of 36 percent of the total country’s land area with only 18 percent of the population living in the area due to increased rural-urban migration from the area, with the region poorly developed with social amenities and infrastructure but having good agricultural land (Nwa, 2003; NPC, 1998). The south west has a total land area of 12 percent with 25 percent of the population living in the area while the south east is the most densely populated region in the country with 22 percent of the total population living in the area on only 8.5 percent of the country’s land area (Nwa, 2003). The southern region forms the commercial centres in the country with high volume of rural-urban and urban-urban migration into the region (ibid).

1.5 Economic importance of water resources development for agricultural sector growth

The development of the water and land resources in Nigeria holds immense potential for development and growth of the agricultural sector and overall economic growth. With water a major input in the agricultural production process, its availability is vital for the success of the farmers in their production effort and achieving increased food supply.

Crop production requires availability of water at the right time in the right quantity and quality. For good agricultural output, water is a necessity, as the crops require water for vegetative production in carrying dissolved nutrients from the soil into their body tissues for
use (FAO, 2003). However, with drought a frequent occurrence in the northern region of Nigeria and some part of the south and west, with the region susceptible to climate abnormalities, incessant changes in the rainfall regime will require adequate provision made available through alternative measures such as irrigation. While the economy of the region is also intrinsically and inextricably tied to agriculture, any climatic calamity does adversely affect the socio-economic activities in the region with mounting pressure on available water and other resources in the face of a fluctuating rainfall regime.

The development of the nation’s water resources thus offer new potentials and opportunities at achieving food security and increased revenue for the farmers and as well ensuring the development of the agricultural sector for economic growth of the country.

1.6 Research Questions
Different government policies and other factors have been affecting the agricultural production and output trend in Nigeria resulting to various degrees of changes in the production trend. With the increasing trend in population growth and the challenges of meeting food security, there is need for increased volume of crop production and increased productivity in the agricultural sector. While the country has been involved in the development of the land and water resources in the country which has great potential for increasing agricultural production, there is need to need to keep pace of the development of the sector in relation to the population growth in the country. However, this development must also be carried out with consideration for the sustainability of the environmental resources used in the production process. The aim of the study is to determine the change in trend of crop production in the country and analyse the effect of different factors and policies on the changes in the trend. It will also investigate how the sustainable development of water resources will contribute to increased volume of agricultural production in the country.

The specific objectives are to:
1. Ascertain the availability of agricultural production inputs including land and water resources in the country
2. Determine the change in trend of agricultural production between the period 1960 to date (2006)
3. Identify the specific problems of food crop production and opportunity for increased production in the country
4. Investigate the possible effect of water resources development on agricultural crop production in Nigeria.
5. Make possible recommendations for agricultural production development in the country

1.7 Justification for the study
The challenges of ensuring food security in Nigeria and meeting the millennium development goals and reduction in the poverty level in the country is hinged on the revitalisation of the agricultural sector in the country based on the role the sector is playing through provision of jobs for majority part of the labour force. However, while the sector has been adjudged to be performing very low in the preceding times after independence, there has been different studies to identify the problems confronting the sector as well as the effect of different policies on the sector (Akande, 2006; Aigbokan, 2001 and Balogun, 2000).

While these researches has tried to identify the problems, it is necessary to ascertain that the sector has the capacity and potential to deliver its expected role with the availability of the
required resources and the would-be impact of the development of the resources. With the change and increase in the population of the country, there has been an increase in the demand for food and other human goods and services with increasing demand for land and water. While these two resources are a compulsory input in the agricultural production process, their availability and development in a sustainable way will have a great impact on the success of the agricultural industry.

This study is thus expected to contribute to an increased understanding of the availability and development of these resources in relation to the demand for them in the agricultural and other sectors and provide a better opportunity for increased knowledge on the potentials available for increased crop production and success in the agricultural sector and industry in the country through their development.
Chapter 2  Climatic conditions in Nigeria and research methodology

2.1 Locations and Climatic Condition in Nigeria
Nigeria lies between latitude of 4° 10' and 13° 50' N and longitudes 2° 15' and 14° 45' E with the Republic of Benin bordering the country on the west, Niger on the north and both Chad and Cameroon on the east while the south is bordered by the Gulf of Guinea with an 800km coastline (Nwa, 2003; FAO, 1995). The country is the tenth largest country in Africa with an approximate 923,768 km$^2$ in total land area and is regarded as the most populous country on the Africa continent with more than 350 ethnic/linguistic groups and a variety of social groups (NPC, 1998).

The country has a variety of landforms with the Niger-Benue trough dividing the country into three major physical blocks, which roughly corresponds to the formal political regions during the colonial period namely the Eastern, Western and Northern Nigeria. The coastal regions in the country including the Niger delta and the areas around the Niger-Benue trough, the Chad basin and the Sokoto-Rima basin are covered with young sedimentary rocks with extensive plains also covered with young sedimentary rocks occurring in the eastern region of the country. High plains which have developed on very old hard rocks occur in the central and northern parts of the country except in the Chad basin, parts of the Gongola valley and the Sokoto-Rima basin while fossil dunes and live sand dunes from the Sahara Desert are commonly found in the northern borderlands with the Niger republic.

The country is well drained with a close network of rivers and streams with four main principal surface water basins namely the Niger Basin, the Lake Chad basin, the south-western littoral basins and the south-eastern littoral basins and also has extensive ground water resources. The total annual renewable water resources for the country are estimated at 286.2 km$^3$ in which the annual internally produced water resources amounts to 221 km$^3$ while the external water resources are estimated at 65.2 km$^3$/year, being surface water coming from Niger, Cameroon and Benin republic (FAO, 2005).

The Niger River and the Benue River both rise outside the country and join together in the central part of the country to form the lower Niger, which empties into the Atlantic Ocean. A network of creeks form the Niger Delta with other short rivers rising from the highlands of the southeast and central region of the country and flowing directly into the Atlantic ocean. The north of the Niger-Benue trough is known as the hydrological centre of Nigeria from where major rivers rise including the Sokoto river, Kaduna river and Gongola river all of which drain into the Niger-Benue system while the Yobe river drains into Lake Chad (Nwa, 2003).
Figure 2.1: Map of Nigeria

The climate in the country is governed largely by seasonal movements of the inter-tropical convergence zone making rainfall strongly seasonal with the rain-bearing southwest monsoon winds from the oceans and the dry, dusty or harmattan northeast winds coming from the Sahara Desert (Nwa, 2003). The two main seasons in the country are the rainy season and the dry season with the rainy season lasting for about seven months (April to October) in the south and only about five months (May to September) in the north. In the southwest coastal region, there is usually a short dry period of one to two weeks between the late July and early August known as the August break while the dry season generally lasts from October to March.

There seems to be a general decrease in the amount of rainfall as well as the length of the rainy season from the southern to northern region of the country with the heaviest rainfall of over 2,650 mm per annum been recorded in the Niger delta region. The lowest annual rainfall of less than 850 mm per annum is recorded in the far northern region of the country namely Sokoto, Kano and Maiduguri regions having approximately annual rainfall of 690 mm, 840 mm, and 640 mm per annum respectively (CBN, 2005). The temperature varies across the different regions in the country with maximum temperature of over 40 degrees been recorded in the extreme northern region where frost also occurs during the dry season. The temperature
is fairly constant in the southern part with the mean daily maximum temperature rarely exceeding 32 degrees in the hottest months of February and March and not falling below 28 degrees in the raining season (Nwa, 2003). Relative humidity varies from over 80 percent in the coastal areas to less than 50 percent in the far north with the highest values usually recorded in the evenings (ibid).

The vegetation in the country can be broadly classified into forest and grassland savanna with the forest zone covering the southern part and gradually changing into the grassland savanna as you move northwards. The vegetation in the forest zone consists of the coastal forest and mangrove, the deltaic swamp forest, the moist forest and the forest savanna mosaic with the zone rich in forest resources such as timber trees and root crops. The grassland savanna zone consists of the Guinea Savanna, the Sudan Savanna and the Sahel Savanna. The Guinea Savanna is made up of a mixture of tall trees and grasses and is the largest vegetation covering the country. The Sudan Savanna consists of grasses that are short and feathery while the Sahel Savanna consist of short grasses and trees that are widely spread and occurs in the extreme north of the country. There is a diversity of species of plants and animals occurring across the different vegetation types, which are of economic value. Hardwood is a chief product found in the Nigerian forest and widely exploited throughout the country as timber-poles, scaffolding planks, stakes and fuel wood. Different varieties of fruits, nuts and seeds are also found in the different forest and savanna zones with parts of the zones also used for game reserves. Agriculture is dominated by smallholders with scattered agricultural landholdings using low-input technology, raising crops such as sorghum, maize, cassava, yam, millet, rice and wheat while plantations are gaining ground in producing raw materials for company use which are sometimes owned by multinational corporation or individuals in partnership. Typical farm sizes ranges from 0.5 hectares in the densely populated high-rainfall south to 4 hectares in the dry north. The dry northern savannah is suitable for sorghum, millet, maize, groundnut and cotton. The middle belt region has major crops like cassava, yam, plantain, maize and sorghum. In the south, the main cash crops are oil palm, cocoa and rubber while the low-lying and seasonally flooded areas are increasingly producing rice.

Nigeria as a country is blessed with three main types of natural resources namely the underground minerals, forest and water resources. The major groups of mineral resources found in the country include the fossil fuels, metallic, non-metallic and radioactive minerals with examples including petroleum, coal, lignite, columbite, gold, iron ore, uranium, limestone, marble, tin, gravel and feldspar. The water resources in the country occur in a variety of both surface and ground water resources.

2.2 Methodology
The methodology used for the research work was a qualitative research technique. However, quantitative statistical data was used to support the qualitative analysis. The thesis was a literature review in which secondary data and information formed the basis for the study. A number of articles, books and statistical records were analysed to answer the questions stated in the objectives of the study. The statistical records provided statistical data and information on different issues such as agricultural production in Nigeria, amount of rainfall, inflation rate, production index, available water resources and irrigation development among others. The qualitative technique which is exploratory in nature to understand the concepts adopted and issues of interest (Silverman, 2000), was used for interpreting and review of information from the articles, books and other literature used in the study. While this technique have different ranges of perspective including post-modern thinking, ideological perspective,
philosophical stances, and systematic procedural guidelines among others with all the different perspective vying for a centre stage (Creswell, 2003), the use of the method in this research has principally centred on an analytical perspective.

The main source of the secondary data and information was:
2. Statistical records and publications from the Food and Agricultural Organisation (FAO) and the World Bank.
3. Mass Media output such as newspaper records and magazines
4. Books, journals and articles
5. Virtual output source such as the Internet.

2.3 Analysis of Data
Qualitative data analysis was carried out in the study. With secondary data used for the research work, the qualitative data was extracted from literature materials while the quantitative statistical data used was presented using bar graphs, pie charts, tables, histograms and multiple graphs. The data was used in support of the qualitative analysis of the issue of agricultural production, resources availability, climatic change and rainfall estimation and other important issues of discussion in the research work.

The qualitative data analysis which involves making an interpretation and sense out of the text and data used in support of the concepts adopted (Crewell, 2003; Tashakkori and Teddlie, 1998) was done based on the premise of establishing evidence in support of the concepts and issue been analysed and discussed. With the field of agricultural production encompassing different subjects of interest, the qualitative data analysis technique was used to establish connection among the different subject of interests and provide a deeper understanding of the phenomenon being studied and analysed (Silverman, 2000).

2.4 Limitation to the Study
There were some limitations associated with the study which is discussed below.

2.4.1 Type of Method Used
The research work was basically a literature and statistical data analysis with a review of different types of documents and statistical records using a qualitative technique and approach. While effort was made to find the relevant literature materials related to the subject of study, problems were encountered in getting access to relevant literature on the subject topic in relation to Nigeria in Sweden. This was because not many books and other materials on the subject matter in Nigeria were available in Swedish library, however, relevant literature materials were obtained from internet sources to supplement the available materials and documents in hard copy form.

2.4.2 Data collection technique
The source of data used for the research played a great role in the data analysis. With the research work involving qualitative data analysis, problems were encountered in getting the required and adequate statistical data for the research work to support the analysis. Nevertheless, it was possible to get the required data to answer the questions stated in the research objective. While secondary data formed the major type of data used for the research
work, the quality of the statistical data used cannot be validated as the reliability and validity of the data cannot be guaranteed due to sampling and measurement errors that could have occurred during the data collection process (Crewell, 2003; Elliott, 2006). However, the data sources were cross-checked with other sources to establish correlation between the different sources in increasing the reliability and validity of the data used (Elliott, 2006).
Chapter 3  Land and Water Resources in Nigeria

3.1 Agricultural development and policies in Nigeria
The challenge for the development of the agricultural sector in Nigeria dates back to the early pre-independence era before the discovery and emergence of the oil sector. Before independence and in the post-colonial era in the early 1960, agricultural policies in Nigeria have traditionally focused on the expansion of commercial (export) crops with such policies been justified by the fact that agricultural export account for the lion share of the foreign exchange earnings for the country (Akande, 2006 and Okurume, 1969).

In the first national development plan in Nigeria, agriculture was signified to perform the role of igniting a fundamental structural transformation of the economy of Nigeria in the drive towards modernization and industrialization. The plan placed much emphasis on the introduction of more modern agricultural methods through farm settlements, cooperatives, plantations, supply of improved farm implements and a more expanded agricultural extension services and the agricultural sector made flexible to provide the expected increase in food demand as a result of increase in population and income rise (Akande, 2006; FAO, 1966). In the period directly after Independence, from 1960 to 1969, the direct involvement of the government in agriculture was at the minimum level with the federal government largely playing a supportive role focusing mainly on extension, marketing, and pricing of export crops while regional and state governments were given the task to take major initiatives (Aigbokhan, 2001). However, there was more direct federal government involvement in the period 1970 to 1985 due to the declining rate in the sector’s performance and dominance of the competing oil sector, with the introduction of a variety of policies and fiscal incentive introduced in form of low tariff on imported agricultural inputs (ibid). Agricultural credit was also identified as a major constraint facing farmers during the period in review leading to the creation of the Nigerian agricultural and Cooperative bank while the World Bank assisted agricultural development programmes (ADPs) were introduced in many states of the country to provide an integrated approach to agricultural and rural development (Aigbokhan, 2001; Balogun, 2000). There was also the establishment of river basin development authorities to help in the development of the water resources in each of the regions to ensure adequate water supply through irrigation, to the farmers year-round (ibid).

