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Full Length Research Paper

Achieving food security and climate change mitigation through entrepreneurship development in rural Nigeria: Gender perspective

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Globally, problem of food security and climate change demands innovative strategies that seek to promote an integrated approach of supporting the full continuum of production, processing and marketing of food to be done. For this reason this paper contends that rural entrepreneurial development could serve as panacea to achieving food security and climate change mitigation. Gender perspective is viewed as significant to achieving this goal since there are more females engaged in rural entrepreneurial practices than male. In 2008, agriculture contributed about 42% to the GDP with a growth rate of 6.54%. Of the 66% of the populace engaged in agriculture, 92% is male and 8% is female. Further, data shows that there are over 75 million females, both adults and children, amongst the about 150 million Nigerians. The population of people living in rural Nigeria is estimated at about 48% as at 2007, meaning that over 72 million persons live there, made up of approximately 35 million females and 37 million males. Agricultural practices through food and livestock production contribute to climate change. As at 2002, arable land in the country was about 34% of the total land mass of about 910,768 km^2. As 2003 livestock and poultry inventory was estimated at about 290 million. In addition, the competing uses of the various food and cash crops, as well as grain from Nigeria's agricultural farmland have added pressure to the need for more land for food and cash crop as well as grain production. Desert encroachment and reduced rainfall have also affected livestock production. These factors have created food security challenges, with threats of hunger and poverty: 70% of the population lives on less than ₦100 (US $ 0.7) per day, about 60.8% of the population is malnourished; even though smallholder farmers constitute 80% of all farm holdings their production system is inefficient and it always results in regular shortfall in national domestic production; this makes food importation a common feature in the country. Secondary data were sourced to analyze the current situation and to proffer recommendations for achieving food security and climate change mitigation. Inventory of greenhouse gases emission from agricultural practices and livestock production in the country was assessed using Inter-governmental panel of climate change (IPCC) methodology. Cost-benefit analysis was then conducted for identified options that enabled informed suggested recommendations for entrepreneurship development in rural Nigeria viewed with gender perspective.

Key words: Food security, climate change mitigation, rural entrepreneurship development, gender perspective.

INTRODUCTION

Food security is defined as a "situation that exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and health life" (Food and Agriculture Organization - FAO, 2002). This definition comprises four key dimensions of food supplies: availability, stability, access, and utilization. Global climate change is defined as a change which is attributed directly or indirectly to human activities that alter global atmospheric composition, added to natural climate variability observed in comparable periods of time; while climate change

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mitigation refers to measures or actions to decrease the intensity of radiative forcing in order to reduce global warming. This involves reductions in the concentrations of greenhouse gases, by reducing their sources and by increasing their sinks. In another report, FAO had estimated that 776 million people located in 98 countries were food insecure during 1997/1999, mostly concentrated in South Asia and Sub-Saharan Africa (FAO, 2003). The report further argued that the greenhouse gas induced climate change would further worsen the food security situation, especially in the tropics.

Climate is an important factor of agricultural productivity, and at the same time agriculture is one of the main greenhouse gas sources, which is important to consider in terms of climate change. The agriculture sector both contributes to climate change, and will be affected by the changing climate. According to Aydinalp and Cresser (2008), agricultural facilities contribute approximately 20% of the annual increase in anthropogenic greenhouse gas emissions through carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (NO) gas emissions, with methane having the highest global warming potential, which is about 300 times the potential of CO and about 20 times that of NO. The main GHG sources are nitrogen fertilizers, flooded rice fields, soil management, land conversion, biomass burning and livestock production and associated manure management. The livestock industry also accounts for approximately between 5 and 10% of the overall contribution to global warming (Aydinalp and Cresser, 2008).

Findings from agronomic studies (Downing, 1992; Masters, 2001; Reilly et al., 2002) all suggest that food security conditions may become even more tenuous under climatic change. However this has not been extensively examined other than in terms of crop yield effects. In this study, we examine food security implications of climate change in a linked economic (rural entrepreneurship development) and agronomic case study for Nigeria. Mitigative policy and research based adaptations that could be implemented through rural entrepreneurship development programmes are also considered in this study. The paper is organized as follows: Following the introduction is background information on Nigeria. Next is a discussion of objectives and study relevance. State of the art analysis of the subject matter is then presented, followed by methodology and approach. The results and analysis is presented, after which the paper concludes with recommendations.

Objectives of study

In this paper, we contend that despite the fact that food production in the country is not meeting demand yet agricultural and pastoral practices have been claiming more land leading to challenges of environmental degradation and climate change. For example, Appendix A shows that desertification and gully sites have increased from their states in 1975 when compared to that in 2005 by about 400 and 15,000% respectively. Thus food security and climate change, which are twin global challenges, are already roosting in the country. These issues require innovative strategies to promote integrative approach of support for their solution. This support is required to guarantee the full continuum of production; processing and marketing of food as well provide avenues to achieve climate change mitigation options.

Our study view rural entrepreneurship development as one important innovative strategy that could be harnessed to promote the required integrative approach for food security as well climate change mitigation. The objectives of the study is therefore to (1) quantify food production in the country for 2005 and project its likely pattern up to 2035; (2) quantify greenhouse gases emission from these food production avenues in the country; (3) analyze various probable food security and climate change mitigating options for rural female entrepreneurship development through cost-benefit analysis for ranking.

Relevance of study

Food security conditions under climatic change have not been extensively examined other than in terms of crop yield effects[1]. Based upon the definition of food security, there are three other dimensions to food security, apart from the issue of crop yield effects, namely availability. The other dimensions are stability, access and utilization. On the other hand, two schools of thought exist to explain climate change phenomenon. The first school of thought believes that climate change is caused mainly by human activities due to release of gases from energy usage. The second school of thought is of the opinion that historic and climate change is a function of nature (Nigerian Communications Commission - NCC, 2009). In this study, we pitch our stand with the first school of thought. So going further, we highlight anthropogenic activities causing climate change to include energy usage, agriculture (including crop production, livestock, forestry and fishery), and industrial activities amongst others. The major gases are CO_2, CH_4, NOx and CFC-12 with significant radiative forcing presented in descending order of influence. This study scope covers activities from agriculture and forestry and its climate change impact as well as rural entrepreneurship development viewed from gender perspective.

Emissions from Nigeria at present may not be globally

[1] The Intergovernmental Panel on Climate Change (2001) asserts there are few, if any, economically based climatic change impact assessments focused on developing countries.

significant, there is however need to keep tab of its amount. Even though there is presently no legislative mandate to inventorize the country's greenhouse gases (GHG) emissions, evidences of changes in the land-use and land cover pattern of the country in the period of 1975 to 2005 indicate that it is important to conduct regular inventory, at least with 10-year interval, if not 5-year, as in some developed countries like the United States of America Environmental Protection Agency (USEPA, 2011) and United Kingdom (department of environment and climate change (DECC, 2011). The results of this effort are expected to contribute to better understanding of how to mitigate climate change impact from agricultural practices as it affects food security in Nigeria. Further, it will also assist policy makers to take informed position to enable female rural entrepreneurship development in the country be more involved in strategies for food security and climate change mitigation. The gender perspective of the study, an innovation to the study of climate change in Nigeria, is to enable quantification of female contribution to rural entrepreneurship development in areas of food production in the country, allow for policy design that caters for women welfare improvement as well as empower them socially and economically.