In the period 1986 to 1999, market and non-market oriented agricultural development policies were introduced with farm input supply policy pursued to ensure adequate and prompt input supply to the farmers (Aigbokhan, 2001). The recent Economic Policy (1999-2003) of the new democratic government in Nigeria also lays emphasis on the revitalization of the agricultural sector and poverty reduction as strategic priority towards increased productivity and higher performance and favours the review of economic opportunities and potential available through the development of the agricultural and rural sectors (IFAD, 2002). However, while many of these policies has had little significant impact on the agricultural sector and its development in the country, achieving progress in the nation’s agriculture and rural sector does not only require the formulation of appropriate macroeconomic and sectoral policies frameworks with aims and goals of revitalising the sectors through the removal of the constraints facing the sector but implementation of such policies without deviation from the original aims and goals of the policies.

Aigbokhan (2001) and Balogun (2000) supported this fact with their argument that many of the agricultural and economic policies formulated and introduced in the country always have good goals and objectives but in many situations are not fully implemented while frequent
changes in government administration also constitute a limiting factor. Thus, the achievement of success and positive results from the implementation of these policies is hindered as many of them required been implemented in whole but when implemented, are done half-way before they are changed and replaced with new policies by new government administration (Aigbokhan 2001). An IFAD document has also shown that technology-based agriculture has not yet been developed on a significant scale in Nigeria as previous growth in the agricultural sector has always come from expansion of land under cultivation rather than from increased productivity (IFAD, 2002). Thus promoting productivity in crop production requires the development and application of agricultural techniques, dissemination and adoption of appropriate technologies by farm households in boosting production output and formulation and implementation of appropriate polices that will encourage the increase of productivity at the farm household level.

Table 3.1: Major agricultural policies in Nigeria from 1960 – 2005

<table>
<thead>
<tr>
<th>Agricultural Policy</th>
<th>Year of Introduction</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Accelerated Food Production Programme</td>
<td>1973</td>
<td>*to increase local production of food</td>
</tr>
<tr>
<td>Operation feed the Nation</td>
<td>1976</td>
<td>*to mobilise the nation towards self reliance and sufficiency in food production</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*encourage general pride in agriculture as a viable and profitable industry</td>
</tr>
<tr>
<td>Green Revolution</td>
<td>1980</td>
<td>*to increase local production of food towards national food security</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*increase agro-allied industry operations in the country</td>
</tr>
<tr>
<td>Abolition of import duties on fishing vessels, agricultural machinery and equipments</td>
<td>N/A</td>
<td>*to provide easy access to cheaper agricultural production inputs</td>
</tr>
<tr>
<td>Establishment of the Nigerian agricultural and cooperative bank</td>
<td>N/A</td>
<td>*to provide credit and loan facilities for agricultural development</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*provision of low interest rate loans to farmers</td>
</tr>
<tr>
<td>The agricultural credit guarantee scheme</td>
<td>1977</td>
<td>*provision of loans to farmers through banks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*provision of guarantee for loans provided by commercial and merchant banks to the agricultural sector.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*to increase level of bank credit to the agricultural sector</td>
</tr>
<tr>
<td>Increasing Agricultural Loans in the banking sector from 60 percent to 80 percent</td>
<td>1980</td>
<td>*to increase commercial and merchant bank participation in the agricultural sector</td>
</tr>
<tr>
<td>Back to Land Programme</td>
<td>1984</td>
<td>*to increase local food production in the country</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*to encourage participation of the younger labour force in agricultural production activities</td>
</tr>
<tr>
<td>First &amp; Second National</td>
<td>1999 &amp; 2004</td>
<td>*to sustainably increase the income of</td>
</tr>
</tbody>
</table>
### Table 3.1

<table>
<thead>
<tr>
<th>Fadama Development Programme</th>
<th>Fadama Users</th>
</tr>
</thead>
</table>

**Source:** Aigbokhan, 2001; CBN, 2005; Nwaobi, 1990

Table 3.1 contains some of the major policies that were introduced in the country after Independence, from 1960 to 2005. While all the policies have good objectives with the potential of solving the problems in the agricultural sector, many of the policies were not implemented while the few ones being implemented were only aborted at a period when the policies were about bearing positive results (Aigbokhan, 2001). The problem of corruption has also being a great disadvantage in the positive implementation of these policies with majority of the programmes started as a means to siphoned government funds into private accounts (ICPC, 2007).

The first and second national fadama development program introduced in 1999 and 2004 respectively is a program being financed by the World Bank in partnership with the Federal, state and local governments in the country. While this program is not so much different from the earlier programs and policies, it was designed specially to adopt a new strategy of empowering the beneficiaries through direct participation in the program. This involves allowing the beneficiaries to voice their problems and opinions and proffering solutions to their problems in their own way as well as channelling funds and other financial assistance directly to the beneficiaries in executing their projects (CBN, 2005). This strategy was to overcome the traditional problem of government bureaucracy in program execution and corrupt practices of government officials through diversion of program funds into private pockets. While massive success was recorded during the first phase of the program (CBN, 2005), the program is now in the second phase and there are plans to go into the third phase after the successful completion of the second phase.

### 3.2 Food security and biotechnology development in Nigeria

With biotechnology having an important role to play in the economic transformation of developing countries in relation to its contribution as a solution to many of the economic, social, food insecurity and environmental problems confronting these countries, its use and adoption as a viable strategy towards realising food security in Nigeria has not been fully utilised. With the challenge of hunger facing mankind in the 21st century due to increasing population especially in sub-Saharan African and other developing countries, the use of GM crops offer the opportunity to boost food production and meet the increase in demand for staple foods towards realising food security. Reports have indicated that many GM crops already in use in rich and some developing countries have success record of food and environmental history with great importance to agricultural development (Cohen 2005). Mongelard and Warnock (2002) also noted that the use of genetically modified crops have benefited the developed country’s farmers that have been growing them with achievement of higher yields and lower cost of production.

Cohen and Paarlberg (2004) also remarked on the increasing research development on safety issues on use of the GM crops in many of the Asian and some African countries to boost food production in the country towards ensuring food security for the teeming population in the country with remarkable success achieved in the goal. With biotechnology providing the potential to produce new, improved, safer and less expensive products and processes, the application of biotechnology in the provision of improved seedlings for meeting food security in Nigeria is very crucial and essential. Cohen (2005) in a research report noted that
significant progress has been made in many of the developing countries in producing genetically modified crops with desirable qualities such as good agronomic properties, herbicide tolerance, fungi and bacteria resistance, insect and virus resistance, high product quality among others. Research into agricultural biotechnology use in Nigeria include the following namely micro-propagation of cassava, yam, banana and ginger, embryo rescue for yam, transformation and regeneration of cowpea for virus and insect resistance, marker assisted selection of maize and cassava, DNA fingerprinting of cassava, yams and banana, pests and microbial pathogens, genome linkage maps for cowpeas, cassava, yams and banana among others (Alhassan, 2002). However, the use of GM crops in Nigeria is still at the pilot stage on research farms and has not been developed for commercial use and distribution to farmers on a large scale but there are discussions already on the process of producing them on commercial scale and disseminating the GM crops to farmers in the country (ibid).

Despite a significant interest by the Nigerian farmers on the use of biotechnology and GM crops for their crop production activities (Ayanwale et al, 2006), there are a number of constraints facing the use of biotechnology in Nigeria with the government having a significant role to play in the promotion of the technology and dissemination of genetically-modified seeds and seedlings to farmers on a large scale level. While there is research into biotechnology use and safety issues, going on in the country, the researches are coordinated and funded by donor agencies and organisations with the government not playing much direct role (ibid). With biotechnology development requiring huge amount of investment and resources, the government active participation is required. Some of the international research organisations involved in biotechnology research in Nigeria includes CGIAR, IITA, and IFPRI (Alhassan, 2002; Ayanwale et al, 2006). However, with current arguments going on in the country emphasising the importance of biotechnology in solving the food problems and reduction in environmental degradations through agriculture, the government is taking new steps towards increased direct role in biotechnology use, development and promotion in the country towards solving the food security problem (ibid).

While the application of biotechnology and use of genetically-modified crops seem very beneficial to the development of agriculture in Nigeria and other developing countries in meeting food security, there are also concerns on the possible human health, environmental, ecological impact and socioeconomic risks involved. Over the decades, there have been debates on the would-be impact of biotechnology on the national and regional development in the developing countries with arguments on the use of biotechnology bringing more ills to the countries and another group supporting it as a solution to the many problems confronting the countries (Cohen, 2005). There are concerns that the genetic diversity would be eroded through the release of genetically modified organisms into the environment and undermining the socio-economic and cultural security of many households in these developing countries (Mongelard and Warnock, 2002). With human health risk of GM crops including the production of toxins in food items through introduction of foreign genes which cannot easily be identified, there are fears of production of allergic reactions by proteins used to engineer pest and disease resistance in crops, and creation of resistance to antibiotics (ibid). The economic risk also identified with the use of GM crops includes the monopolisation of the production and marketing of GM crop inputs by a few large companies thus decreasing the freedom and choice for farmers and consumers as well as the use of terminator technology which forces farmers to always buy new seeds each planting season without the option of keeping seeds from previous harvesting period which is traditional to farmers in the developing countries (Mugabe, 2006). The compulsory use of specific package of proprietary seed and inputs without the choice of buying inputs from other companies as the GM crops
usually engineered through the use of the Genetic Use Restriction Technology (GURT) otherwise known as the Traitor technology is also a limiting factor/disadvantage (Mongelard and Warnock, 2002; Mugabe, 2006). Other economic risks identified include favouritism of larger and wealthier farmers at the detriment of the smaller and poorer ones which can lead to consolidation landholdings and displacement of the poor farmers and the risk to the developing countries’ export with many of the importing countries increasingly demanding organic and non-GM crops (ibid).

However, despite all these disadvantages, there is need for Nigeria to explore the potential available for the country through biotechnology development, in achieving the millennium developmental goals and ensuring food security for the increasing population. Mugabe (2006) in writing on the development and global trends in modern biotechnology noted that the use of genetic engineering has provided a source of new products that are improving agricultural production, human and animal health, the environment and industry in general. Genetic engineering allows the effective selection of more precise desirable characteristics and facilitates the more rapid development of new varieties with the transfer of genes into a plant of different variety or species (Mongelard and Warnock, 2002). Some of the advantages on the use of the GM crops as listed by Mongelard and Warnock (2002) and Cohen (2005) to enhance quality of life in agricultural communities with specific reference to basic staple foods that have importance on local economies with potential to yield several quality of life improvement include the following:

1. Reduction in the use of conventional pesticides which has quantifiable environmental and human health benefit and also a reduction in cost of application per acre
2. Reduction in the use of other agrochemicals which are widely used to fight viruses, fungi and other diseases which does help to reduce costs and increase production through the use of crops that have been developed with in-built disease resistance.
3. Improvement in the abiotic stress crop tolerance such as soil and weather conditions, drought and salinity which limits farmers’ potentials in disadvantaged regions from achieving increased production.
4. Getting better product quality such as prolonged shelf life which helps improve transportation and consumer appeal of crops as well producing nutrient dense staple foods.
5. Increased and improved crop yield resulting in spill-over effects on local economies through generation of direct and indirect employment, increase in personal income and food security.

Nevertheless, researches to clarify the safety issues associated with use and consumption of GM crops must also be undertaken in Nigeria like her other counterpart African countries to alleviate the fear in the mind of producers and consumers on the safety, healthy and environmental implications associated with use and consumption of the crops. This is to help in the general wide adoption of the crops among the different groups of farmers while adequate technical knowledge must also be provided with appropriate extension services and machinery put in place to aid the widespread use and adoption of the technology.

### 3.3 Land use and crop production in Nigeria

Availability of land resources as one of the factors of agricultural production is required before any meaningful development can take place in the agricultural sector in Nigeria. With agricultural production comprising of both food crop and cash crops production in the country, the wide range of agro-ecological zones available in the country provides
opportunity for diversity of crop and livestock production activities. Crop production activities are traditionally done by the many peasant farmers living in the rural areas growing different varieties of crops with the stable food crops produced basically for household consumption and local sales while the cash crops are produced for export (Akande, 2006).

Table 3.2: Area of Land use in Nigeria

<table>
<thead>
<tr>
<th>Land Use in Nigeria</th>
<th>Area of land (Ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total land area in Nigeria</td>
<td>92,377,000</td>
</tr>
<tr>
<td>Total cultivable area</td>
<td>71,200,000</td>
</tr>
<tr>
<td>Total cultivated land</td>
<td>34,200,000</td>
</tr>
<tr>
<td>Grassland</td>
<td>28,110,000</td>
</tr>
<tr>
<td>Forest land including woodland, tropical rain forest, mangrove swamps</td>
<td>13,680,000</td>
</tr>
<tr>
<td>Wetland</td>
<td>2,510,000</td>
</tr>
<tr>
<td>Others (including urban disturbed, bare land and water)</td>
<td>8,850,000</td>
</tr>
</tbody>
</table>

Source: FAO, 2002; Nwa, 2003

The total landmass in Nigeria is estimated to be around 92 million hectares out of which 71 million hectares are suitable for agricultural crop cultivation (table 3.2). Only 48 percent of this cultivable land is actually used for agricultural production leaving a balance of 52 percent uncultivated (ibid). Table 3.2 also shows that out of the total cultivable land in the country, 19.2 percent falls in the rainforest zone which is suitable for cash crop production such as the oil palm, cocoa, cashew and rubber as well as major food crops like yam, cassava, maize, plantains and rice production. A high proportion of cash crop production takes place in the tropical rain forest located mostly in the western region of the country where the soils are very rich in humus with a high percentage of soil fertility (Balogun, 2000). An estimated 2.7 percent of the total landmass in Nigeria and 3.5 percent of the cultivable landmass are wetlands (table 3.2) which play a vital role (in their function) to the human society and the ecology of the watershed through atmospheric maintenance as wetlands store carbons within their plants communities and soil instead of releasing it to the atmosphere as carbon dioxide thus helping to moderate global climatic conditions (Mitsch & Gosselink, 1993). Other functions of the wetlands include natural water quality improvement, flood protection and shoreline erosion control, stability of the global levels of available nitrogen, atmospheric sulphur and methane and opportunities for recreation and aesthetic appreciation and supply of natural products for human use (ibid).
Some of the food crop production in the country has followed a sliding trend in the country over the years. However, a few of the food crops in production in the country followed a rising trend in their production. Figure 3.1 show that most of the food crops have sliding trend from preceding periods to periods around 1985 when the production trend started rising again. The changes in their production trend may be attributed to the series of political and economic events in the country during the period in review. In the preceding years before 1983, there was massive importation of food to meet the growing demand of the increasing population and less emphasis on the agricultural sector, with a high inflation rate making the production of the local food items unsustainable due to rising higher cost of production and lower profit margin for the farmers (Okolo, 2004). However, with the ban on importation of a number of food items by the new military government in 1983 and the introduction of the Structural Adjustment Program (SAP) in 1985, placing much emphasis on the production of food crops locally, the trend in the production of food crops in the country started rising (Akande, 2006). Okurume (1969) and Balogun (2000) also noted that yam, maize and cassava are the most important food crops grown in the western part of the country with yam having a slight edge over the other two crops but current data show that cassava is gaining more popularity than all other crops with the popularity in production attributed to the local diet of the people (Balogun, 2000). Current available data also shows that cassava is the most widely grown crop (figure 3.1) in many regions in the country followed by yam, which is more common to the areas in the middle belt and the southern region of the country.
The production of cash crops in the country received much attention in the period before independence with the colonial government encouraging the production to boost the source of raw materials for their local industry in their country and increased the foreign exchange earning for Nigeria (Akande, 2006). Cocoa had been the dominant export crop in the period before 1970 but the production had declined steadily over the years from over 50 percent of non-oil exports in the 1970s to 22 percent in 1998 (Aigbokhan, 2001). Rubber was the second major agricultural export crop growing from its share of below 10 percent in the 1970s to 22 percent in the 1990s (ibid). However, while figure 3.2 shows inconsistency in the production trend of the different cash crops, it also shows that palm oil has the highest production output in the country with a rising trend over the years most of which is consumed locally due to the increasing demand (Aigbokhan, 2001).

Different government policies had great impact on the local production of cotton in the country, which is a major raw material for the textile industry. Cotton production received much boost in the country in the era before independence for its position as major export crop and raw material for the textile industries in the colonial master’s home country and shortly after independence due to series of local textiles industries that were established in the country (Akande, 2006). However, with the relaxation of importation policies allowing uncontrolled importation of cheap textiles into the country coupled with other factors, Nigeria soon became a dumping ground for imported cheap textiles having a negative impact on the local textile industries and leading to the collapse of many of them (Aigbokhan, 2001). This reduced the demand for cotton consumption by the local textile industries.

However, despite years of neglect in the agricultural sector with significant decline in traditional export crops and terms of trade, an IFAD document revealed that Nigeria remains one of the world’s most important producers of cassava and the second largest in palm kernel and oil palm production as well as the largest yam and cowpea producer in Africa (IFAD, 2001). Nevertheless, much of the crops produced are consumed locally by the teeming and rapidly growing population of the country (Akande, 2006).
3.4 Available water resources in Nigeria

Availability of water resources as part of the production inputs also constitutes a major criterion to the development of the agricultural sector in the country. With evidence of availability of adequate water resources in the country (table 3.3), the development of the country’s water resources for irrigation, control of floods for prevention of invadation of fertile lands along river banks and the delta areas and the increasing of water use efficiency and productivity are required for the full exploitation of the agricultural potential in Nigeria.

Table 3.3: Water resources in Nigeria

<table>
<thead>
<tr>
<th>Water resources</th>
<th>Year</th>
<th>Amount</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average precipitation</td>
<td>2005</td>
<td>1150</td>
<td>mm/yr</td>
</tr>
<tr>
<td>Total precipitation</td>
<td>2005</td>
<td>1062,336</td>
<td>Km³/yr</td>
</tr>
<tr>
<td>Internal renewable water resources-total</td>
<td>2005</td>
<td>221,000</td>
<td>Km³/yr</td>
</tr>
<tr>
<td>External renewable water resources-total</td>
<td>2005</td>
<td>65,200</td>
<td>Km³/yr</td>
</tr>
<tr>
<td>Total water resources</td>
<td>2005</td>
<td>286,200</td>
<td>Km³/yr</td>
</tr>
<tr>
<td>Irrigation water requirement</td>
<td>2000</td>
<td>1650</td>
<td>Km³/yr</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water withdrawal</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>2000</td>
<td>5507</td>
<td>Km³/yr</td>
</tr>
<tr>
<td>Domestic</td>
<td>2000</td>
<td>1687</td>
<td>Km³/yr</td>
</tr>
<tr>
<td>Industrial</td>
<td>2000</td>
<td>810</td>
<td>Km³/yr</td>
</tr>
<tr>
<td>Total</td>
<td>2000</td>
<td>8000</td>
<td>Km³/yr</td>
</tr>
</tbody>
</table>

Source: Aquasat, 2005

Nigeria is rich in both surface and ground water resources. Table 3.3 shows that the average total precipitation in the country is 1150 mm/yr with total precipitation of 1062,336 km³/yr for the whole country. The total water resource available in the country is estimated at 286,200 km³/yr. This shows that the country has abundant water resources available for use when compared to the total water withdrawal of 8000 Km³/yr, leaving a potential balance of 278,200 Km³/yr. However, it is unevenly distributed across the different region of the country with surplus in some regions and scarcity in other regions. This gives challenges for efficiency in use and productivity improvement in the water scarce regions.
Figure 3.3: Water resources usage in Nigeria as a percentage of the total actual water resources (2000)

<table>
<thead>
<tr>
<th></th>
<th>Agriculture</th>
<th>Domestic</th>
<th>Industry</th>
<th>Unused water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serie1</td>
<td>192,00%</td>
<td>59,00%</td>
<td>28,00%</td>
<td>9720,00%</td>
</tr>
</tbody>
</table>

Source: Aquasat, 2005

Figure 3.4: Total water withdrawal in Nigeria (2000)

Water Withdrawal in Nigeria

- Agriculture: 69%
- Domestic: 21%
- Industrial: 10%

Source: Aquasat, 2005

Agriculture accounts for the highest water withdrawal in the country with a total annual withdrawal of 69 percent (figure 3.4) from the inland water resources available in the country. Rain-fed agriculture still plays a dominant role in agricultural crop production in
Nigeria especially in the western region of the country. However in the northern region of the country, agriculture depends on rain and irrigation with increasing dependence on irrigation to guide against the incessant supply in precipitation due to changes in rainfall pattern and increasing aridity of the northern region (Arnborg, 1988). The increasing rate of industrialization in the country and the high population growth rate have also placed much pressure on available water resources especially in areas where incidences of shortages has already been recorded necessitating the need and requirement for better management techniques of the water resources.

While the total inland water body is estimated to be slightly over 12 million hectares, there are three major drainage systems in the country namely the river of Niger, Benue, coastal and Lake Chad (IFAD, 2001). The four principal surface water catchments in Nigeria include the Niger, lake Chad, eastern littoral and the western littoral with the total annual runoff from all the sources estimated to be 257.30 x 10^9 m^3 (Nwa, 2003).

3.4.1 River Niger: the Niger River is the third longest river in Africa with a total length of about 4100 km, which has its source from the mountain of Guinea and passes through 10 countries before joining with river Benue in Nigeria and flowing into the Atlantic Ocean (FAO, 1997). The Niger River along with its left bank attribute, the river Benue drains about 63 percent of the Nigeria’s total surface water network and forms an extensive delta in the southern part of the country. The major tributaries of the Niger River are the Benue along with its own tributaries namely, Kastina-Ala, Donga, Gongola, taraba, Ankwe and Mada; Sokoto-Rima, Kaduna, Gbako, Kempe, Gurara and river Kontagora (Nwa, 2003). The total area of the Niger River basin which falls within the country is estimated at 584,193,000 hectares representing about 63 percent of the total area of the country. The irrigation potential of Niger river basin is estimated at 1,678,510 hectares from which 885,510 hectares represent the potential for public schemes development while the balance of 793,000 hectares represent the potential for fadama development out of which a total of 670,000 hectares is already under irrigation (FAO, 1997). The flood plain of the Niger River is also regarded as the largest untapped potential area for irrigation development in Nigeria (ibid).

3.4.2 Lake Chad: the Lake Chad is the largest lake in Northern Nigeria with approximately 95 percent of the total river inflow into the lake coming from the Chari-Logone river system situated outside Nigeria while the main rivers that flow into the lake from inside Nigeria are the Komadougou-Yobe, Yedseram and Ebeji (Nwa, 2003). The Lake Chad basin spreads over seven countries with about 21 percent of the total area of the basin located in Nigeria. The total irrigation potential in the basin is estimated at 356,000 hectares from which only about 32,000 hectares is presently under irrigation (FAO, 1997). However, there is already evidence of water shortages in the basin resulting from incidence of drought in the region around the basin which has adversely reduced the water inflow into the lake coupled with the high population pressure on the available water resources in the lake region (FAO, 1997; Nwa, 2003).

3.4.3 Western littoral: the western littoral comprises of a number of smaller catchments which drain the south-west of the country between the Niger catchments and the Atlantic Ocean with the most important river in the network namely Yewa, Ogun, Oshun, Ona, Sg’hasha, Omi, Oluwa, Owena, Osse, ossiomo and Benin (Nwa, 2003).
3.4.4 Eastern littoral: the eastern littoral is in the eastern region of the country with the river Cross as the major while the others are river Imo and a smaller river Qua Iboe with all the rivers flowing into the Gulf of Guinea (Nwa, 2003).

3.5 Increasing aridity and desertification problem in Northern Nigeria

The problem of aridity in Nigeria and the whole of the sub-Saharan African region is a complex one with increasing aridity and desertification in many parts of the region. Changes in the climatic conditions in many parts of the region with incessant changes and alteration in the rainfall pattern resulted in many parts of the region becoming more arid with decreasing values of their aridity index (Amissah-Arthur, 2005). The sub-Saharan African region is divided into four bioclimatic zones based on the ratio between the precipitation and evaporation taking place; namely the hyper-arid, arid, semi-arid and the sub humid zones, with the arid zone having an aridity index of between 0.03 and 0.20 and the semi-arid zone having an aridity index of between 0.20 and 0.50 (Mortimore, 1989).

The northern region of Nigeria which consist of both arid and semi-arid zones, is an area characterised with low rainfall, with the annual rainfall diminishing northwards to an average of less than 500mm in a season of sixty days with the upper and lower confidence limits being 635 and 389 mm respectively (Arnborg, 1988). A study of the rainfall pattern in the region from 1970 to 2002 (figure 3.6) shows that there was a decreasing amount in the average annual rainfall which is less than 500 mm from periods around 1990 to 1998, with a minimum average annual rainfall value of 68 mm recorded in 1995. Over the years, there have been records of incidence of events of drought in the region with increasing pressure on available water resources and requirement for better management of the resources (Nwa, 2003). The increasing desertification in the northern region is also attributed to the incessant case of deforestation of the savannah woodland and bushes been converted into open agricultural land with no protection during the heavy rain downpours leading to erosion and soil deterioration/degradation (Arnborg, 1988; FAO, 1997). With the increasing and fast growing population, arable land is also required for food production and wood for energy purposes, thus resulting in trees being cut down and leaving the fields open during the dry seasons when there are no crops on the field with eroding of the top soil layer during heavy rain downpour a frequent occurrence.

Figure 3.5: Average monthly rainfall in Abuja, Northern Nigeria

Due to the limiting factor of increasing aridity, crop production in the region is carried out predominantly on the fadama farmlands, which are the wetland along riverbanks rich in humus-clay and seasonally flooded, with capacity to meet the food requirement of the small rural population (Nwa, 2003). However, with increasing rural and urban population, there are increasing demand for the development and cultivation of areas of previous savannah woodland, with increasing risk of desertification and the vegetation subject to widespread modification.

In the southern region of the country, there has been rapid modification of the vegetation with increasing demand for timber and arable farmlands. Obasanjo and Orville (1992) noted that the tropical rain forest of most of the sub-Saharan Africa were still fairly intact until the late 1960s when accelerated deforestation began in earnest with an average loss of 1.5 million hectares of forest a year due to intensive logging resulting in the conversion of the rain forest into grasslands and the savanna in turn becoming deserts. This has been the case in Nigeria especially in the southern region of the country where the exploration for crude oil and other types of natural resources had led to the exploitation of the forest resources and grass lands and also in the northern region of the country where increase need for agricultural lands has led to the conversion of more savannah wood lands into open fields without any sustainable soil and environmental conservation programs and techniques.

3.6 Water Resources and irrigation development in Nigeria

The annual rainfall across the different regions of the country varies greatly with an average mean rainfall of 10 inches in the extreme northern part and over 160 inches in the south-east and western region of the country (Nwa, 2003). While agriculture can be carried out independently (with rain) without any supplementary irrigation activities in the southern region, the northern region of the country required irrigation either partially (supplementary), or on a full-scale basis for crop production activities and increased productivity (Arnborg, 1988). With irrigation permitting double cropping and ensuring sufficient water for the wet season and dry season cropping with good potential for increase yields of plantation crops, irrigated agriculture can make a large contribution to food security and accounts for a high share in water abstraction, about 20.6 percent in Nigeria (Aquasat, 2005).
Irrigation development in Nigeria has been centred on institutional strengthening of irrigation agencies and farmers groups, development of down-stream irrigation and drainage facilities, technical support to River Basin Development Authority in programme initiation, design, implementation, operational and maintenance as well as provision of support services and operational guidelines to the river Basin Development Authorities (Nwa, 2003). With a good network of rivers and water bodies in the northern region, there are a number of irrigation projects been developed in the region (ibid). Some of the major irrigation projects in Northern Nigeria (FMWR, 2006) include the South Chad Irrigation project, Kano River irrigation project, Middle Rima Valley Irrigation Project and the Doma Irrigation project among others.

**South Chad Irrigation Project:** This irrigation project, which comprises Phase 1 and 2, is coordinated by the Chad Basin Development Authority. It is situated south of Lake Chad, about 120 km north of Maiduguri and the project is planned for the development of 67,000 hectares of irrigable land which is to be undertaken in three stages. Stage 1 covers a total of 22,000 hectares, stage 2 covers 27,000 hectares and stage 3 a total of 18,000 hectares. There is also work presently going on, on an additional 413,394 hectares out of which 35,127 hectares have been developed and already in use by farmers with other irrigation schemes at various levels of completion.