Study area – Nigeria background

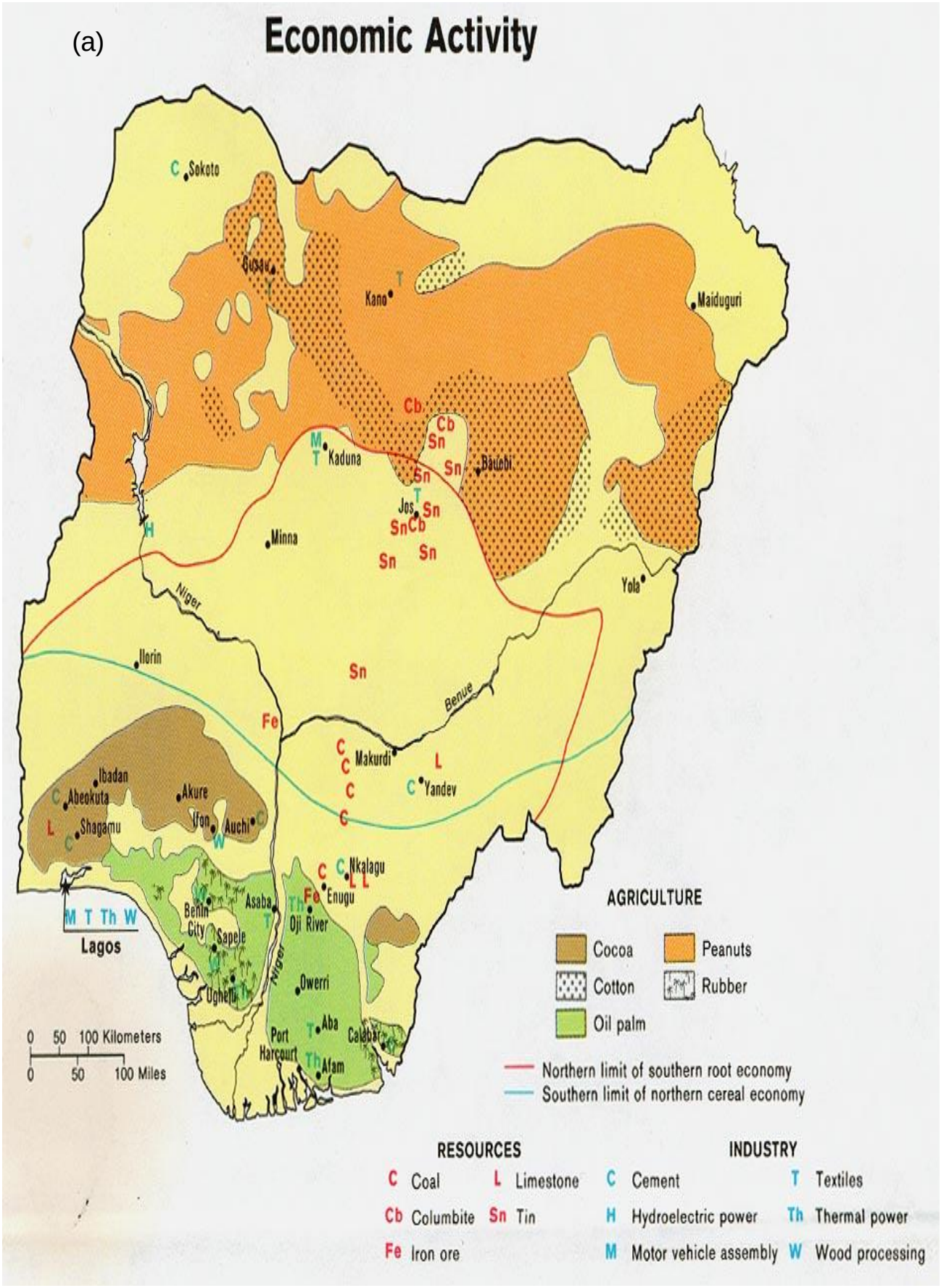
Nigeria is situated in West Africa between Latitudes 4° to 14° North and between Longitudes 2°2' and 14° 30' East. To the north the country is bounded by the Niger Republic and Chad; in the west by the Benin Republic, in the East by the Cameroon Republic and to the south by the Atlantic Ocean. Nigeria has a land area of about 923,769 km^2 a north-south length of about 1,450 km and a west-east breadth of about 800 km. Its total land boundary is 4,047 km while the coastline is 853 km. The Federal Ministry of Environment of Nigeria (FMEN, 2001) 1993 estimate of irrigated land is 9,570 km^2 and arable land about 35%; 15% pasture; 10% forest reserve; 10% for settlements and the remaining 30% considered uncultivable for one reason or the other. Boomie (1998) corroborated the irrigated land at 9,570 km^2 with arable land at 33%; permanent crops 3 %; permanent pastures 44%; forests and woodland 12% and others 8% (Aregheore, 2009). Cleaver and Shreiber (1994) put the surface area of Nigeria as 91.07 million hectares, 57% of which is believed to be either under crops or pastures while the remaining 43% is divided amongst forest, water bodies and other uses.

By year 2020, Nigeria aims at having a modern technologically enabled agricultural sector that fully exploits the vast agricultural resources of the country, ensures national food security and contributes significantly to foreign exchange earnings. Agriculture has always played a key role in the nation's economy, currently contributing about 42% of gross domestic product as against about 35% for Oil and Gas (Nigerian National Petroleum Corporation - NNPC, 2006); and employing two thirds of the entire labour force. However, growth in the sector has not kept pace with the needs and expectations of the nation. Over the past 20 years, value added per capita in agriculture has risen by less than 1% annually. Food production increase has not kept pace with population growth (except in recent times), resulting in rising food imports and declining levels of national food self-sufficiency. Several factors have accounted for this poor performance. Low mechanization, subsistence small scale holdings, outdated land tenure systems, low adoption of research findings and technologies, high cost of farm inputs, poor access to credit, overemphasis on inefficient fertilizer procurement and distribution, inadequate irrigation and storage and poor access to markets have all combined to keep agricultural productivity low with high wastages and below optimum contributions to export earnings (NPC, 2009).

In 2009, the country's population was estimated at 149.3 million from an annual growth rate of 2.8% from 2006 population figures. Female population amongst this is estimated at about 49%. Rural population is put at 48% of the total population of the country with 35 million females. This pool of resource is reputed to be a veritable source to affect the economy of the nation through entrepreneurial development (Minniti et al., 2006). Rural entrepreneurship is more engaged in by females than male in most countries, particularly developing ones like Nigeria (Akinbami, 2010). In 2009, the country's GDP was put at $157.2 billion with a per capita GDP of $1,418 ($2400 PPP) and a real growth rate of 4.5% for the economy. Agriculture is the most engaged activity in these rural areas, so for this, most rural communities operate agrarian economy. Contribution from agriculture (that is crop production, livestock, forestry and fishery) in the country was an average of 34.07% to the GDP from 2004 to 2009 (Table 2). Agriculture involves land use issues, and thus agricultural practices have influence on the immediate environment which invariably contributes to greenhouse gas emission in the country that contributes to climate change. Figure 1a and b presents economic activity profile and vegetation zones of Nigeria from Aregheore (2009).

The country has varying climatic[2] conditions ranging from equatorial in the south, to tropical in the central and arid in the north. Despite having a low per capita emissions record in 2000 estimated at 0.3 metric tons(World Bank, 2004), there is need for mitigative policy and research addressing food security induced by climate change. Going by the definition of food security and its various dimensions, Nigeria is not yet food secure.

[2] Based on Köppen Climate Classification System accessed from www.blueplanetbiomes.org/climate.htm on April 21, 2010


(a)
Economic Activity
Sokoto
Gusau
Kano
Maiduguri
Kaduna
Bauchi
Jos
Minna
Yola
Niger
Ilorin
Benue
Makurdi
Yandev
Ibadan
Abeokuta
Akure
Ijon
Auchi
Shagamu
Lagos
Nkalagu
Enugu
Asaba
Benin City
Sapele
Oji River
Owerri
Ughelli
Port Harcourt
Aba
Calabar
Afam
0 50 100 Kilometers
0 50 100 Miles
AGRICULTURE
Cocoa
Peanuts
Cotton
Rubber
Oil palm
Northern limit of southern root economy
Southern limit of northern cereal economy
RESOURCES
C Coal
L Limestone
Cb Columbite
Sn Tin
Fe Iron ore
INDUSTRY
C Cement
T Textiles
H Hydroelectric power
Th Thermal power
M Motor vehicle assembly
W Wood processing