**Kano River Irrigation Project:** The irrigation project has a total of 22,000 hectares of irrigable land out of which 15,000 hectares has been fully developed and operational since 1983. Work is speedily going on the remaining balance of 7,000 hectares with major structures already put in place for the irrigation project.

**Doma Irrigation Project:** This irrigation project is coordinated by the Upper Niger River Basin Development Authority and has a total of 2,000 hectare of irrigable land out of which 1,600 hectares has been developed and operational with installation of sprinkling irrigation component. The water for the irrigation project is been sourced from the Doma Dam and the project is aimed at developing the water potential of the dam for irrigation purposes, public water supply and hydropower generation.

**Middle Rima Valley Irrigation Project:** This irrigation project is coordinated by the Sokoto Rima Valley basin Development Authority and the irrigation project has a total irrigable land of 20,000 hectares. It is being developed in phases with the first phase having a capacity to irrigate 8,170 hectares of land.

**Hadeija Valley Irrigation Project:** The irrigation project is coordinated by the Hadeija Jama’are River Basin Development Authority with about 3,000 hectares of land already in use for irrigation activities. An estimated 120,000 farm families are gainfully employed in the irrigation project.

**Bakolori Irrigation Project:** The irrigation project is coordinated by the Sokoto Rima River Basin Development Authority and has a 5.5 kilometre dam with a storage capacity of 450 million cubic metres. The total irrigable land under the irrigation project is 23,000 hectares of land out of which 15,000 hectares is for sprinkler irrigation and the remaining balance of 8,000 hectares for gravity irrigation but plans are underway to convert the sprinkler irrigation to gravity.
In all, an estimated 2.1 million hectares of land comprising of 1.6 million hectares from surface water and 0.5 million from ground water has been developed in the country (Aquasat, 2005).

### 3.7 Irrigation and crop production

With the requirement for annexing all opportunities towards increasing volume of food production in the country due to increasing food demand in Nigeria and guaranteeing internal food security, increasing agricultural productivity and volume of food production to meet the current food demand requires the use of modern technology and improved irrigation techniques and management practices.

While an FAO report has indicated that Nigeria is a country where the population has already exceeded the carrying capacity of the developed land and labour resources when cultivated at low levels of technology, the potentials available through irrigation development in increasing land productivity by three to seven times must be viewed as key factors and annexed for use in realising the goal of increased volume of food production and food security in the country (FAO, 1995).

In irrigated agriculture, water taken up by crops is partly or totally provided through human intervention and it provides a powerful management tool against the vagaries of rainfall and makes it economically attractive to grow high-yield seed varieties and to apply adequate plant nutrition as well as pest control and other inputs, thus giving room for a boost in yields (FAO 2003). Supplementary irrigation is the provision of water through irrigation to supplement rain-fed and is very common in many part of the northern region of the country with farmers using traditional methods to supplement their crop water need and requirement.

Irrigation projects and schemes have been a responsibility of the government in Nigeria and many part of the African region. The government play a central role in the development and management of the irrigation schemes. The irrigation schemes are developed and plots allocated to farmers in the scheme and the government carrying out a supervisory role. Many Nigerian communities have been practicing irrigation for centuries wherever water is available in the coastal and inland swamps, estuaries, floodplains, river banks and lowland areas and furrow irrigation has been practiced throughout the country using local technology and small pumps. The challenge of developing small-scale irrigation by farmers has come in response to demand to intensify food production in response to the increasing population pressure, land demands and market opportunities (Barghouti and Moigne, 1990; Nwa, 2003). An investment program in support of public irrigation scheme was launched during the oil boom era in the 1970s which was run by the rive basin development authorities with the construction of dams and pumping stations which resulted in the development of about 162 dams by 1990 with a total storage capacity to irrigate about 725,000 hectares (Aquasat, 2005). However, many of the dams were not equipped with adequate infrastructures which resulted in about only 20 percent of the total area planned for irrigation development being developed and about 32 percent of the developed area being irrigated (ibid).

In Nigeria, sub-irrigation system has also been practiced in the northeastern part of the country for centuries with the system concentrated in the villages of Marma, Kaban and the Guri in the Burum gana and Marma flood plains south of Nguru. The rivers have natural command over their plains in the area and the flood plains sloping away from the river on either side (Nwa, 2003). There has also been a widespread use of the natural flooding of rivers and lakes across the country while diversion of streams for irrigation purposes has been
practiced by local people as well as construction of canals and water conservation works for water diversion for irrigation and retaining/impounding flood water for use during off-season periods when the water level had gone down (ibid). However, while all these methods represent the local indigenous methods of irrigation on small scale basis, there is a challenge for large scale development of irrigation potentials across the different regions of the country.

3.8 Irrigation development and potential in Nigeria

The development of irrigation schemes started during the colonial period in Nigeria. Between 1855 and 1924, the famine in the northern region of the country directed attention to irrigation as one of the means of increasing agricultural food production. The series of famine and event of the first world war in 1912-1914 also stimulated the desire to use irrigation to solve food problems of the dry north in particular and Nigeria in general (Nwa, 2003). An experimental irrigation farm, the Baro Experimental farm was started in 1908 with the objective to test the performance of certain crops during the dry season using irrigation with the installation of a diaphragm pump to lift water from the river to irrigate the farm with record of crop performance said to be satisfactory (ibid).

Irrigation schemes and projects in Nigeria consist of three categories namely the public irrigation schemes which are government executed schemes, the farmer-owned irrigation projects and the residual fadama or floodplains. An FAO further classification of irrigation schemes based on land mass size in Africa made the following classification namely very large-scale schemes (over 10,000 hectares); large-scale schemes (from 1000 – 10,000 hectares); medium-scale schemes (from 100 – 1000 hectares); and small-scale schemes (less than 100 hectares) (Moris & Thom, 1999).

The large scale and medium scale irrigation scheme in the country are controlled by the River basin development Authority with a current estimate of 119,350 hectares under the two schemes while the combined area equipped for irrigation in the country stands at 293,117 hectares and an additional 681,914 hectares non-equipped flood recession cropping area making a total of 975,031 hectares water-managed area (Aquasat, 2005). However, while the irrigation potential for the country stands at 2,330,510 hectares, the actual irrigated land is less than 1 percent of the cultivated land thus making the contribution of irrigated agriculture to crop production very small (ibid).

Table 3.4: Irrigated area in Nigeria (2004)

<table>
<thead>
<tr>
<th>Irrigated Area</th>
<th>Year</th>
<th>Number of Hectares (Ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface irrigation equipped</td>
<td>2004</td>
<td>238,067</td>
</tr>
<tr>
<td>Sprinkler irrigation equipped</td>
<td>2004</td>
<td>50</td>
</tr>
<tr>
<td>Localised irrigation equipped</td>
<td>2004</td>
<td>0</td>
</tr>
<tr>
<td>Equipped lowlands (wetlands, flood plains, mangroves etc)</td>
<td>2004</td>
<td>55,000</td>
</tr>
<tr>
<td>Non-equipped flood recession area</td>
<td>2004</td>
<td>681,914</td>
</tr>
<tr>
<td><strong>Total water-managed area</strong></td>
<td>2004</td>
<td><strong>975,031</strong></td>
</tr>
</tbody>
</table>

Source: Aquasat (2005)
Table 3.5: Equipped and actually irrigated areas in the River Basin Development Authorities for the year 2004

<table>
<thead>
<tr>
<th>RBDA</th>
<th>Equipped area</th>
<th>Actually irrigated area</th>
<th>Actually irrigated area as % of equipped area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anambra-Imo</td>
<td>3941</td>
<td>10</td>
<td>0.3</td>
</tr>
<tr>
<td>Benin-Owena</td>
<td>317</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Chad Basin</td>
<td>26,180</td>
<td>1000</td>
<td>3.8</td>
</tr>
<tr>
<td>Cross River</td>
<td>364</td>
<td>40</td>
<td>11.0</td>
</tr>
<tr>
<td>Lower Benue</td>
<td>1310</td>
<td>70</td>
<td>5.3</td>
</tr>
<tr>
<td>Hadejia Jamâre*</td>
<td>18,475</td>
<td>21000</td>
<td>113.7*</td>
</tr>
<tr>
<td>Niger Delta</td>
<td>187</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Lower Niger</td>
<td>1344</td>
<td>115</td>
<td>8.6</td>
</tr>
<tr>
<td>Upper Niger</td>
<td>3697</td>
<td>722</td>
<td>19.5</td>
</tr>
<tr>
<td>Ogun-Osun</td>
<td>512</td>
<td>110</td>
<td>21.5</td>
</tr>
<tr>
<td>Sokoto Rima</td>
<td>27,580</td>
<td>5290</td>
<td>19.2</td>
</tr>
<tr>
<td>Upper Benue</td>
<td>8410</td>
<td>783</td>
<td>9.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>92,317</strong></td>
<td><strong>29,140</strong></td>
<td><strong>31.6</strong></td>
</tr>
</tbody>
</table>

Source: Aquasat (2005)

Table 3.5 give information on the equipped area for irrigation and actually irrigated area in some of the RBDAs in the country. The higher value for Hadejia Jam`are of the actually irrigated area in comparison to the equipped areas is a reflection of the fact that water from the canal for the irrigation scheme is used to water farm lands outside the irrigation scheme while many of the schemes that has low values of actually irrigated area are located in the southern part of the country where the demand for irrigation services due the low incidence of drought and high rainfall value (Aquasat, 2005; Nwa, 2003). The equipped area value for Hadejia Jamare, Sokoto Rima and Chad Basin in the table, represent the importance of irrigation to their individual regional location which is in the Northern part of the country where the incessant changes in the rainfall pattern and frequent drought occurrences has necessitated the need for alternative measures for water supply for agricultural use. However, the low value of the actually irrigated values for these irrigation schemes except Hadejia Jamare give indication of the under-utilisation of irrigation facilities in the schemes which calls for an increased understanding of the benefit of irrigation to crop production in these regions and utilisation of available resources efficiently and effectively.

Table 3.6: Extent of formal irrigation development in Nigeria, 1965-1993

<table>
<thead>
<tr>
<th>Year</th>
<th>Irrigated area (ha)</th>
<th>Rate of development (ha/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965</td>
<td>12200</td>
<td>N/A</td>
</tr>
<tr>
<td>1970</td>
<td>14570</td>
<td>474</td>
</tr>
<tr>
<td>1978</td>
<td>20,000</td>
<td>679</td>
</tr>
<tr>
<td>1980</td>
<td>30,706</td>
<td>5,353</td>
</tr>
<tr>
<td>1984</td>
<td>36,163</td>
<td>1,364</td>
</tr>
<tr>
<td>1993</td>
<td>69,000</td>
<td>3,649</td>
</tr>
<tr>
<td>2004</td>
<td>293,117</td>
<td>N/A</td>
</tr>
</tbody>
</table>

(N/A: not available)

Source: Nwa, 2003; Aquasat, 2005
Table 3.6 shows that the rate of irrigation development is low in the country compared to the irrigation potential of the country (2,330,510 hectares); nevertheless, the rate of development witnessed in the period 1993 to 2004 compared to the period 1984 to 1993 is a positive result of the increased relevance of irrigated agriculture to the agricultural sector development in the country. However, comparing total value of actually irrigated area in table 3.6 with quantity of grains produced in table 3.7, there is indication that irrigated agriculture has not benefit much from the higher rate of irrigation development witnessed in the period 1993 to 2004 with the decreased number of tonnage of grains produced in the period 1999 compared to 1989.

Table 3.7: Irrigated crops in Nigeria in 1989 and 1999

<table>
<thead>
<tr>
<th>Irrigated crops</th>
<th>Quantity in 1999</th>
<th>Quantity in 1989</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total irrigated grain production</td>
<td>135,000</td>
<td>1,852,200</td>
<td>Tons</td>
</tr>
<tr>
<td>As a % of total grain production</td>
<td>0.6</td>
<td>14.2</td>
<td>%</td>
</tr>
<tr>
<td>Harvested crop under irrigation</td>
<td>N/A</td>
<td>950,000</td>
<td>Ha</td>
</tr>
<tr>
<td>Rice</td>
<td>7,000</td>
<td>714,000</td>
<td>Ha</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>28,000</td>
<td>52,000</td>
<td>Ha</td>
</tr>
<tr>
<td>Wheat</td>
<td>19,000</td>
<td>50,000</td>
<td>Ha</td>
</tr>
<tr>
<td>Potatoes</td>
<td>4,000</td>
<td>26,000</td>
<td>Ha</td>
</tr>
<tr>
<td>Onions</td>
<td>20,000</td>
<td>23,000</td>
<td>Ha</td>
</tr>
<tr>
<td>Pepper</td>
<td>16,000</td>
<td>80,000</td>
<td>Ha</td>
</tr>
<tr>
<td>Sugar Cane</td>
<td>8,000</td>
<td>26,000</td>
<td>Ha</td>
</tr>
</tbody>
</table>

Source: FAO, 1995; Aquasat, 2005

While irrigated crops represent about 8 percent of the total crop production output in Nigeria (FAO, 1995), various types of crops are grown in irrigation schemes with hardly any type of crop that cannot benefit from irrigation. Table 3.7 shows the total product of irrigated grain crops in Nigeria in 1989 to be 1,852,200 tons and 135,000 tons in 1999 respectively, the table however revealed that vegetable crops especially tomato, pepper, cabbage and onions among others are benefiting more from irrigation particularly in the northern part of Nigeria where they are specifically grown in irrigated plots throughout the year (Oluwasemire et al., 2002).