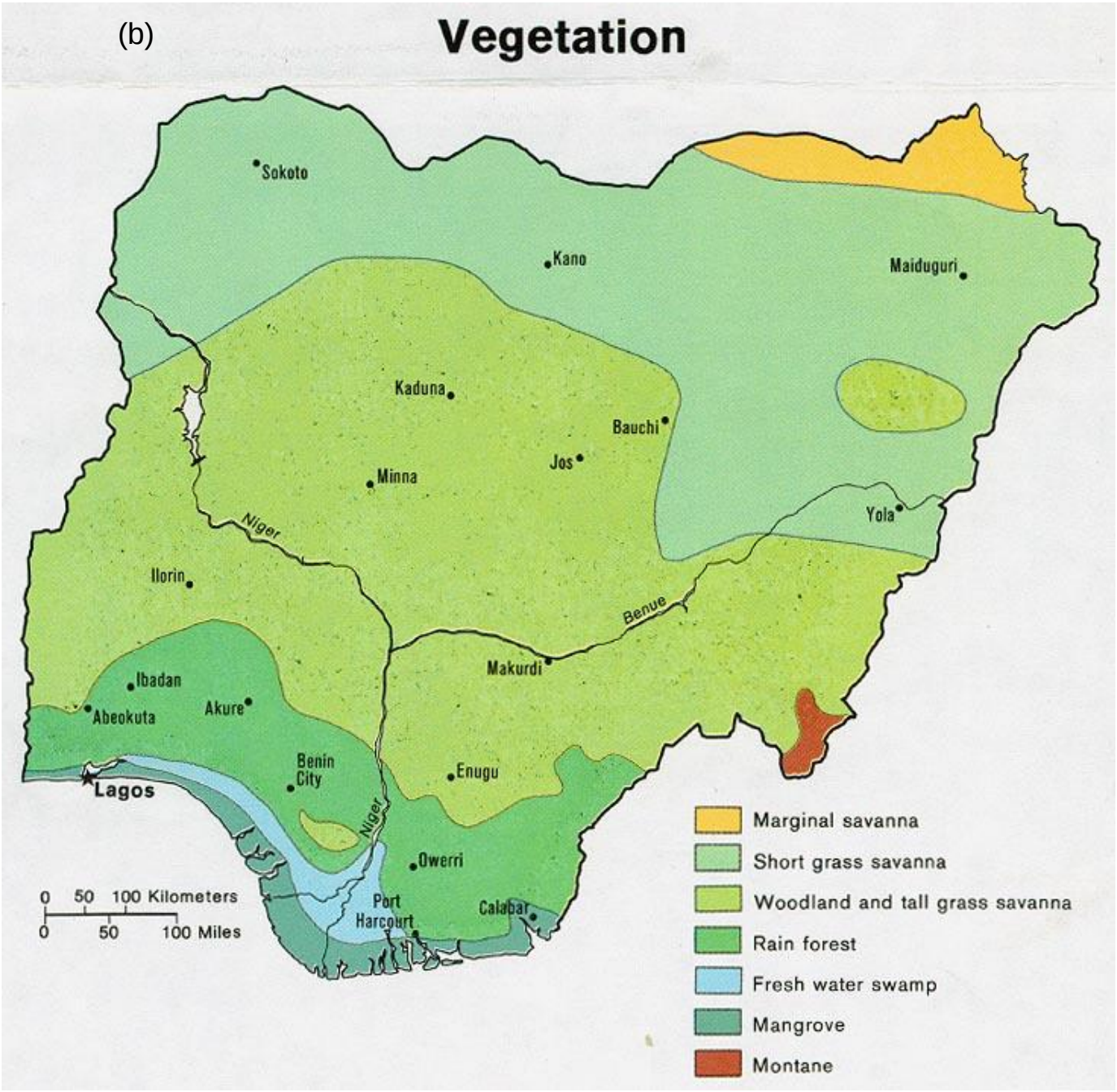


Figure 1. a) Economic activity profile b) Vegetation zones of Nigeria.

To put food production in perspective, Table 1a shows population of the country from 2000 to 2006[3]; decadal growth rates from 1952 to 2005 are presented in Table 1b. Table 1b formed the basis of projecting future population for the country with estimated annual growth rate of between 1.7 and 2.92% from 2007 to 2035 based on population figure for 2006. Table 1b also contained expected economic growth rate for the country based on Vision 20-2020 documents.

Table 2 presents the gross domestic product (GDP) in 1990 current prices in Billions of Naira, activity sector contributions and annual growth rate both in percentage. The average contribution of non-oil sector to GDP from 2004 to 2009 is 62.2% of which agriculture contributed an average of 52.3% annually. Other sources indicate different economic growth rate in the period of 2007 to 2009. Whereas CBN indicates a double-digit growth rate,

[3] Population for 2000 to 2005 was extrapolated from that of 2006 based on growth rate data presented in Table 1b.

Table 1a. Nigeria population and urban versus rural distribution: 2000 to 2006.

Year	Male	Female	Total	Urban (%)	Rural (%)
2000	59,549,322	57,214,054	116,763,376		
2001	61,378,398	58,971,402	120,349,800		
2002	63,263,655	60,782,728	124,046,383		
2003	65,206,818	62,649,688	127,856,507		
2004	67,209,666	64,573,993	131,783,660		
2005	69,274,033	66,557,404	135,831,436		
2006	71,401,806	68,601,736	140,003,542	52	48
2007	73,486,739	70,604,906	144,091,645		
2008	75,632,552	72,666,570	148,299,121		
2009	77,841,022	74,788,433	152,629,456		

Source: National Population Commission, Federal Gazette (2007); Authors' calculations.

Table 1b. Decadal growth rate for Nigeria.

Year	Population growth rate (%)	Economic growth rate (%)
1952 – 1991	2.8	
1991 – 1995	2.86	
1995 – 2000	2.99	
2000 – 2005	2.98	
2006 – 2010	2.92	7
2011 – 2015	2.86	13
2016 – 2020	2.8	13
2021 – 2025	2.74	10
2026 – 2030	2.64	7
2031 – 2035	2.5	5

Source: U.S. Bureau of the Census (1995).

other sources indicate single digit growth rate. However, the figures CBN were normalized in the local currency, the Naira whereas other sources normalized to the US Dollar.

Record shows that Nigeria had experienced loss of prime arable land between 1975 and 2005, a period of 30 years. According to Abbas (2009), results of static land cover changes for the 30-year period show that disturbed forest increased by about 33%, extensive small holder rain-fed agriculture by about 13% and flood plain agriculture by about 123%, with increase in forest plantation by about 58% and rain fed arable crop plantation by about 3000%. Table 3 shows changes in some land use - land cover in Nigeria between 1975 and land degradation.

There are various competing uses to which various food and cash crops as well as grain from Nigeria's agricultural farmland could be put to. These have added pressure to the need for more land for food and cash crop as well as grain production. Desert encroachment and reduced rainfall have also affected livestock production. These factors have created food security challenges, with threats of hunger and poverty and also having 70% of the population live on less than N100 (US $ 0.7) per day, about 60.8% of the population being malnourished. This is an addition to the fact that even though smallholder farmers constitute 80% of all farm holdings; their production system is inefficient and it always results in regular shortfall in national domestic production making food importation a common feature in the country. Table 4 presents a breakdown of distribution sexes into some occupation types in the country. Many more people are engaged in agriculture with women contributing about 48% of the labour force compared to 63% for men. Men are surpassed by women on sales in the breakdown.

To put burden of workload by gender distribution in perspective, Table 5 presents breakdown of tasks and percent borne by women. In terms of farming tasks, aside from soil turning and marketing, women bore more of the load than men. Even though Tables 4 and 5 display the various tasks borne by the different sexes in rural areas, it needs be pointed out that their entrepreneurial role, as well as food security and climate change mitigating

Table 2. GDP, sector contributions and annual growth rate: 2004 – 2009.

Activity sector	2004	2005	2006	2007	2008	2009
GDP (billion N-1990 current prices)	11,411.07	14,572.24	18,564.59	20,657.32	24,552.78	25,189.21
GDP per capita (₦) (current prices)	86,589.41	107,281.79	132,600.86	143,362.37	165,562.55	165,035.05
Growth rate (%) (CBN)	15.11	27.70	27.40	11.27	15.42	2.59
Agriculture (%)	34.21	32.76	32.00	32.71	30.87	41.84
Industry (%)	40.40	41.83	40.34	39.14	41.70	
Building and Construction (%)	1.46	1.48	1.35	1.29	1.23	No data
Wholesale and retail trade (%)	13.01	12.82	14.77	14.74	14.63	No data
Services (%)	10.93	11.12	11.55	12.12	11.58	No data
Non-oil GDP (billion N-1990 current prices)	7,163.35	8,907.36	11,581.66	13,124.28	14,542.63	No data
Growth rate (%)	23.51	24.35	30.02	13.52	10.81	No data
Contribution of activity sector to non-oil GDP growth rate (%)						
Agriculture	20.81	22.27	24.45	13.76	8.90	No data
Industry	0.44	32.21	22.87	7.97	22.35	No data
Services	41.81	29.95	32.30	16.76	10.20	No data
Finance and Insurance	26.98	27.00	126.93	14.90	7.38	No data
Manufacturing	-25.01	18.15	15.95	8.85	16.26	No data
Mining and Quarrying	30.75	32.57	57.70	15.29	15.10	No data
Communications	26.57	79.23	306.44	46.85	7.63	No data
Other sources of Nigeria's economic growth rate (%)						
FSDH (2011)	No data	No data	No data	6.45	5.98	6.96
Global Finance (2011)	No data	No data	No data	No data	6.0	7.0

Source: CBN (2008, 2009).

Table 3. Changes in some land use – land cover in Nigeria between 1975 and 2005.

Land use	1975	2005	Difference	Change (%)
Forest land	224,822.4	142,439.5	-82,382.9	-36.6
Crop land	504,273.2	601,395.0	97,121.8	19.3
Grassland	142,897.1	110,804.7	-32,092.3	-22.5
Wetlands	42,215.9	28,681.6	-13,534.3	-32.1
Settlements	2,061.3	5,385.4	3,324.1	161.3
Other land	11,224.8	38,788.4	27,471.7	244.7
Total	927,494.6	927,494.6	0.0	

Source: Abbas (2009).

Table 4. Distribution of persons by occupation (%).

Occupation	Both sexes	Male	Female
Professional	6.4	7.1	5.9
Clerical	4.7	6.0	3.2
Sales	21.5	12.0	37.8
Service	1.6	2.0	1.3
Agriculture	57.2	63.0	47.6
Production related	8.2	10.11	4.3

Source: Jeminiwa et al. (2004).

Table 5. Women's share of domestic workload in rural areas.

Tasks		% of load borne by women
Household tasks	Fetching and carrying water	90
	Cooking and preparing meals	90
	Domestic stocks	90
	Clearing fields	50
Farming tasks	Turning soils	30
	Planting	50
	Hoeing and weeding	70
	Harvesting	60
	Transporting	80
	Storing	80
	Processing	90
	Marketing	40
Child raising tasks	Child rearing	95
	Payment of school fees	50
	Home education	75

Source: Wodon and Ying (2010).

capability would be hinged on gender factors on rural entrepreneurial development as shown in Table 6.

Gender perspective and rural entrepreneurship development

According to UNDP (2008), gender is defined as "the differences in socially constructed roles and opportunities associated with being a woman or a man and the interactions and social relations between women and men." It influences social expectations, values and what society perceives as normal. Thus gender perspective recognizes the fact that women and men react to and participate in social, economic and environmental realities differently depending on their age, socio-economic status and culture (UNDP, 2008). In this study, we view rural entrepreneurship as the use of traditional knowledge in the context of agricultural productivity and economic development to respond to climate change issues to achieve food security.

In the light of ravaging influence of various conflicts in the continent for many years, women and rural entrepreneurship development had become very relevant to development in African countries. This is because in most of these conflicts, the greatest victims have been women and children. They have been affected socially, economically, physically and psychologically with the result that the long-term humanitarian and rehabilitation of their needs affected by conflicts, followed by vicious cycles of poverty sidelining the women and children from reconstruction efforts. One way to correct this gap is to create women entrepreneurs to help sustain family income for survival. Rural economies in Africa, particularly in Nigeria, could easily be grown with emphasis on developing the agricultural system. This could be achieved through teaching women 'simple' income-generation business skills in line with climate change mitigation and food security as well as to help them manage their micro-enterprises in their villages. This simple yet important move will create a community of women entrepreneurs who will be, and in many parts they already are, a dominant force in the economic development of their countries. However, this is not to overlook the "constraints" these women entrepreneurs in terms of challenges they face.

Table 6 gives the factors that influence entrepreneurship development particularly as it relates to micro and small enterprises (MSEs). These are freedom, decision making capacity, education and experience, information, productive resources and markets, effects of market saturation, access to credit and compliance costs. Each of the factors would affect female response to entrepreneurial, food security and climate change mitigating opportunities as they arise. There are quite a number of definitions to all of the factors in Table 6. However, the ones applied for this study are shown in the 'meaning' column of Table 6. The ranking column was arrived at through review of relevant literature and brainstorming exercise. They are arranged in order of significance with the most significant being at the top. Freedom was ranked as the highest as represents the power or right for the female rural entrepreneur to act, speak or think as she wants without hindrance or

Table 6. Entrepreneurship development factors, meaning and ranking as relevant to female participation.

Entrepreneurship development factors	Meaning	Ranking as relevant to female participation in rural entrepreneurship development
Freedom	The power or right to act, speak, or think as one wants without hindrance or restraint.	8
Information	Knowledge obtained from investigation, study, or instruction	7
Access to credit	Access to finance refers to the possibility that individuals or enterprises can access financial services, including credit, deposit, payment, insurance, and other risk management services	6
Decision making capacity	The ability to make choices that reflect an understanding and appreciation of the nature and consequences of one's actions.	5
Education and experience	Education in the general sense is any act or experience that has a formative effect on the mind, character, or physical ability of an individual. In its technical sense, education is the process by which society deliberately transmits its accumulated knowledge, skills, and values from one generation to another.	4
Productive resources and markets	Materials, labour or money which is used to create goods and services.	3
Compliance costs	a governmental assessment (charge) upon property value, transactions (transfers and sales), licenses granting a right, and/or income	2
Effects of market saturation	When the amount of product provided in a market has been maximized in the current state of the marketplace.	1

Sources: Kantor (2001); UN (2008).

restraint. This is followed by information because it represents investigative capacity of the rural entrepreneurship.

METHODOLOGY AND APPROACH

The study made use of secondary data, and applied descriptive statistics to analyze the data. The baseline year for assessment was 2005. However, because of data paucity, where 2005 data were not available, the nearest available year data was used. For estimate of food and livestock production, both local and international sources were employed. Likely future food production projection was driven by yield per hectare for crop production, and that of livestock was driven by productive capacity of livestock; other drivers considered for projection were demographic and economic growth rates respectively. Two scenarios were used to project for crop production, namely, Business-As-Usual (BAU) and Intervention (I) Scenario respectively, while the livestock production was projected at three different scenarios, namely, Low, Normal and Improved Scenarios respectively. Baseline emission inventory of GHGs from agriculture and livestock production in Nigeria were done based on 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006). The methodology enabled the capture of amounts of emissions caused by agricultural and pastoral practices in the country.

However, before crop production projection, an assessment of baseline emissions from land use and land cover changes as affected by agriculture for food production was done, and the result applied for scenario projection. The time frame for projection was from 2005 to 2035 sourced from Nigeria's mid- to long-term planning document, namely vision 20-2020. In other to quantify mitigation impact from the scenarios, the factors considered for

Table 7. Staple crop production and projection in Nigeria (tonnes): BAU scenario 2005 to 2035.

Crop type	Tonnes of crop production						
	2005	2010	2015	2020	2025	2030	2035
Millet	6,479.42	7,493.31	8,627.93	9,905.40	11,338.87	12,916.75	14,614.11
Sorghum	8,137.25	9,410.57	10,835.48	12,439.81	14,240.06	16,221.65	18,353.30
Groundnuts	2,941.71	3,402.03	3,917.16	4,497.14	5,147.95	5,864.32	6,634.94
Beans	5,504.16	6,365.45	7,329.28	8,414.48	9,632.19	10,972.56	12,414.45
Yams	3,237.05	3,743.59	4,310.43	4,948.64	5,664.79	6,453.08	7,301.07
Cotton	639.55	739.63	851.62	977.71	1,119.20	1,274.94	1,442.48
Maize	4,744.56	5,486.99	6,317.81	7,253.24	8,302.90	9,458.30	10,701.20
Cassava	3,707.69	4,287.86	4,937.12	5,668.12	6,488.39	7,391.28	8,362.56
Rice	3,751.24	4,338.23	4,995.12	5,734.71	6,564.61	7,478.12	8,460.80
Melon	385.64	445.99	513.52	589.55	674.87	768.78	869.80
Cocoyam	780.84	903.03	1,039.77	1,193.72	1,366.47	1,556.62	1,761.17
Plantains	412.20	476.70	548.88	630.15	721.34	821.72	929.71
Sweet potato	2,284.10	2,641.52	3,041.49	3,491.82	3,997.14	4,553.37	5,151.72
Potato	637.42	737.17	848.79	974.46	1,115.48	1,270.71	1,437.69
Total	45,647.83	52,482.07	60,129.4	68,738.95	78,399.26	89,032.2	100,470

Source: This study.

probable mitigating purposes are increased land productivity and conservation tillage; improved livestock productivity. This is in addition to production of biomass feedstock and energy efficiency measures (Lybbert and Summer, 2010). These factors are potential rallying points for developing rural entrepreneurship.

To introduce gender perspective to these scenarios, a ranking of the factors[4] considered in gender equality (Kantor, 2001) was done based on a scale of 1 to 8, with 8 being most significant. This ranking was achieved through literature review and brainstorming exercise (Koo et al., 2007) to identify their importance to entrepreneurship development. This was then linked to objective ranking for food security and climate change mitigation options for integrative approach of rural entrepreneurship development in the country, from which cost-benefit analysis of various identified options was conducted. This was done with the intention to rank these identified options based on a least cost path. That is, ranking of the options will depend largely on how much it will cost to achieve their deployment, the least cost being ranked the highest and most costly being ranked the lowest. So that the gender perspective enabled the ranking of the options to be screened on the basis of not being sex discriminatory for rural entrepreneurial development even though preference was given to option(s) that allow strategic empowerment of the rural female entrepreneur.

RESULTS AND ANALYSIS

Results of the assessment of the study based on objectives set out are presented here.

Staple crop production

According to Central Bank of Nigeria (CBN) reports, crop production in Nigeria contributes an average of about 30% to the agricultural GDP (CBN, 2008). Table 7 presents food production for 2005 and 5 yearly projection to 2035. To arrive at this projection, output value for 2003 was first converted to per capita production measured in kilogramme per hectare, which was then multiplied with projected population. From Table 8, land requirement for this production level was then estimated for each year based on yield of each crop type per hectare for 2003, measured in tonnes per hectare. The result is presented in Table 8. It was assumed that the yield level of each crop type will remain the same from 2005 to 2035, all other parameters of production such fuel costs, economic development, technology, water availability, consumer attitudes and diet remain constant.