While table 3.7 shows that rice has the highest tonnage production in 1989 with a figure of 714,000 hectares, its production has suffered a set back in the country with a figure of 7,000 hectares cultivated in 1999 with irrigation, which may be due to increased importation of the food item with the imported brand having better quality than the local brands. The increased production of rice experienced in 1989 was also as a result of the restriction on its importation at the period thus encouraging its local production, but with the restriction removed at the later years, it lead to the discouragement of local producers in its continuous production (Okolo, 2004). However, with the new initiatives aimed at boosting local rice production in the country coupled with increased import duties on the imported brand to discourage its consumption in the country, it is expected that its production locally will increase in the coming years.
3.9 Irrigation development and the challenge for increased water productivity

With the increasing need for water resource and irrigation development in the country, there are also challenges for increased water productivity for more efficient and effective use of the resource. The availability of water has been an important factor in economic and social development throughout human history, as freshwater is the most fundamental resource in sustaining life (Obeng-Asiedu, 2004). Water also plays a key role in the development and functioning of society and thus recognised as a high priority resource for sustainable development. The amount of water available for use and its quality are directly linked to economic activities, urban and industrial growth and development, lifestyle and consumption patterns and is a key determinant of population growth and distribution and density, social and political organisation (Nwa, 2003; Obeng-Asiedu, 2004). With increasing population around the world and most particularly in the sub-Saharan African, there is increasing demand and competition for freshwater for human consumption, industrial and agricultural production and generation of hydropower. With the increasing problem of water scarcity and aridity of the northern region of Nigeria, the available water resources must be used in an efficient way to meet the increasing demand of water users. Water is a limiting factor to improving agricultural production in this region, thus maximizing water productivity is viewed as a good strategy for on-farm water management and ensuring water security. Meeting the water demand for food production to achieve food security, rainfall and irrigation must encompass the efficient use of the resource and increasing the water productivity towards achieving a higher yield.

Crop water productivity relates to increasing crop yield per unit of water consumed and this depends on a number of factors such as crop genetic material, water management practices, agronomic practices as well as the economic and policy incentives to produce with improved water productivity (Kijne et al, 2003). Water productivity can be expressed in physical or in economic terms as partial factor productivity. Physical productivity is the quantity of product divided by the quantity of input and this is usually expressed in mass or monetary terms for comparison purposes (ibid). Economic productivity on the other hand uses valuation techniques to derive the value of water, income derived from water use as well as the benefits also derived. Increasing water productivity for agricultural use has a significant role to play in reducing the competition for the increasing scarce water resources, prevention of environmental degradation and provision of food security.

There are a number of different strategies that can be used to improve water productivity at the farm level, irrigation system and basin-level. Increasing the productivity of per unit of water consumed can be achieved through improving water management practices in use, improving non-water inputs, lessening of non-beneficial evaporation, reducing water flows to sinks, minimizing salination of return flows, shunting polluted water to sinks, reusing return flows, reallocating water from lower-value to higher-value uses, improving management of existing facilities as well as addition of more storage facilities (Obeng-Asiedu, 2004).

Crop water productivity varies with location depending on factors such as cropping pattern, climatic conditions, irrigation technology, field water management and infrastructure as well as on labour, fertilizer machinery inputs (Kijne et al, 2003). With agricultural crop production predominantly rain-fed in many parts of the country, which are often characterised by low yields and large on-farm water losses during occasional period of heavy rains, there is challenge for improvement in crop water productivity and water conservation techniques. With increased competition for freshwater resources, there is prediction that investment in agricultural infrastructure and research will have higher payoff than only investments in new
irrigation systems in order to accelerate the increase in water productivity towards ensuring food security for the future (Obeng-Asiedu, 2004). Kijne et al, (2003) however opined that sustainable increases in water productivity can only be achieved through integrated farm-resources management approach which combines water conservation, supplemental irrigation, better crop selection, improved agronomic practices and political and institutional interventions. This also includes the efficient use of rain water to achieve higher crop water productivity and increase groundwater recharge (ibid).

3.10 Challenges to the development of irrigation in Nigeria

There are records of massive investment in irrigation projects in the past in Nigeria that have failed to produce the expected results. Some of the factors that contributed to the failure include high overhead and management cost, underestimation of construction costs, inaccurate irrigation cost/benefit analysis, technical and management problems (Carsell, 1997). While many of these problems are attributed to large scale irrigation projects, there are also a few number of small scale irrigation schemes that have been rather costly and bad at meeting the needs of the poor (ibid). Irrigation performance in Nigeria and Africa is generally adjourned to be poor and often characterised with inefficiency and poor management (Nwa, 2003).

One significant problem facing irrigation development in Nigeria is the cost of investment. An FAO report reviewed that the average cost for large scale irrigation development in Nigeria with an estimated per capital income of 1000 dollars, is estimated to be 15,000 US dollars per hectare in 1993 with the annual operation and maintenance cost varying between 50 US dollars per hectare for gravity systems and 290 US dollars per hectare for pumping systems and up to 800 US dollars per hectare for sprinkler irrigation system (FAO, 1995). Investment in the agricultural sector in the country has been low with many investors uncertain of the inconsistent policy changes in the country thus creating an atmosphere for insecurity for their investment in the sector. While irrigation development requires huge amount of funds for investment especially in the semi-arid and arid regions where the development of irrigation schemes often require the construction of dams, many of the private investors most times cannot raise the required amount of capital often needed for this type of investment thus leaving the role to government and international donor agencies. In situations where the investors are capable of raising the required funds for such type of investment, insecurity of guaranteeing returns to their investments do inhibit them from making such type of investment. However, while government often makes effort at developing large-scale irrigation schemes, the problem of poor management, inefficiency and poor maintenance of the irrigation facilities do rendered lot of government owned irrigation schemes unsuccessful in the country.

A review of previous project feasibility reports also indicated that many of the proposed irrigation projects in the country lack adequate preparation of topographic maps, soil and land classification surveys as well as misinterpretation of hydrological information rendering the projects unsustainable (Uwa, 2003). Some of the established projects showed poor performance in the form of decreasing crop yields, low return on investment, increasing salinity, rising water table and water logging problems among others most of which were due to poor operation and maintenance (ibid).

For a success story in irrigation development in Nigeria, all the traditional problems associated with irrigation must be addressed with adequate machinery put in place for good management of government controlled irrigation schemes in the country. Large scale
irrigation scheme beneficiaries must be well informed and orientated to carry out joint/group management of their irrigation schemes with adequate management and maintenance structure put in place. Current research must also aim at addressing the problem of increasing salinity, rising water table and water logging problem in irrigation scheme sites across the country for sustainability of the irrigation schemes.

3.11 Requirement for water resources development and management in Nigeria

The full exploitation of the agricultural potential of Nigeria requires the development of the water resources of the country as one of the strategies, inform of irrigation projects which is however capital intensive under a long range program and the indoctrination of the farmers in radically different agricultural techniques (FAO, 1997). With water representing a major resource input for agricultural production, and the recognition for the need for irrigation development to permit double cropping in the northern region and parts of the western region towards ensuring sufficient water for crops and increased productivity, water resources development and management structures must be put in place to achieve this aim.

While an FAO document signified that the development of irrigated agriculture in Nigeria will signify a radical change in farming practices (FAO, 1966) the establishment of the first irrigation division in the northern region in 1949 (Nwa, 2003) saddled with the responsibility of investigating, designing and constructing irrigation schemes as well as collection of hydrological data signified positive steps towards realising this goal.

With current available data indicating agriculture as the single largest contributor to the well-being of the rural poor sustaining 70 percent of the labour force and 90 percent of the rural poor as well as contributing 30 percent of the GDP with 90 percent coming from the rural smallholder sector (IFAD, 2001), guaranteeing the livelihood security of these people requires the development of the nation’s water resources and adopting good management techniques for the management of the resources for sustainability and also increasing its productive use.

Water resources management in simple terms relates to having the right amount of water available for a particular use at the right time and with the right quality and this has become imperative due to the growing demand for water and the need for planning in the use of water (Mather, 1984). The management of water resources requires quality and quantity management of the resource and with water use involving diverse areas such as domestic, agriculture, industrial, recreation, navigation, power generation among others, efficient management of the resource will reduce competition among the various users of the resource. Water resource management policies in Nigeria principally focus on the development of the resources for irrigation and management of the irrigation schemes and projects. At the national level, the Federal Ministry of Water Resources (FMWR) is the government agency responsible for the development, use, management and control of the nation’s water resources. The objective of the water resources sectors include harnessing underground and surface water supply for irrigation, navigation, recreation, hydropower generation and water supply for domestic and industrial use. The ministry also participates actively at the international level in ensuring rational use and management of water resources common to the nation’s riparian countries with a number of bilateral technical cooperation agreements with other countries in the area of information exchange, capacity building and efficient resource management of their common trans-boundary water resources.
However, with records of inefficiency and poor management of the nation's water resources with increased water pollution and water-related problems in many areas in the country, the new vision of FMWR is the provision of sustainable access to safe and sufficient water resources in meeting the cultural, social, and economic needs of every Nigerian towards enhancing food security, poverty eradication, and public health while ensuring the integrity of the nation's freshwater ecosystems (National report, 2006). This is expected to be achieved with the proposed adoption of the integrated water resources management for comprehensive planning, facilitation, and creation of an enabled environment for integrated conservation, development, and management of the various water-uses for the preservation of the quality and quantity of the freshwater ecosystems (ibid). There is also a water resources development master plan on the drawing table for water resources development in the country to ensure the optimum water resource use for development activities in the country and meet the socio-economic demand for water use for all regions in the different range of water activities including irrigation and drainage, domestic water supply and sanitation, hydropower generation, inland navigation, and inland fisheries (National report, 2006). The master plan also has in its objectives and implementation guideline the integrated management of surface and groundwater and rivers in the country with reference to gully erosion disaster management and water-related environmental management.
Chapter 4        Agricultural sector growth and development in Nigeria

4.1 Link between agricultural development and economic growth

The development of the agricultural sector has a significant role to play in the transformation and structuring of the economy of Nigeria and other economies where the majority of the labour force is primarily dependent on agriculture. The challenge of achieving the millennium development goals and global food security requires annexing all available opportunities together with water and land resource development, in boasting rural income of the rural populace and raising the per capita income and the standard of living through increased production and productivity in the agricultural sector. The pre-colonial Africa was pre-eminently an agricultural world and despite that trade played a very significant role in the fortunes of some of the economies, the latter along with commerce and industry were usually secondary to agriculture with the agricultural cycle dictating the rhythm of social life (Obasanjo and Orville, 1992).

In the Nigerian rural agrarian economy, there is a challenge to increase the productivity and reducing poverty among the rural populace predominantly engaged in agricultural production along with effort at developing the water and land resources available. Low productivity in the agricultural sector has been identified as a problem and root of poverty in the rural areas and the rate of increase in farm labour productivity had not kept pace with increase in land productivity (Tomich et al, 1995). Nwaobi (1990) also remarked that the Nigerian agricultural sector is characterised with low farm incomes, low capacity level in meeting the food and cash crop needs and requirements of the country and primitive methods and techniques of production, resulting in low production output and high poverty incident among the rural agrarian populace. However, despite the decreasing role of the sector’s contribution to the national GDP, it still plays a dominant role at the grassroots level in providing employment and source of livelihood for the majority of the rural population engaged in the sector and also has the potential of providing employment to interested participants.

Aigbokhan (2001) in an analysis highlighted that the colonial government in Nigeria recognised the potential of agriculture in propelling the Nigerian economic and regional development, thus put in place policies to encourage output growth in the sector. In terms of contribution to the national GDP, agriculture was a leading sector in the 1950s and 1960s, accounting for 63 percent of the GDP in the period 1960 to 1964 with the share of food imports in the country’s total import low during the period, about 9.6 percent (ibid).
However, there was a sharp decline in the share of the sector’s contribution to national GDP from the 1970s, reducing from 54 percent in 1969 to 33 percent in 1974 which was also the period that marked the watershed in Nigeria’s economic history through the 1973/74 crude oil price shocks (Aigbokhan, 2001).

Figure 4.1 give evidence of a growth in agricultural output in the country but a sharp relative decline in its contribution to the national GDP when compared with the crude oil sector. While agricultural exports accounted for 86 percent of the total export in the 1955 to 1959 period, it declined to 26 percent by the period 1970 to 1974 (Aigbokhan, 2001; Balogun, 2001). The contribution decreased further to 5.7 percent in the period 1975 to 1979, 2.7 percent in 1980-1984, 5.6 percent in 1985 to 1989 and nose-diving to the lowest in 1990-1994 accounting for only 1.8 percent before increasing back to 8.6 percent in the period 1994 to 1998 (ibid). These give evidence of the need for restructuring of the sector towards increasing its aggregate contribution to the national GDP and economic development of the country.

4.2 Population growth and food security problems in Nigeria
The current food security problem in Nigeria and other African countries is widely acknowledged to have originated in part from the stagnation or decline in the development of the agricultural sector with challenges for resuscitating agricultural production to meet the increasing food demand and increasing the productivity in the sector (Balogun, 2001). With population growth and increasing food demand in the country, local food production has not meet up with the demand, thus, there has been an increase in food imports and reliance on external food supply in meeting the local food demand in the country (Okolo, 2004).
Figure 4.2: Value of Food Imports into Nigeria in the period 1962 – 1998

Source: FOS, 2005

Figure 4.2 shows the growth in the value of food import into the country with a slight growth in the period 1960 to 1990. However, there has been a sharp rise in the growth rate since 1990 with dramatic rise in food import experienced in the country from 1990 up till the present moment. The dramatic rise in food import into the country can be related to the rapid population growth experienced in the period in review (Guardian, 2007 and table 1.1) creating shortages in supply for food items to meet the food requirement of the increasing population. Despite the fact that the ADP and SAP programs in the country brought a significant increase in the volume of agricultural production in the country (Akande, 2006), the demand for food items has overtaken the supply with a considerable margin thus necessitating the need for import of the food items. Another dramatic rise was witnessed from the period 1993 which connotes with the period of political problems due to cancellation of democratic election results with international sanctions imposed on the country towards forcing the military rulers in embracing democracy. The sanctions imposed have with it the introduction of embargo on the nation’s imports and export which made it difficult for the import of agricultural inputs and other industrial machineries into the country (Okolo, 2004).

However, while the country was allowed to import food items with the proceeds of the crude oil revenue, the military administration introduced new fiscal policies to counter the negative effects of the sanctions by encouraging the local production and consumption of the food items (ibid). But because the new policies could not be sustained due to difficulties in procuring farm inputs, the value of food import increased again. The period after 1998 witness a decline in the food import again in the country with a change in government administration to a democratically elected civilian regime and introduction of new policies.
including attempt at revitalisation of the agricultural sector for increased food production and productivity and increased import duties on imported food items to encourage local food production and reduced consumption of foreign food items. However, with rapid growth and changes in the population of Nigeria, the challenge of meeting the food demand and nutrition requirement of the increasing population requires a dynamic change in the agricultural sector through increase in the agricultural productivity, the agricultural labour productivity and unlimited access to the production inputs.

4.3 Impact of Green Revolution and Structural Adjustment Program on agricultural production and development in Nigeria

The transformation of the food production system in Nigeria is of paramount importance to economic reformation in the country, with a wide range of macro and micro implications including reduction in food imports and foreign exchange, lifting the level of consumption, reducing inequality, extracting surpluses for investments and stimulating the demand for industrial goods (Roy, 1990). The use of modern technology in form of biological and mechanical inputs can make a significant contribution to accelerating and increasing food production and adopting strategies that sustain the adoption of these technologies for increased farm productivity (Akande, 2006; Roy, 1990).

The use of technology to boost food production in Nigeria did not receive much attention in the country until the late mid seventies when it was realised that food production was lagging behind all other sectors of the economy (Smith, et al, 1994). While the country has relatively abundance of land for agricultural use, the pursuing of technology-based farming was not given much attention coupled with inconsistency in agricultural and economic policies due to frequent changes in government and administration. The green revolution policy in Nigeria in the mid sixties has as one of the primary objectives the introduction and adoption of the use of modern technology in boosting agricultural production and the country has been trying to implement use of modern technology in pockets of the country from the mid seventies onwards (Balogun, 2000). While the policy has the goal of accelerating increase in agricultural production through the removal of all known constraints to increased production, the recommendations were for a greater participating role of the private sector in input distribution and concentration on specific types of crops and production of hybrid seeds with complementary input packages (Akande, 2006). However, while a success record was achieved with reports of increased volume of crop production, the long term positive impact of the policy was inhibited with constraints such as lack of funding for the program and the eventual termination of the policy during the change of government administration in 1983 (ibid).

Roy (1990) remarked that in boosting crop production with increased agricultural investment and the pursuing of intensive farming through modern technology, there is a need for investment in scientific agricultural research with the support of the use of mechanical equipments to increase farm efficiency. This must also be supported with the provision of extension services to peasant farmers to adopt the use of technology and creating policies that would enhance profitability as well as procurement of inputs at reasonable prices for the farmers to get higher prices for their outputs (ibid). This was demonstrated with the introduction of policies such as the green revolution and incorporation of the latter into national programmes such as the Operation Feed the Nation (OFN), the National Accelerated Food production Programme (NAFPP), the Agricultural Development Project (ADP) and the River Basin Development Project (RBDP) (Akande, 2006). The World Bank policies in
Nigeria from 1969 to 1978 also emphasised food production with the use of technology as a major instrument in meeting the goal and target (Roy, 1990).

The importance of technology use was reflected in a research work by Smith et al (1994) which demonstrated the positive effect of technological use on agricultural production with their research findings in the case study indicating that new technological and input use adoption increased the volume of cereal production in the northern part of Nigeria with increased productivity on input use. Akande (2006) also remarked on the success story achieved in the ADP projects which combined technology, effective extension services, access to physical inputs, adequate markets and other infrastructural facilities with evidence of the ADPs playing a significant role in the evolution of Green revolution in Nigeria and reducing trend of poverty in the rural areas at the period.

The Structural Adjustment (SAP) program which was introduced to salvage the country from total collapse of her local industries due to high dependency on imported goods and encourage local production of those goods, also saw a significant positive impact on the agricultural sector at the initial stage of implementation of the program. With the primary objective of the SAP to change the pattern of aggregate domestic expenditure and production, broaden the narrow economic base to embrace non-oil sectors and promote self-sufficiency in domestic food production and supply and reducing importation of the food items, the SAP policies does have some positive impact on the agricultural sector in the country (Akande, 2006; Okolo, 2004).

Akande (2006) in an analysis on SAP policy effects on agriculture in Nigeria outlined that the exchange rate policy change the pricing system by readjusting the overvalued local currency which had hitherto made imports of agricultural commodities much cheaper than the locally produced items thus serving as a disincentive to local farmers whose returns could not cover the cost of production talk less of generating a profit margin for them. The local agricultural input suppliers also found it more rewarding to import the inputs than producing them locally with the technological base of the country been laid on foreign sources (ibid). The new exchange rate had a positive impact much more in the cash crop sector as it made it possible for farmers notably the cocoa growers to increase their revenue base coupled with the jump in the prices of the commodity, the dismantling of government administrative controls including the commodity marketing boards and removal of export restrictions (Akande, 2006; Mustapha, 1999). The food crop sector also benefited on the long run but not as much as the cash crop sector which came as a result of the reduced competition with imported food items and imposition of import bans on specific food items (ibid). However, while Akande (2006) argued on the positive impact of the SAP program on channelling of credit to the agricultural sector with the liberalization of the banking sector in the country, there were no much evidence of flow of credit facilities from the commercial banks in the country to the agricultural sector (Mustapha, 1999). Nevertheless, there was a significant increase in the flow of credit from governmental financial institutions to the sector with much of the credits going to the crop production sector (Akande, 2006). The impact of the SAP policy on the agricultural sector was however adjudged to be positive with evidence of increased crop output production due to favourable prices compared to preceding periods, although with differences with individual crop performance, and attraction of more labour force to the sector (Akande, 2006, Mustapha, 1999 and Mosley, 1992).
4.4 **Sustainability of the agricultural sector in Nigeria**

Despite promising future for the agricultural sector in Nigeria, sustainability of the sector has continued to pose as a major issue confronting the sector’s development over time. One of the new strategies by the rural people in Nigeria in meeting the increasing demand for food and attaining sustainable livelihood is agricultural intensification. This relates to the use of the land resources on a continuous basis using good agronomic practices and with an increase in the gross output in fixed proportions due to inputs expanding proportionate increase in input use (Okike, *et al.*, 2001). It can also occur by a shift towards more valuable outputs and by a technical progress that raises land productivity (Carsell, 1997). Agricultural intensification increases value of output per hectare which can occur though changes in cultivation method, increase in labour inputs, changes in technologies, increased use of natural and artificial fertilizer, improved seed, animal traction, mechanisation, multi-cropping, irrigation and soil conservation methods (ibid). However, it may have the negative effect in terms of environmental and economic sustainability and soil fertility maintenance.

Okike *et al.*, (2001) identified soil fertility maintenance as posing the greatest challenge to the sustainability of the agricultural sector in many of the densely populated areas in Nigeria. With the need to intensify agricultural crop production to meet the food supply of the increasing population in the region, there is a need to address the problem of rapid decline in soil productivity due to continuous cultivation as many of the land areas in the region are susceptible to soil degradation (ibid). The level of the soil fertility determines the cropping patterns and yields to a much greater degree and as farmers face the changing situation imposed by the increasing demand for food, they have to adapt and adopt different forms of technologies for maintenance of the soil fertility (Carr, 1989).

Identifying the problem as a major constraint to crop production must be given adequate attention for sustainability of the sector. With the need for increased volume of food production, there have been calls for increased use of inorganic fertilizers and new varieties of seed and greater consideration given to use of biotechnology. However, the increased reliance on chemicals and other hi-tech inputs do have consequences on the sustainability of the environment and biodiversity, thus, the call for a sustainable agricultural sector calls for the pursuance of a number of goals. These goals include the incorporation of natural processes such as nutrient cycling, minimisation of the use of external and non-renewable inputs, the participation of farmers and rural people in all processes of problem analysis and a greater use of local knowledge (Carsell, 1997). Carr (1989) also noted that greater attention should be paid to getting the appropriate technology for the maintenance of soil fertility which requires a combination of both external and internal sources nutrients and the crop management technology must be evaluated in terms of effects on seasonal labour demand.

There have been some success stories in the battle to meet food security in Nigeria in the face of environmental degradation and sustainability. Research report has shown that agricultural intensification had enhanced soil fertility through the use of indigenous knowledge and techniques with opportunities for farmers to maximise the fertility of their soil (Carsell, 1997). Harris (1996) also noted that there were success stories in Kano, Nigeria where land has been intensively farmed successfully for 30 years under annual cultivation with integration of crops with legumes and inorganic fertilizers. However, there are still challenges to be met in ensuring a sustainable agricultural industry in Nigeria and the use of the right technology that will enhance the sustainability of the environment as well as ensuring sustainable development in the region.
4.5 Constraints of agricultural credit supply and rural finance

Credit supply has been a major constraint to agricultural development in Nigeria. Different government policies in Nigeria have focused on eradicating the problem of credit supply to farmers and making it accessible. One policy is the Export Incentive and Miscellaneous Degree of 1986 which was enacted to give the Central Bank of Nigeria the power to provide refinancing and discounting facilities to commercial and merchant banks to encourage them in providing credit and risk bearing facilities in support of agricultural export and local production of crops (Aigbokhan, 2001). The establishment of the agricultural credit guarantee scheme fund in 1977 and other financial institutions were also to provide cheap and easily accessible credit to farmers. The Central Bank of Nigeria has made different fiscal guidelines such as the prescription of the size of credit allocation by banks to designated sectors of the economy. The banks in the country were required to lend a minimum portion of their loan to agriculture with penalty attached to any form of default and failure to follow the guidelines (Aigbokhan, 2001). However, research studies indicated that the guidelines were not adhered to by the banks with the agricultural sector suffering much neglect and inaccessibility to credit facilities (ibid). Rural banking policy was introduced in the country in 1977 to mobilise rural savings and channel same into rural productive activities. The agricultural credit guarantee scheme (ACGSF) has played a significant role in providing cheap and easily accessible credit to farmers in the country with low interest rates ranging from two to five percent depending on the type of agricultural economic activity it is used for (Akande, 2006; Aigbokhan, 2001). The different agricultural economic activities which could benefit from the scheme include food crop and cash crop production, livestock production, fishery, agricultural trade, processing and other services. The scheme which was funded by the federal government and the Central Bank on the ratio 60:40 was to facilitate the provision of loans to farmers through banks and encourage the banks increase their credit facilities to farmers and provide guarantee against inherent risks (Aigbokhan, 2001). The fund was to repay the banks their share of the fund invested in face of a repayment default by any of the beneficiary of the scheme.

Figure 4.3: Credit Supply to farmers in Nigeria through ACGSF from 1978 to 2003

![ACGSF scheme credit supply to farmers, 1978-2003](chart)

Source: CBN, 2005
The SAP policy in the country has impacted a positive effect on credit supply to farmers with increase in the amount of loans to the farmers through the ACGSF scheme. Akande (2006) remarked that the agricultural and manufacturing sectors were designated as high priority sectors for loan channelling with an increase in the proportion of loan portfolio of the commercial banks and credit institutions that must go to the agricultural sector. Figure 4.3 gives evidence of this as it shows that credit supply to farmers through the ACGSF scheme increased significantly over the years with more funds going to the farmers involved in food crop production, with the rising trend starting from SAP policy era in 1985. This is evident by the changing role the food crop production sector is playing in meeting with the demand for food production due to the increasing population in the country. Available record also showed that the small scale farmers form majority of the loan beneficiary with opportunities to collect loans up to the value of 20,000 naira without the provision of any collateral (CBN, 2006). However, with the termination of the SAP policy in 1988, there has been a continuous rise in credit supply from the ACGSF scheme to the crop production sector with the figure showing a dramatic rise in credit supply much more from 1999 period. This period however connotes with a change in government administration in the country and the introduction of new economic policies and determination to ensure the revitalization of the agricultural sector in its contribution to the national GDP, ensuring livelihood security and guaranteeing food security in the country (Mustapha, 1999; Okoli, 2004).

With the challenge of meeting the food requirement of the increasing population, there is need for more credit to the food sector towards the development of the sector in meeting the food demand of the country and ensuring food security in the country. With the increasing rate of inflation in the country, the farmers will require more funds than the present amount they can collect without collateral from the ACGSF fund for use in their production activity. However, while there is evidence that the food crop production sector has been receiving more credit support from the ACGSF scheme, figure 4.3 shows that the cash crop production sector did not receive much boost at ensuring adequate credit supply to the sector. This call for attention due to the role the cash crop sector also plays in the economic development of the country and its contribution to the GDP through supply of raw materials to the nations industries and generation of foreign exchange earning. One reason why the cash crop sector may not be benefiting much from the scheme presently is due to the fact that the production often requires large amount of capital and most of the time require large scale operation basis (Mustapha, 1999). However, with the role of the sector in the economic development of the country, there is challenge in ensuring more credit facility to the sector.
Chapter 5  Strategy and potentials for increasing agricultural production and improvement in Nigeria

5.1  Agricultural productivity in Nigeria

Productivity is of key issue in the agricultural sector in Nigeria due to its importance as a strategy for agricultural development and its impact on economic and social development. Increasing productivity can serve as a means through which humans can deliver themselves out of the menace of poverty as productivity improvement create wealth that can be used to meet present needs and increase the chances of meeting future needs (Ukeje, 2000).

With Nigeria having an estimated 71.2 million hectares cultivatable agricultural land and about 60 percent of the population labour force engaged in the sector, the output of the sector is adjudged to be low and labour intensive despite a higher percentage of the total country’s labour force engaged in the sector (FAO, 2002; Ukeje, 2000). Thus increasing land, labour and resource/input use productivity in combination with water and land resource development has a critical role to play in the country’s journey towards domestic food security.

Productivity which relates to a measurement of the efficient and effective use of resources or inputs in the production of goods and services for societal use can help in ensuring the production of these goods and services at lower cost of production (Ukeje, 2000). Okuneye (2002) identified productivity as a function of the combination of research and the application of skills and is measured per unit of land, per unit of labour input or per unit of investment.