These factors actually represent scenario I – business-as-usual (BAU). Thus land requirement is driven mainly by population growth rate and demand for that crop type. Sorghum, millet, maize and beans are crop types with very high demand for land with melon and plantain returning the least land requirement, respectively.

Table 9 presents yield per hectare of each staple crop measured in tonnes per hectare. It was assumed that yield improvement would be achieved in a 5-year cycle through improved funding of research efforts on improved livestock and crop production activities as well as better land use management practices. Technological improvements assumed include increased mechanization, improved irrigation and fertilizer distribution, better water management techniques and storage of crops amongst others to help the farmer achieve improved productivity. Table 10 presents results for the mitigation/intervention scenario in the staple crop production sector for 2005 to 2035 in 5-yearly period. In

[4]Freedom, decision making, education and experience, information, productive resources and markets, effects of market saturation, access to credit, and compliance costs.

Table 8. Land requirement for production of staple crops in Nigeria: real and projected from 2005 to 2035.

Crop	Land requirement in hectares							
	2003	2005	2010	2015	2020	2025	2030	2035
Millet	5,921.4	6,290.7	7,275.1	8,376.6	9,616.9	11,008.6	12,540.5	14,188.5
Guinea corn/sorghum	6,518.7	6,925.3	8,009.0	9,221.7	10,587.1	12,119.2	13,805.7	15,619.8
Groundnuts	2,741.6	2,912.6	3,368.3	3,878.4	4,452.6	5,097.0	5,806.3	6,569.2
Beans	12,048.8	12,800.4	14,803.4	17,044.8	19,568.5	22,400.4	25,517.6	28,870.8
Yams	352.7	374.7	433.3	498.9	572.8	655.7	747.0	845.1
Cotton	913.5	970.5	1,122.3	1,292.3	1,483.6	1,698.3	1,934.7	2,188.9
Maize	4,173.8	4,434.2	5,128.0	5,904.5	6,778.7	7,759.7	8,839.5	10,001.1
Cassava	370.1	393.1	454.7	523.5	601.0	688.0	783.7	886.7
Rice	3,697.4	3,928.0	4,542.7	5,230.5	6,004.9	6,873.9	7,830.5	8,859.5
Melon	386.6	410.7	475.0	546.9	627.8	718.7	818.7	926.3
Cocoyam	134.1	142.5	164.8	189.8	217.9	249.4	284.1	321.4
Plantains	71.6	76.1	88.0	101.3	116.3	133.1	151.6	171.5
Sweet potato	307.1	326.3	377.4	434.5	498.8	571.0	650.5	736.0
Potato	193.5	205.6	237.8	273.8	314.3	359.8	409.9	463.8
Total	37,831.0	40,190.7	46,479.7	53,517.5	61,441.4	70,333.0	80,120.2	90,648.7

Source: This study.

Table 9. Estimated yields per hectare (tonnes/ha/annum) for staple crops.

Crop type	Estimated yield/ha/annum (T/ha)					
	2003/04	2009/10	2014/15	2019/20	2024/25	2029/34
Millet	1.03	1.2	1.4	1.6	1.8	1.9
Sorghum	1.175	1.2	1.3	1.4	1.5	1.6
Groundnuts	1.01	1.1	1.15	1.2	1.25	1.3
Beans	0.43	0.5	0.56	0.6	0.64	0.7
Yams	8.639	9	9.5	10	11	12
Cotton	0.659	0.7	0.75	0.82	0.89	0.97
Maize	1.07	1.2	1.25	1.31	1.45	1.52
Cassava	9.431	9.9	10.5	10.89	11.02	12
Rice	0.955	1.05	1.15	1.28	1.37	1.43
Melon	0.939	1.05	1.25	1.45	1.76	1.98
Cocoyam	5.479	5.54	5.61	5.74	5.9	6.2
Plantains	5.42	5.6	5.78	5.97	6.12	6.54
Sweet potato	7	9	11	13	15	17
Potato	3.1	3.5	4	4.6	5.1	5.7

Source: This study

other words: to project for the land requirement in this scenario to meet staple crop demand as driven by population growth rate, technology was varied, while other factors including a more stable pricing regime to encourage involvement of youths in agriculture were assumed to remain constant.

As seen from Table 10, land requirement dropped significantly by intervention in one of the factors of production, namely technological improvement. For example, in 2010, land requirement without improved yield is about 46,500 ha while that in mitigation or intervention scenario was a little over 30,000 hectares. This comparison for staple crop production is presented in Figure 2. Thus, merely improving on the yield through technology intervention could lead to land being freed for other uses such as forestation, energy plants amongst others.

Table 11 presents the intervention scenario, where there is improvement in the yield per hectare of each staple crop type to increase output from the same size of

Table 10. Land requirement for staple crop production with improved agricultural techniques.

Crop type	Land requirement (Ha)						
	2005	2010	2015	2020	2025	2030	2035
Millet	6,290.7	6,244.4	6,162.8	6,190.9	6,299.4	6,798.3	7,691.6
Sorghum	6,925.3	7,842.1	8,335.0	8,885.6	9,493.4	10,138.5	11,470.8
Groundnuts	2,912.6	3,092.8	3,406.2	3,747.6	4,118.4	4,511.0	5,103.8
Beans	12,800.4	707.3	13,088.0	14,024.1	15,050.3	15,675.1	17,734.9
Yams	374.7	5,348.0	453.7	494.9	515.0	537.8	608.4
Cotton	970.5	616.4	1,135.5	1,192.3	1,257.5	1,314.4	1,487.1
Maize	4,434.2	554.2	5,054.2	5,536.8	5,726.1	6,222.6	7,040.3
Cassava	393.1	433.1	470.2	520.5	588.8	615.9	696.9
Rice	3,928.0	4,131.7	4,343.6	4,480.2	4,791.7	5,229.5	5,916.6
Melon	410.7	424.7	410.8	406.6	383.4	388.3	439.3
Cocoyam	142.5	163.0	185.3	208.0	231.6	251.1	284.1
Plantains	76.1	85.1	95.0	105.6	117.9	125.6	142.2
Sweet potato	326.3	293.5	276.5	268.6	266.5	267.8	303.0
Potato	205.6	210.6	212.2	211.8	218.7	222.9	252.2
Total	40,190.7	30,146.9	43,629.1	46,273.5	49,058.6	52,298.8	59,171.3

Source: This study.

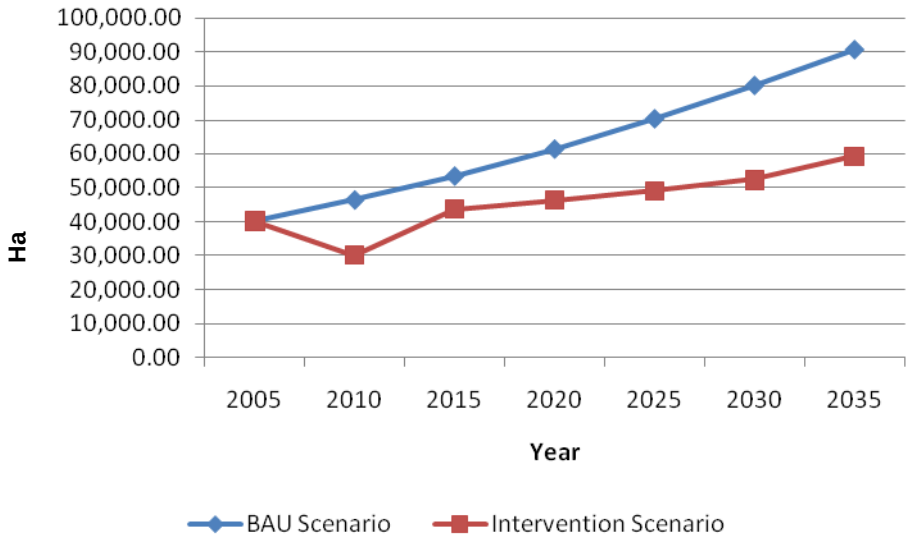


Figure 2. Land requirements for staple crop production under two scenarios (Source: This study).

land needed to meet the projected demand in Table 6. Comparative result of the two scenarios is presented in Figure 3. The difference in output from intervention in yield per hectare could be used to meet demand, be exported or to run industries.

Ruminant livestock

Livestock play a very important role in Nigerian agriculture contributing about 12.7% of the total agricultural GDP (CBN, 2009). Nigeria is one of the four leading livestock producers in Sub-Sahara. In 1990 the livestock population comprised about 14 million cattle, 23 million goats and 13 million sheep (RIM, 1990); however these figures have since increased to 15.2 million cattle, 28 million goats and 23 million sheep. Other ruminant livestock species of economic importance are asses, horses and camels. Accurate statistics on livestock production and marketing are not easy to obtain, and therefore, detailed projections of the supply and demand of the livestock sub-sector may be estimates. Thus the

Table 11. Staple crop production and projection in Nigeria (tonnes): Intervention scenario 2005 to 2035.