In the agricultural sector, the basic resource inputs consist of labour, capital and natural resources (land and water) and with a direct relationship between individual resource productivity and economic growth of the nation, as improvement in the productivity of each worker on the farm leads to improvement in earnings of the farmer/investor, more financial capital for management and more revenue for government (Ukeje, 2000). In a comparison between the developed countries and the developing countries like Nigeria, Bhaduri and Skarstein (1997) noted that in the 1950s, the agricultural labour productivity of the developed countries was seven times that of the developing countries but by 1990, the agricultural labour productivity in the developed countries was already thirty-seven times higher than that of the developing relating to higher labour cost for the developing countries and lower production cost for the developed countries. This is reflected in the huge increase of food imports by developing countries as this made them net importers of food and there was also a sharp reduction of particular export commodities of the developing countries such as cotton, oil crops and sugar (ibid).
Figure 5.1: Agricultural Production Index in Nigeria, 1970 - 2003

Source: CBN, 2005

Figure 5.1 gives a summary of the production index in the agricultural sector from 1970 to 2003. With agriculture making a large contribution to the GDP of the country, agricultural productivity must be pursued for good performance of the sector and ensuring higher revenue for the players in the industry with increased output potentials. Different methods for increasing agricultural productivity evolved over the years in the Nigeria farm sector through the application of modern technology with such methods including the use of improved crops and stocks, fertilizers and soil conditioner, better husbandry and cultural practices and provision of more and efficient use of water resources (Ukeje, 2000). However, despite the evidence of agricultural intensification in the country with expected increase in productivity ratio, agricultural productivity is still very low in the country with reason for this been that the rate of technology adoption is low due to low level of extension services for increased adoption of these modern technology of production (Okike et al, 2001). Figure 5.1 shows that production level had increased significantly in the food crop production sector while the cash crop production sector had only witness a smaller growth in the production level when compared with the corresponding sector of the food crop production. The positive effect of the SAP program in the country was also reflected in figure 5.1 with the marginal increase in the food crop production increasing from the 1985 period. However, Okike et al (2001) from their research findings remarked that increase in productivity accompanying increased agricultural production witnessed in the country comes with higher cost of farm operations with a decreasing to scale returns on general farm operations. This is in contrary to the general aim of productivity improvement which is to lower the cost of production. Nevertheless, there are still opportunities available for more improvement in both the food and cash crop production sector in the country for increased agricultural productivity and optimum use of resources and production inputs considering the low resource-use efficiency rate being witnessed presently in the sector (Okike et al, 2001). This can come through increased extension service delivery to the farmers to acquaint them more of new technological developments and methods of production (ibid).
5.2 Problems of agricultural development in Nigeria

In the economic and national development of Nigeria, agriculture is expected to provide adequate supply of food to the people, produce a high level of agricultural raw materials for the industries and also generate employment for the people and a high level of returns to the farmers. However, despite evidence of availability of natural resource inputs including land and water and ample supply of human labour force which are the principal agricultural inputs, different problems have been confronting the sector over the years and one of such is the inconsistent government policies which have been described as a fatal perturbation that had rocked the boat of food security in Nigeria (Okuneye, 2002). Other problems identified include the socio-economic characteristics of the farmers, poor infrastructural facilities, credit facility problem, agricultural inputs and land tenure problem, all of which interact in a synergism, resulting in low production, high prices of food items, inflation, underdevelopment and concomitant poverty (ibid).

The various problems confronting the agricultural sector can be grouped into the following categories:

(a) Infrastructural facilities

This consists of poor and inadequate road network between the rural areas where agricultural production mainly takes place and the urban areas where there is available market for the commodities. Smith et al (1994) identified this as a problem militating against increased productivity in the agricultural sector as the availability of these infrastructural facilities is crucial to increasing productivity in the sector. With research findings indicating the availability of good road networks and transportation having a positive effect on boosting agricultural productivity in the country (ibid), tackling this problem is a critical tool towards increasing food security in the country. There is also lack of storage facilities for storage of farm produce with a high volume of annual loss of agricultural produce attributed to inadequate storage facilities. Many of the rural areas also lack electricity needed for processing and storage of perishable agricultural produces as well as other needs of the farmers. Provision of social amenities in the rural area such as health facilities, pipe borne water, schools and relaxation/sport centres is grossly inadequate which is responsible for the high incidence of migration especially the youths to the urban area (Fadayomi, 1988). A lot of man-days and hours are also lost to ill health resulting in low labour productivity of the farmers (Smith et al, 1994). Series of steps have been taken by different government administration in Nigeria to address these problems some of which include construction of silos in specific locations in the rural areas, construction of feeder roads into the rural areas and building of health care centres (Okoli, 2004). However, due to poor maintenance culture in the country, many of the facilities in the rural areas are not maintained to ensure their sustainability while many of the road networks constructed are not motorable due to destruction by erosion and low quality of job done during their construction. In places where electricity has been provided, insecurity in the country had made the electricity poles and equipments venerable to vandalisation by hoodlums coupled with incessant supply of electricity.

(b) Socio-cultural and land tenure problems

This relates to the problem of land tenure system in Nigeria in relation to socio-cultural factors especially in the southern region of the country where the system of land tenure limits the availability of land to the would-be farmers. In the northern part of the country, land belongs to the state which is supervised by the emirs and chiefs for allocation to users while it is owned by individuals in the eastern part with a similar case in western region too (Akande,
The cultural system and beliefs also limit the role of women to few activities in some cultural settings while religion also plays a major role in defining the roles played by women and other potential source of labour for agricultural purposes (Okike et al., 2001). The government has taken steps to address the problem of land tenure system in the country with the promulgation of the Land Act of 1978 which reversed the ownership of all land in the country to the federal government. However, the Act is only a statement on paper as it has not been implemented in the country while the implementation may also be practically and technically impossible due to cultural reason associated to land ownership structure in the country. While Akande (2006) opined that the land degree had an impact the land ownership structure in the East and Western region of the country with the state having control of land, available records still shows that a vast majority of the land in these regions are still controlled by the communities, individuals and family households (Okolo, 2004; Onokerhoraye, 1995). Nevertheless, different government administration has taken steps to provide land to would-be farmers through the demarcation of specific area of land in the different region of the country as agricultural lands with programs such as the farm settlement scheme (Akande, 2006). While some of the would-be farmers do benefit at the start of such programmes, many of the land areas are eventually taken over by the political leaders and influential government officials and converted for personal use (ibid).

(c) Economic factors

The economic situation in the country and inconsistent policies has led to increasing prices of farm inputs such as fertilizers, herbicides, pesticides while some of the inputs are also not readily available in the input market. This limits the adoption of these inputs which does have a great impact on yield and production levels (Okike, et al. 2001). While some policies such as the SAP program has encouraged the local production of inputs in the country (Akande, 2006), others like the austerity measures has had a negative effect on input supply in the country (Mustapha, 1999). The unavailability of major inputs at the time required also generates a demand pull situation for higher prices of the input materials. Inadequate credit facilities to farmers also limit farm size in a commensurate to what they can afford and where credit is available, the commercial sources always come with high interest rate while many of the government source are not easily accessible to the farmers. Government administrations in the country both at the federal and state level have taken steps to address these problems some of which include construction of fertiliser blending plants, setting up of agricultural input procurement boards among others (Akande, 2006). However, due to corrupt practices of government officials and political leaders in the country, many of these projects are only used to siphon fund into private accounts and the plants packing up after a few years of operation (Okolo, 2004). Many of the credit facilities provided by government are also associated with bureaucratic bottlenecks in accessing while the few lucky farmers that are able to access the loans do not make any attempt to repay them back, seeing such as their own share of the ‘national cake’ (ibid). However, the ACGSF scheme has achieved immense success in providing cheap credit to farmers except that the amount provided are low compared to the actual credit requirement for the farmers. Nevertheless, the current civilian government administration in the country is making attempt to change the orientation of the citizens towards repaying back government loans and reduction of corrupt practices in the country with the setting up of government agencies such as the Economic and Financial Crime Commission and the Independent Corrupt Practices Commission saddled with the responsibility of prosecuting corrupt government officials and individuals in the country and increasing public confidence in government programs and fund management. There are also series of policy review concerning the commercial banks in the country with the compulsory allocation of about 10 percent of their yearly pre-tax profit demarcated as loans to the
agricultural and small-scale manufacturing sector (Balogun, 2000; Guardian, 2006). However, the successful impact of these efforts cannot be determined now but will be on a long term effect.

(d) Environmental problems
A major problem confronting the agricultural crop production sector in Nigeria is the high incidence of pests and disease. This problem was identified to be responsible for loss of high amount of revenue to farmers due to pest and disease attack on the field and during storage (Akoroda *et al.*, 2004; Okike *et al.*, 2001). The problem of pollution of freshwater resources through industrial activities by manufacturing and oil exploration companies is also posing a great challenge to the livelihood security of many rural people who are dependent on the use of these resources for their sustainability. Drought incidence, desert encroachment, soil erosion and degradation are other environmental limitations to agricultural development in Nigeria (Oluwasemire *et al.*, 2002). The Nigerian government did not have any environmental protection agency until 1999 when the new civilian administration was sworn-in. However, with the new environmental protection agency in the county saddled with the responsibility of policy formulation for environmental protection and implementation of such policies and environmental laws, new initiatives has been taken to address the different environmental problems in the country with environmental issues becoming very significant in public debates and issues of interest. However, a possible limitation presently is that the research organisations in the country lack adequate fund in conducting research to find solutions to the environmental problems confronting the agricultural sector in the country.

(e) Extension, manpower and skill development problems
The extension service delivery system in Nigeria has suffered many set back from inefficiency and inadequate numbers of extension personnel. While experience had indicated the advances in the agriculture of developed countries was sustained by technological innovations and practices, the role of extension in agricultural development in the country through the provision of linkages to the farmers with research institution for the delivery of research findings and information of new techniques of agricultural production has been lacking (Akande, 2006). Available records has indicated the failure of the extension strategies adopted under the various agricultural programs in the country except the ADP which has immense success records with the uses of different extension methods and approaches (Akande, 2006; Oladele *et al.*, 2004). With extension creating access for the farmers to procure production inputs which are ordinarily difficult to procure and training on the use of the inputs and new innovations, achieving any successful record in increasing volume of production and meeting food security is intrinsically tied to good extension system being put in place in the country. The shortage of experienced professionals and technical manpower for tractorisation and mechanization is another limitation while there is a mass drift of able-body men and women from the rural areas to the urban areas thus having a negative impact on labour availability for agricultural production in those areas. While the government is making steps to address these problems through different programmes such as the National Fadama program currently going on in the country, many of which are been sponsored by international agencies such as the World bank, IFAD, CGIAR, IITA among others and significant amount of progress being achieved, there is still a long way to go in addressing all these problems in the country.
Inconsistency in government policies

Inconsistency in agricultural and economic policies that directly affect the agricultural production is a major problem confronting the agricultural sector in Nigeria today. Different government administrations bring different policies and abort other policies that are in existence all of which are not supportive for the positive transformation of the agricultural sector. This also does not serve as motivation and good morale for would-be farmers and investors in the sector. The low rate of investment on agriculture in terms of research, incentives to industries and banks to finance agriculture and capacity building have negative impact on agricultural development in the country with insufficient encouragement to foreign investors. While government laws make it mandatory for banks and other financial institutions to allocate certain percentage of their credit facilities to the agricultural sector in the country (Guardian, 2006), the government agencies saddled with the responsibility of monitoring the implementation of such laws and allocation of funds to the agricultural sector by banks have failed in ensuring compliance by the financial institutions to such laws and guidelines (Balogun, 2000). However, steps are being taken by the current government administration to formulate policies that will make the agricultural sector attractive for investment to institutional investors and also re-orientate the policy makers and political leaders on the need to ensure consistency in government policies and agendas.

5.3 Effect of food prices and consumer purchasing power

The situation in the agricultural production landscape in Nigeria with reference to agricultural growth has followed the general trend of regressing measures of poverty against agricultural output per head and on time trend (Okuneye, 2002). With the small-scale farmers producing about 85 percent of the total crop production in the country, the farmers are characterised with strong dependence on the agricultural labour market with little or no savings and storage facilities, and their adopted cultural practices highly labour intensive (ibid).

Despite evidence of significant increase in crop production output in the country from the 1985 period (Figure 5.1), the socio-economic and production characteristics of the farmers, inconsistency government policies, poor infrastructural base, all interact together resulting in low production output per head, high prices of food items, underdevelopment and concomitant poverty (Okuneye, 2002). With the production of food crops following a downward trend most especially in the period after independence of the country in 1960 but an upward trend from the SAP era, the high rate of inflation in the country has complicated the scenario resulting in higher cost of production and rising price of the food items thus affecting the rate of increase of agricultural productivity in the country. This occurs as a result of the higher cost of agricultural production inputs, higher cost of labour with expected rise in the cost of production and a rise in the cost of the food being produced. Figure 5.2 shows the rate of inflation in Nigeria.
The inflation rate in the country has been on the rise from the early 1970s to the present time with variations in the rising trend and reaching the peak in the mid-1990s. The high peak of the inflation rate in 1976 marked the era of the oil boom in the country at the period with total dependence on the oil revenue marked with lavish spending by government and mass importation of food items (Akande, 2006). However, shortly after the period, there was the introduction of an agricultural policy tagged “Operation Feed the Nation” program in the same year to encourage the local production of food items in the country (ibid). There was another inflation rate peak point in 1985 which characterised the change in government administration in Nigeria with changes in policies and the introduction of the Structural adjustment program (SAP). The fiscal measure adopted under the SAP program had an initial positive effect on the inflation rate due to the resuscitation of the local industry and less reliance on the foreign importations which was however short-lived as the inflation rate started rising again due to the unanticipated socio-economic problems enacted by the SAP policy (Akande, 2006; Mosley, 1992).

Other higher peaks of the inflation rate points in the country were marked with changes in government policies which had negative impact on the inflation rate in the country. The period 1993 to 1996 connotes the change in government administration in mid-1993 to a military rule with introduction of economic sanctions by the international community on the country (Akande, 2006). The inflation rate was at the highest peak at this period as there was no free flow of goods and services in and out of the country with shortage of production inputs and inaccessibility to external market and implementation of series of policy measures which largely reversed some of the SAP measures (ibid).

Possessing confidence to continue and increase production by farmers is basically hinged on the potential and opportunity available for recovery of invested resources and generating high returns and revenue on their investment. With inaccessibility to good markets for the
produced commodities and high cost of input prices, the farmers are not guaranteed of the recovery of their investments on the farm. Also, the problem of inadequate storage facilities hinders the farmers during bumper harvest periods from storing their crops to sell in the off-season period when there are higher prices. While figure 5.3 shows the average cost of food items in the Lagos areas from 1970 – 2003 to be on a rising trend from the period 1980 to 2002 after which it start diminishing, the rise may be due to the inflation rate in the country thus increasing the cost of production and transportation from the production area to the market where they are sold.