Crop types	Projected crop output (tonnes)						
	2005	2010	2015	2020	2025	2030	2035
Millet	6,479.4	8,730.1	11,727.3	15,387.0	19,815.5	23,827.0	26,958.1
Sorghum	8,137.3	9,610.8	11,988.2	14,821.9	18,178.8	22,089.0	24,991.7
Groundnuts	2,941.7	3,705.2	4,460.1	5,343.1	6,371.2	7,548.1	8,540.0
Beans	5,504.2	7,401.7	9,545.1	11,741.1	14,336.3	17,862.3	20,209.6
Yams	3,237.1	3,900.0	4,740.0	5,728.3	7,213.0	8,963.6	10,141.5
Cotton	639.5	785.6	969.2	1,216.6	1,511.5	1,876.6	2,123.2
Maize	4,744.6	6,153.6	7,380.6	8,880.1	11,251.6	13,436.1	15,201.7
Cassava	3,707.7	4,501.1	5,496.7	6,545.0	7,581.6	9,404.7	10,640.5
Rice	3,751.2	4,769.8	6,015.1	7,686.3	9,417.3	11,197.6	12,669.1
Melon	385.6	498.7	683.6	910.4	1,264.9	1,621.1	1,834.1
Cocoyam	780.8	913.1	1,064.6	1,250.6	1,471.5	1,761.5	1,992.9
Plantains	412.2	492.5	585.3	694.1	814.5	991.5	1,121.8
Sweet potato	2,284.1	3,396.2	4,779.5	6,484.8	8,565.3	11,058.2	12,511.3
Potato	637.4	832.3	1,095.2	1,446.0	1,835.1	2,336.5	2,643.5
Total	45,647.8	57,700.7	72,545.5	90,155.3	111,653.1	136,003.8	153,614

Source: This study.

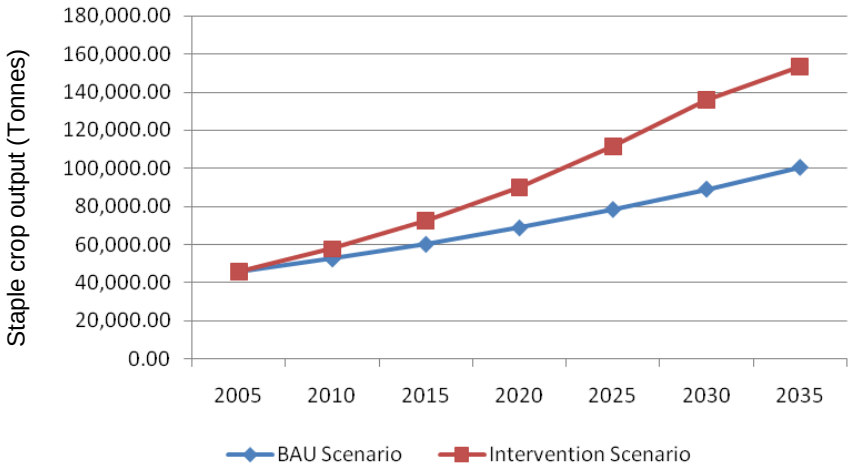


Figure 3. Comparison of the staple crop output (Tonnes) from two scenarios on the same land sizes.

Table 12. Livestock per capita production.

Livestock specie	Cattle	Sheep	Goats	Camels	Donkey	Swine	Poultry	Horses
2003 production per capita	0.12	0.20	0.20	0.00	0.001	0.02	1.05	0.002

Source: This study.

estimate of livestock production was done using information of 2003 as baseline, and then calculating the per capita production from this. Future livestock production was then projected based on this per capita value multiplied by population for each of the years. Thus, for the purpose of this study, it was assumed that annual livestock production growth rate matched the annual population growth rate. Large numbers of live cattle, sheep and goats are imported as well as various milk products (Aregheore, 2009).

Table 12 presents livestock baseline inventory for 2005. From this figure, the per capita livestock

Table 13. Livestock demand: 2005 to 2035.

Livestock specie	Heads						
	2005	2010	2015	2020	2025	2030	2035
Cattle	15,200,000	16,570,779	19,079,875	21,904,891	25,074,882	28,564,203	32,317,774
Sheep	23,000,000	25,074,205	28,870,863	33,145,559	37,942,256	43,222,150	48,901,895
Goats	28,000,000	30,525,119	35,147,138	40,351,115	46,190,572	52,618,269	59,532,742
Camels	18,000	19,623	22,595	25,940	29,694	33,826	38,271
Donkey	1,050,000	1,144,692	1,318,018	1,513,167	1,732,146	1,973,185	2,232,478
Swine	3,500,000	3,815,640	4,393,392	5,043,889	5,773,822	6,577,284	7,441,593
Poultry	142,343,762	164,617,605	189,543,493	217,607,797	249,099,158	283,762,810	321,051,574
Horses	206,000	238,235	274,307	314,922	360,496	410,662	464,626

Source: This study.

Table 13. Average annual increment for the scenarios.

Livestock specie	Cattle	Sheep	Goats	Camels	Donkey	Swine	Poultry	Horses
BAU scenario	0.001	0.062	0.013	-0.006	0.006	0.059	0.068	0.001
Low growth scenario	0.001	0.054	0.011	-0.007	0.005	0.051	0.059	0.001
Improved scenario	0.001	0.07	0.014	-0.006	0.006	0.066	0.077	0.001

Source: This study.

Table 14. Livestock production under business-as-usual scenario.

Livestock specie	2005	2010	2015	2020	2025	2030	2035
Cattle	15,200,000	15,283,991	15,368,447	15,453,369	15,538,761	15,624,624	15,710,962
Sheep	23,000,000	31,101,603	42,056,944	56,871,233	76,903,762	103,992,620	140,623,356
Goats	28,000,000	29,830,996	31,781,727	33,860,020	36,074,220	38,433,211	40,946,464
Camels	18,000	17,429	16,876	16,341	15,822	15,320	14,834
Donkey	1,050,000	1,079,493	1,109,813	1,140,986	1,173,034	1,205,983	1,239,856
Swine	3,500,000	4,652,938	6,185,667	8,223,294	10,932,137	14,533,302	19,320,731
Poultry	142,343,762	197,525,878	274,100,331	380,360,247	527,813,727	732,430,196	1,016,369,914
Horses	206,000	207,122	208,250	209,383	210,524	211,670	212,823

Source: This study.

production was computed and then used to project for demand to 2035 driven by population growth. The table is reported in 5-year period. Cattle demand is projected to rise up to over 32 million from a figure of 15 million in 2005. Poultry demand increased to over 321 million in 2035 from a figure of 142 million in 2005.

The three scenario approaches adopted to meet livestock demand are low growth, BAU and improved scenario, respectively. In the low growth scenario, it was assumed that the economy dipped by as much 13%, with income being severely impacted and the economy not being able to meet expected demand in all sectors including agriculture. The BAU scenario assumed that the economy continues as usual without any improvement or decline. The improved scenario was driven by a medium to long term vision of Nigeria as described in Vision 20-2020 documents where the economy grew by as much as 13%, with import of livestock reduced to the barest minimum.

Table 12, presents demand of livestock as driven by the population growth rate while Table 13 presents annual increment rate used to project livestock production in three different scenarios, namely, BAU, low growth and improved economy scenario. These annual incremental rates were then used to project production from 2005 to 2035, reported for 5-year periods in Tables 14 to 16. Comparing the tables shows that demands for cattle, goats, donkeys, camels and horses are not met by the BAU scenario based on annual incremental rate, whereas the demand for other livestock were easily met and surpassed. The same pattern was observed for low growth and improved scenarios respectively as presented

Table 15. Livestock production under low scenario – slow economic growth rate**.**

Livestock specie	2005	2010	2015	2020	2025	2030	2035
Cattle	15,200,000	15,273,052	15,346,454	15,420,210	15,494,320	15,568,786	15,643,610
Sheep	23,000,000	29,935,485	38,962,316	50,711,124	66,002,700	85,905,341	111,809,481
Goats	28,000,000	29,587,696	31,265,419	33,038,275	34,911,658	36,891,268	38,983,129
Camels	18,000	17,356	16,735	16,136	15,558	15,002	14,465
Donkey	1,050,000	1,075,621	1,101,868	1,128,755	1,156,299	1,184,514	1,213,418
Swine	3,500,000	4,487,911	5,754,671	7,378,986	9,461,781	12,132,467	15,556,982
Poultry	142,343,762	189,515,898	252,320,684	335,938,718	447,267,423	595,490,002	792,832,932
Horses	206,000	206,976	207,956	208,941	209,930	210,924	211,923

Source: This study.

Table 16. Improved scenario – vision 2020 driven; GDP growth rate of 13%.

Livestock specie	2005	2010	2015	2020	2025	2030	2035
Cattle	15,200,000	15,294,938	15,390,468	15,486,595	15,583,323	15,680,654	15,778,594
Sheep	23,000,000	32,303,781	45,371,055	63,724,202	89,501,421	125,705,839	176,555,388
Goats	28,000,000	30,075,895	32,305,695	34,700,811	37,273,498	40,036,922	43,005,224
Camels	18,000	17,502	17,019	16,548	16,091	15,646	15,213
Donkey	1,050,000	1,083,375	1,117,810	1,153,340	1,190,000	1,227,825	1,266,852
Swine	3,500,000	4,822,785	6,645,501	9,157,091	12,617,908	17,386,701	23,957,805
Poultry	142,343,762	205,804,433	297,557,576	430,216,733	622,018,904	899,331,634	1,300,277,824
Horses	206,000	207,268	208,544	209,827	211,119	212,418	213,725

Source: This study.

in Tables 15 and 16. The strategic livestock whose demand were not met in the three scenarios are cattle and goat though their production levels varied in each scenario. The climate change implication of each production level in the scenarios would be discussed subsequently.

Greenhouse gas emission implication of staple crop and livestock productions

Presented in Table 17 is the carbon balance for Nigeria's forest cover vegetation in 2005, based on Table 3. From this table, the annual deforestation rate was estimated to be 3.04%. Based on this removal rate for over 30 years, carbon balance showed net emission from the vegetation cover. Net emissions were experienced in disturbed and riparian forests, respectively, while the other vegetation types recorded net sinks. This result is indicative of challenges faced in the forestry sector, which in years past had been depleted in an unrestrained manner. This had definitely led to loss of important sink source (Luyssaert et al., 2008) for greenhouse emissions in Nigeria.

Land use and land cover change due to staple food crop production from 2005 to 2035 are examined and presented in Tables 7 to 11. The results in these tables gives an idea of area needed to meet staple crop production as estimated from per capita demand in 2003. Tables 7 and 11, respectively, present crop production for 2005 and projections to 2035 reported for 5-year periods, while Tables 8 and 10, respectively, present the land requirement in different scenarios. These scenarios were defined by no-intervention and intervention in yield per hectare of each of the staple crop. The result in Table 7 presents land requirement when per capita production and yield per hectare are held constant at 2003 value, while Table 10 present land requirement with yield per hectare intervention, i.e. deliberate improvement in the yield per hectare of each of the staple crops with constant per capita production and deliberate agricultural land restriction policy. Table 7 shows the staple crop production where yield per hectare is kept constant and land available for agriculture is assumed to be unlimited. Table 11 presents staple crop production in 2005 and projections to 2035 with constant per capita production, improvement in crop yield per hectare and unrestricted agriculture land policy.

Figures 4 and 5 present the trend of cumulative methane and nitrous oxide emissions from livestock production for 2005 to 2035. For the cumulative methane emissions from livestock production, BAU and improved scenarios both show about the same values, with the low growth scenario returning a little lesser value.

Table 17. Carbon balance in forests: 2005.

Forest type	Area occupied (Ha)	Biomass Carbon stocks (tonnes)	Carbon removal (tonnes)	Balance (tonnes carbon)
Disturbed forest	19,491,290.00	26,383,410.10	30,907,358.10	-4,523,948.00
Dominantly tree	83,281,150.00	24,659,548.50	174,846,614.30	150,187,065.80
Forest plantation	1,581,240.00	17,836,387.20	2,150,486.85	15,685,900.35
Mangrove forest	10,067,310.00	28,389,814.20	14,571,375.41	13,818,438.79
Montane forest	8,053,760.00	16,825,512.70	15,608,933.72	1,216,578.98
Riparian forest	5,330,460.00	15,031,897.20	15,167,835.53	-135,938.33
Teak/Gmnelia	1,156,430.00	13,044,530.40	1,572,745.21	11,471,785.19
Undisturbed forest	13,477,900.00	86,784,198.10	38,417,932.75	48,366,265.35
Total	142,439,540	228,955,298.40	293,243,281.87	-64,287,983.47

Source: This study.

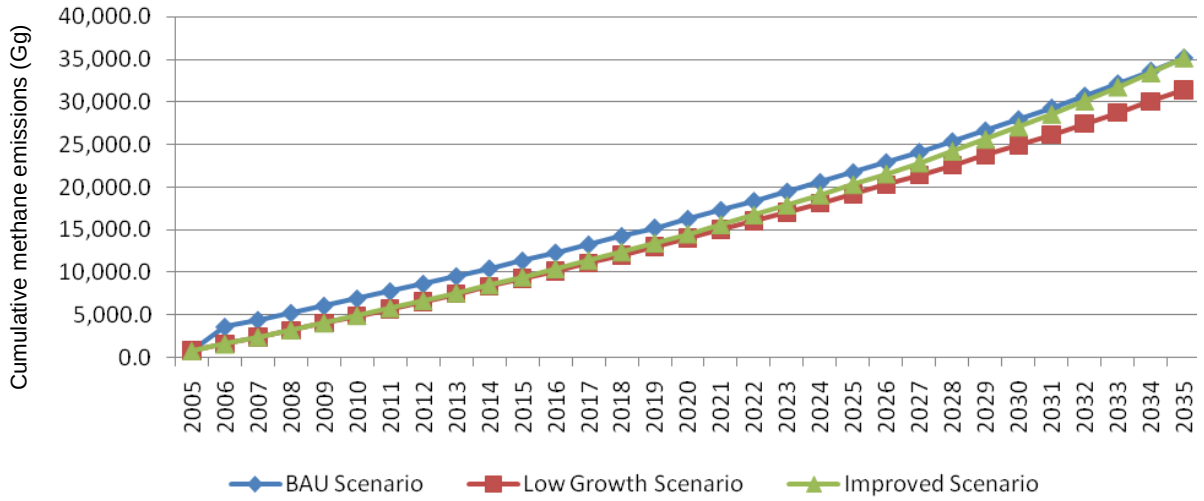


Figure 4. Cumulative methane emissions (Gg) from livestock production for the scenarios.

Probable food security and climate change mitigating options through cost-benefit analysis for ranking

For staple crop production, three scenarios were examined, namely, business-as-usual (BAU), Intervention with improved yield and land restriction policy (I-1) and Intervention with improved yield and no agricultural land restriction policy (I-2). Each of these scenarios implies some form of outlook that has both food security and climate change implications.

For the BAU Scenario, based on annual land requirement as reported in Table 8, the average annual land addition to meet staple crop

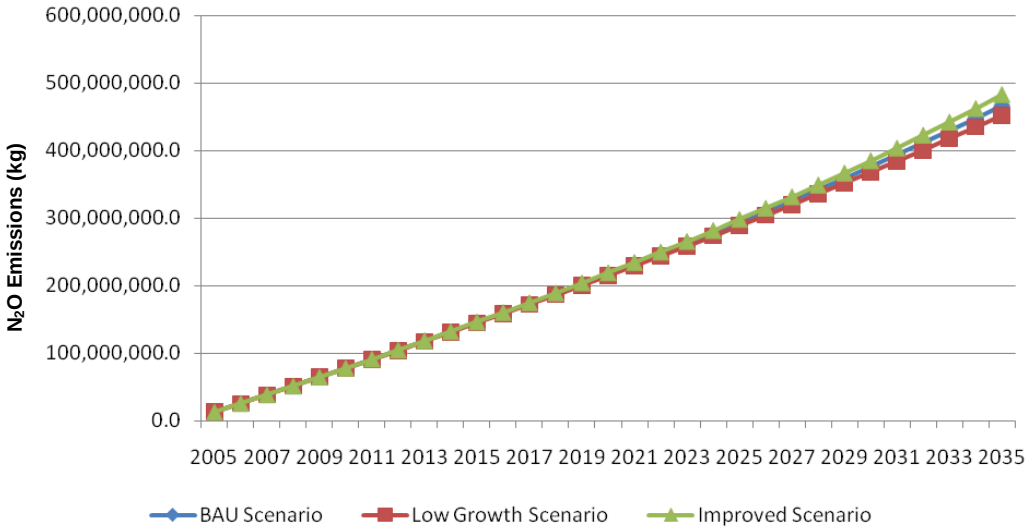


Figure 5. Cumulative N_2O emissions (kg) from livestock production for the Scenarios: 2005 to 2035.

production in the country from 2005 to 2035 is estimated at 1,681.93 Ha/year. This gives an annual emission estimate of 218,669.30 tonnes of carbon equivalent. The I-1 Scenario as reported in Table 10, 2005 to 2010 returned a drop in land requirement before experiencing an increase from 2015 to 2035. Since there would be no clearance of land for staple crop production, it is assumed that there would be a net sink of carbon in these years. From 2014, when land requirement would have increased compared to 2005, there would be a net emission experienced from land clearing for staple crop production. The combination of these two time periods affected the average annual land requirement (632.29 ha/year) as reported in Table 10, which in turn has an effect on the annual net emission, estimated at 82,268.10 tonnes of Carbon. Compared to BAU, I-1 scenario returns a better outlook.