Figure 5.3: Average cost of food items in Lagos, 1970 – 2003

![Retail Price Index (Food) in Lagos Area, 1970 - 2003](chart)

Source: CBN, 2005

However, with records also showing an increase in food import during the same period (figure 4.2), it is evidence that it is not just only the inflation rate in the country that is responsible for the increase in prices but increase in demand due to supply shortages. This has also been affected with the different government polices from the 1980 period that has tried to encourage the local production and consumption of the food items and less reliance on imported items.

However, while the cost of food items has been on a general increase over the years with increasing rate of inflation, analysis shows that the consumer price index in the country is also on the increase (figure 5.4). With the consumer price index technically indicating an increasing percentage of consumer’s income been spent on food and goods consumptions (Moulton, 1996), this gives evidence that that the inflation rate in the country which has consequently affected the prices of food items has resulted in the consumers spending a higher percentage of their income on food items.
Figure 5.4: Consumer Price Index in Nigeria, 1960 – 2003

![Graph showing the Consumer Price Index in Nigeria from 1950 to 2010. The CPI (1985 = 100) is depicted on the y-axis, and the years are marked on the x-axis. The line graph indicates a steady increase from 1960 to 1990 with a sharp rise from 1990 onwards.]

Source: CBN, 2005

Figure 5.4 shows that the consumer price index in the country has increased steadily from 1960 to 1990 with little or no variation in the rise pattern but however there was a sharp increase from 1990 until date. This was also identified as a negative impact of the SAP policy with rise in the unemployment rates and prices of items and high inflation rate pervading in the whole economic system (Akande, 2006). However, while there has been an aggregate increase in the share of consumer revenue being spent on food items, this as not reflected as higher revenue for the farmers as the marginal increase are taken away by the rising cost of the production inputs and overall cost of production. Nevertheless, with gradual implementation of new policy measures to reduce the cost of production and inputs, there are expectations that the amount of revenue accruing to the farmers will continue to increase over time.
Chapter 6  Conclusion

6.1 Annexing untapped potentials for agricultural crop production

Nigeria has the potential for increasing the volume of crop production to meet the food requirement of the population and guarantee food security in the country. Available data shows that there are available land and water resources that could be developed to support the production of food and agricultural development with opportunity for increased productivity.

The country has a total cultivable land area of 71,200,000 hectares from which only an estimated 34,200,000 hectares is presently under cultivation leaving a balance of 37,000,000 hectares uncultivated which could be developed for future agricultural production. There is also opportunity for increase in land use productivity with evidence of current increases in crop production in the country coming from land expansion and not through increased productivity. The total amount of water resources in the country is also estimated at 286,200km$^3$ per year comprising of both inland and underground water resources. A breakdown of the water resources shows that 221,000 km$^3$ per year are internally renewable waters resources and the balance of 65,200km$^3$ per year externally renewable water resources. While agriculture accounts for the lion’s share of the use of total water resources of the country, its actual amount of water consumption stands at 5507 km$^3$ per year while the total water consumption by agriculture, industrial and domestics stands at 8000 km$^3$ per year. This leaves a balance of 278,200 km$^3$ per year part of which could further be developed and annexed for agricultural use. However, with the unequal distribution of the water resources in the different regions of the country and the water productivity in the agricultural sector adjourned to be very low at the moment, the water productivity could be improved most especially in the arid and semi-arid regions of the country where there is already evidence of incidence of water scarcity with competing need for water among the different sectors of the economy.

There is evidence of opportunities for water resources development in boosting food supply in the country through irrigation to supplement the water requirements and needs of farmers for agricultural production activities in many areas in the semi-arid and arid regions with an estimated irrigation potential of 2,330,510 hectares of land that can be developed for irrigation purposes from which only about 975,031 hectares has been developed so far. This is necessary in the areas where changes in the climatic conditions and inadequate rainfall require the provision of water for agricultural use through alternative means. While findings have indicted that part of the land already equipped for irrigation is not currently been used, operating the fully equipped irrigated lands at full potential will ultimately lead to an increase in the amount of crops been produced through irrigation and increased food supply for the country.

However, despite evidence of opportunities for boosting agricultural production and guaranteeing food security in the country through land and water resources development, there are other problems confronting the agricultural sector that has to be addressed jointly in combination with land and water resources development towards increasing food supply for the increasing population. The achievement of a sustainable agricultural industry and sector in the country, meeting the nutritional requirement and guaranteeing food security for the total populace must come with a holistic effort at resource development and eradicating the major problems outlined in the research findings confronting the sector. This can be in a number of ways as outlined in the recommendations below.
6.2 Possible recommendations

With an estimated annual population growth rate of 2.7 percent in the country, there is expected continuous growth in demand for agricultural crops to meet the food and nutritional requirement of the increasing population with opportunities for increased revenue for farmers. However, considering the prevailing unfavourable conditions the farmers are currently producing in the country with high cost of production leaving only a small profit margin for them to make profit, steps must be taken by government in formulating good agricultural policies and implementing them to create favourable conditions for agricultural production purposes. In lieu of this, a number of recommendations are made in conjunction with the requirement for water resources development, towards increased volume of agricultural crop production in Nigeria and increased revenue for the farmers. These include the following:

1. Unlimited accessibility to markets: the farmers must have accessibility to market for sale of their produce at good prices without the traditional problem of hijacking of profit by the middlemen. With good market for their products, the farmers will be encouraged to produce more with guarantee of increased revenue and source of income for them (Smith et al., 1994). While marketing boards have been created in the past such as the cocoa marketing boards to help farmers get good prices for their farm produce, the government owned marketing boards has always been faced with bureaucratic problems and eventual hijacking by the powerful individuals with the farmers losing at the end of the day. One of the strategies adopted by government and non-governmental organisation presently is the creation of farmers’ groups at the local level aimed at bringing farmers together for micro-credit administration and sell their produce together. The strategy has been successful with the NGOs proving extremely efficient and effective in the provision of micro-credit management, service and linking farmers with market outlets (Akande, 2006). However, while the NGO activities are been limited due to coverage inadequacies, the government can play more prominently role in the use of this strategy which has had demonstrated positive results. Opportunities must be created by the government institutions saddled with the responsibility of information dissemination, for the farmers to have access to information on where to get good prices for their produce and access such markets. This strategy has helped many farmers living close to the urban centres and the educated ones to have direct access to the market, bypassing the middlemen and getting good prices for their produce.

2. Accessibility and sourcing of production inputs. One of the major problems facing farmers in the country is the difficulty in having unlimited access to inputs and sourcing of production inputs at higher and exorbitant cost thus increasing their cost of production (Akande, 2006). The different agricultural departments at the federal and state levels in the past have been responsible for sourcing of production inputs for the farmers. The government also has different subsidy programs for many of the production inputs. However, with recommendations from the World Bank through the International Monetary Fund (IMF), many of the subsidies were removed on the inputs increasing the direct cost to the farmers. The government agencies saddled with the responsibility of procuring inputs for the farmers has also failed in their duties coupled with unavailability of fund to carry out such duties and corrupt practices by some of the officials. The untimely delivery of the procured inputs also has negative impact on the effective use and utilization of the inputs during the planting season. (Akande, 2006; Okolo, 2004). Experience during the implementation of the ADP program has also indicated the possibility of farmers increasing their volume of production when they have access to all the production inputs (ibid). New government policies should aim at tackling the problem of inaccessibility to production inputs through the removal of
every government bureaucracy in the input sourcing channel and increasing the efficiency in the channel system and reduction/total abolition of import duties on such inputs. Group sourcing of agricultural production inputs must also be encouraged to create avenue for reduction in the cost of the inputs while appropriate government agencies saddled with the responsibility of helping farmers in the sourcing of production inputs must stand up to their responsibility and increase their service delivery efficiency.

3. Reduction in imported food items and encouragement of local production. Government policies in the country must aim at reducing the amount of imported food items into the country and encouraging the local production of those food items. With the right incentives put in place, farmers in the country are ready to increase their local production of food items for increase revenue, however, they must be guaranteed of opportunities for increased profit margin through reduction in production cost and better market for the produced goods. This is evidenced by past records when the government has placed total ban on food importation and the farmers were encouraged to increase their production but due to inability to meet the total demand created by the vacuum from the ban, the ban has been lifted and food import unregulated leading to dumping of cheap food items in the country and losses to the local farmers. While steps are being taken by the current government administration to discourage the consumption of imported food items such as rice and encourage the local production through increase in the import duties on the food items, such types of initiatives must be done with evidence of sincerity to put confidence in the farmers for motivation to increase production. The government and NGOs in the country has started a campaign to encourage the local production of rice with distribution of the seeds to farmers and adaptable rice production technology which has started bearing positive results with increased yield of rice production (Fashola et al, 2006). There is also a promise to ban the importation and start export of the food item after the vacuum has been filled to alley the fears of the farmers against stiff completion by the imported high quality brand (National Report, 2006). However, the problem of smuggling must also be cobbled as many of the food items are smuggled into the country from neighbouring countries where lower import duties are charged on such food items.

4. Creation of opportunities for increased agricultural productivity. Smith et al, (1994) remarked that with availability of production inputs at affordable prices and credit availability to purchase such inputs, the farmers in the country are ready to increased production. Akande (2006) also supported this claim with the evidence of success records achieved in the ADPs where farmers were given opportunity to have access to all required production inputs with evidence of increase in their production outputs and increased revenue. With this problem of limited opportunities limiting the farmers in the country from competing with their counterparts from the developed world and enjoy higher profit margin, opportunities must be created through the formulation of appropriate policies for the farmers to increase their efficiency level and productivity rate with reduction in cost of production. Such policy must focus on the adoption and use of better techniques of production and technology, increased use of agricultural machinery for increased labour efficiency and adoption of improved seedling varieties for crop production. While there is evidence of increased adoption of better crop variety of seedlings in the country, the adoption process must be coupled with better education of the farmers on the use of the technologies and availability of required inputs to achieve success result in the use of the adopted seedlings and technology (Fashola et al, 2006; Smith et al, 1994)
5. Unlimited accessibility to credit facilities. The problem of accessibility to credit has been in existence for long in the agricultural sector in the country. With credit schemes such as the ACGSF having record of success in the provision of credits to farmers with favourable credit accessibility conditions, opportunities must be created for farmers to have unlimited access to credit with low interest rates and better terms of payments. With access to capital, the farmers will be able to make investment into their production activities through the adoption of better techniques of production and technology which is capital intensive but highly rewarding. This will create opportunities for the farmers to increase their efficiency level and productivity and produce more crops at lower cost of production for increase revenue. The current government administration has taken steps to address this problem with the recent restructuring and recapitalising of the Nigerian Agricultural Cooperative and Rural Development Bank to provide credit to all segment in the agricultural sector and creation of an agricultural fund which farmers can access through the local banks in the country (Guardian, 2006; National Report, 2006). While the government has taken steps to address the problem of government bureaucracy in accessing government funds through the use of private banks in the disbursement of such funds to farmers, steps must also be taken in creating easy access to the funds through the removal of traditional high bank security collateral demands with flexibility in the collateral demands for fund accessing and orientation of loan beneficiaries in the repayment of such type of loans. There are already positive results from the new initiatives of government in the disbursement of credit to farmers in the country (National Report, 2006).

6. Accessibility to land resources. The traditional problem of land tenure has been in existence for long in the agricultural sector in the country in which would-be farmers do not have access to land for production purposes. While the Land Act degree of 1978 stipulates that all the land in the country belongs to the federal government to create opportunities for farmers in having easy access to land, the law has only been a written statement without any form of implementation due to cultural reason associated with land ownership in the country as individual and communal land ownerships is still widely practised across the different region of the country (Smith et al, 1994). New government policies and initiatives must aim at creating opportunities for the farmers without land in having easy access to land for agricultural production purposes. This must be without any form of conflict with original land owners. New land resources must be developed for agricultural use by the government parastatal having the constitutional responsibility to carry out such tasks, with accessible road network for transportation of farm produce to the urban centres for sale. The current national policy on integrated rural development in the country is aimed at developing rural areas in a more coordinated and sustainable way with provision of infrastructure such accessible road networks, electricity, social development centres among others (National report, 2006). With programs similar to this strategy such as the DFRRI program having success record in their implementation in achieving the set goals and objectives (Akande, 2006), there are expectations that this policy if implemented will have a positive impact on agricultural sector development in the country. Nevertheless, the common problems, limitations and constraints associated with the DFRRI program must be avoided to have a sustainable success record of the policy after implementation.

7. Continuity in agricultural and economic policies. Government policies relating to the agricultural sector and overall economic development of the country must be consistent in their implementation. With the new National Agricultural Policy in the country assigning supportive role to the government and investments left to the private sector initiative (National Report, 2006), long term investments in the agricultural sector requires consistency
in the policies and laws guiding the sector as potential investors must be guaranteed of the recovery of their investment funds as well as high rate of return on the investment made. New orientation of political leaders and government officials must aim at continuity in government programmes and policies and new policy formulation must aim at improving the old ones without aborting them. This has been demonstrated with the introduction of new policies in the country by the current civilian administration which are technically restructuring of the old policies but with a new strategy in their implementation procedure (National Report, 2006). Akande (2006) also suggested an overall restructuring of the agricultural sector and the rural economy with effort to encourage the participation of a new generation of young, educated, able and dynamic population in the sector. This he believes can be a catalyst to change the agrarian landscape with the provision of necessary infrastructure to encourage the young people to stay in the rural areas (ibid).

8. Development and implementation of a new framework for water resources development in the country: The Federal Ministry of Water Resource which is the government institutional arm responsible for water resources development in the country has a National Water Resources Master Plan on the drawing table. The master plan is to ensure the optimum water resource use for development activities in the country and meet the socio-economic demand for water use for all regions for the different range of water-related activities including irrigation and drainage, domestic water supply and sanitation, hydropower generation, inland navigation and inland fisheries and the integrated management of surface and groundwater and rivers in the country with reference to gully erosion disaster management and water related environmental management. The master plan should be implemented to ensure the development of the abundance water resources in the country with reference to the environmental implications in the development process and funds allocated to carry out such task. However, while the current master plan put the sole responsibility of the water resources development in the country on government, a new framework should be developed to allow and encourage the participation of the private sector in the development process. Available records shows that steps are been taken currently to develop the water resources through irrigation development for agricultural purposes with a number of farmers already benefiting from such initiatives (National Report, 2006).
References