A look into the I-2 Scenario with the policy of increasing yield per hectare of each of the staple crop together with better land use management practices (or restricted land availability) is expected to boost food security in terms of availability and stability. Should the country be able to adequately export the excess over domestic demand or turn them over for industrial utilization, it is expected that if properly managed in a sustainable manner, this would also boost real income through raised agricultural productivity. This could also translate to the improved access and utilization for the citizenry. In each of the scenarios examined therefore, it is imperative for policy intervention to achieve desired food security and climate change mitigation in the agricultural sector of the economy. Even though this appear as a very tall order, considering their 'push[5]' and 'pull' direction, however, for this paper, we see it as imperative to achieve a needed convergence of goals through deliberate compromise in the objectives of these two policy goals, namely food security and climate change mitigation. Thus in ranking, I-2 comes first to meet both food security and climate change mitigation compared to the other two scenarios, namely, BAU and I-1 scenarios respectively.

In terms of livestock production, the three scenarios examined are BAU, low growth and improved. the BAU scenario assumed no change in livestock production policy from 2005 upwards; the Low growth scenario assumes an economy that is severely depressed and therefore does not have priority to improve its domestic livestock production. The Improved Scenario is derived from the country's Vision 20-2020 document to grow the economy at an annual rate of 13% per annum (NPC, 2009).

In examining the climate change implication of these scenarios, it was revealed that with or without intervention, methane emission will still accumulate in the atmosphere. In projecting the emissions, it must be pointed out that it was assumed that the management system would remain at the pre-2005 pattern without any marked improvement. Similar pattern was also observed for the N_2O emission from livestock production.

Integrating rural entrepreneurial development into food security and climate change mitigation viewed with gender perspective

Examining food security based on its definition and its

[5] Food security presents a push direction, in that it is government desire to increase food production, reduce importation and achieve sustainability. On the other hand, the pull direction is exerted by climate change mitigation in that it aims at reducing greenhouse gas emissions through better land use management practices, improved livestock production and increased crop yield per hectare. That is climate change mitigation policy aims at reducing forest destruction for food production while food security demands more land for use.

Table 18. Assessment of Nigeria food situation.

Food security dimension	Present country status	Rural female entrepreneurship development opportunities
Availability	Inadequate	Establish rural female entrepreneurship programmes to enhance rural female participation in solving food security and climate change challenges. The entrepreneurship programmes could be in the area of:
Stability	Unstable	
Access	Inflationary trend erodes purchasing power	
Utilization	Inadequate	i) Storage ii) Value addition through processing of agricultural outputs iii) Improved livestock production iv) Bio-feedstock production v) Agro-allied industries

Source: This study.

four key dimensions set out previously in this study; an assessment of Nigeria's food situation is presented Table 18. The assessment in the table indicates that Nigeria is not yet food secure. This is further accentuated by the huge future demand of both staple crop and livestock demands. A combination of these two assessments indicate a need for innovative strategies that seek to promote integrated approach for meeting future food needs in the country. However, Tables 4 and 5 shows that presently, the burden of workload in agriculture is borne more by the female than the male. Besides, as is presently constituted, Nigeria's rural economy reflects rural entrepreneurship practices that are tedious, injurious and highly unprofitable. It is even more alarming when the exposure that the female entrepreneur had to go through in processing food for the economy is considered. There is a need therefore, if food security in its four dimensions for the country is to be attained, improvement has to be introduced into rural entrepreneurship practices. One avenue is to harness the female entrepreneur as a formidable resource particularly in the rural areas. This could be achieved through the use of climate change mitigation technologies (increased land productivity and conservation tillage, improved livestock productivity, production of biomass feedstock and energy efficiency measures) mentioned earlier to become rallying points for developing female rural entrepreneurship projects.

CONCLUSION AND RECOMMENDATIONS

With the foregoing we conclude that food security and climate change mitigation are twin problems requiring urgent intervention from all stakeholders in the country – government and her citizenry. Even though these twin problems have divergent policy objectives, the compromise possibilities in the policy objectives could become the basis to develop a robust female rural entrepreneurship development programme. The climate change mitigation technologies identified in this study could become good platform to rally rural women projects for improving agricultural productivity (and also achieve food security), enhancing land use management and increased livestock production in the rural areas. Thus we contend that female entrepreneurship, particularly in the rural areas in Nigeria, could be harnessed as a formidable resource base to catalyze economic growth and development, as well as be deployed to mitigate and adapt to impact of climate change in the country. Thus, mobilizing the potential productivity of rural people and particularly of women is indispensable to achieve the kind of resilient economic growth needed to will pull people above the poverty line, and also mitigate climate change impact.

Given the hours they put into food production processes (Akinbami, 2008), women in the country have demonstrated a very high level of commitment on their part to rural entrepreneurship development. However, to maximize their efforts in being integrated into the efforts of achieving food security goal and at the same time are climate change friendly, their health condition should be improved through improvement of the current traditional/outdated technology for processing. Education and finance have a great impact on the ability to achieve needed raise in agricultural productivity as well increase real income. Furthermore, women involved in rural entrepreneurship practices usually operate in isolation, not being involved in any guild association to coordinate their activities and make representation to appropriate quarters for help. Our recommendations are therefore:

1) Encourage agricultural and livestock production and management practices that embraces climate change mitigation friendly approach.
2) Counseling centres that could be of help for entrepreneurship incubation and climate change impact on and from agricultural practices should be established

in our rural areas.
3) The female entrepreneur should be encouraged to acquire formal education and training in order to properly develop and manage rural industries geared towards food security and climate change mitigation.
4) Rural entrepreneurs should form or join an association in their respective localities and be networked to such similar associations in and around their communities in order to be able access various facilities for improving their production capacities and learn mitigative and adaptive approaches to climate change.
5) Encourage, where possible, communal efforts at solving commonly related problems in agricultural practices
6) Introduce improved (modernized) technology for various production processes to reduce drudgery involved in the production processes and also significantly affect output from the women;
7) Provision of adequate community based market outlets to protect the women from perennial price fluctuation of products produced by the women in each of the communities and to prevent their exploitation from middle men/women.
8) Establish functional health centres in the various communities for enhancing entrepreneurial operations of the women at the grassroots/micro and small-scale levels.
9) Provide infrastructural facilities and improve existing ones, particularly functional roads, electricity[6] and water
10) Increased input for farming such as fertilizer, tractors, seedlings, etc.
11) Ensure, through adequate political will that various government intervention measures leads to improve the women entrepreneur at the grassroots/micro and small scale levels as it relates to climate change mitigation e.g. Agreement from Copenhagen.

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[6]Electricity provision should be in distributed form and mostly using renewable energy sources, which are known to climate friendly.

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Appendix A. Detail land cover change: 1975 to 2005.

No	Land use type	Area (km^2) 1975	Area (km^2) 2005	Change (1975 – 2005)	Change (%)
1	Agricultural tree crop plantation	824.15	1,656.88	832.73	101.00
2	Alluvial	523.61	282.38	-241.23	-46.10
3	Discontinuous grassland dominated by grasses and bare surfaces	7,614.72	1,251.23	4,902.51	64.40
4	Disturbed Forest	14,677.70	19,491.29	4,813.59	32.80
5	Dominantly grasses with discontinuous shrubs and scattered trees	13,053.77	12,487.62	-566.15	-4.30
6	Dominantly shrubs and dense grasses with a minor tree component	118,529.55	85,020.98	-33,508.57	-28.30
7	Dominantly trees/woodlands/shrubs with a subdominant grass component	154,933.40	83,281.15	-71,652.25	-46.20
8	Extensive small holder rainfed agriculture	170,837.55	192,892.33	22,054.77	12.90
9	Extensive small holder rainfed agriculture with denuded areas	447.88	10,118.47	5,700.58	129.00
10	Floodplain agriculture	9,671.81	21,576.03	11,904.21	123.10
11	Forest plantation	1,000.85	1,581.24	580.39	58.00
12	Forested freshwater swamp	18,564.71	16,696.51	-1,868.20	-10.10
13	Graminoid/sedge fresh water marsh	5,882.74	1,136.51	-4,746.22	-80.70
14	Grass land	1,196.74	8,146.74	6,950.00	580.70
15	Gullies	125.35	16,848.37	18,945.13	15,113.20
16	Intensive row crops	322,275.97	373,481.34	44,253.37	13.40
17	Irrigation project	148.85	1,008.86	860.01	577.80
18	Livestock project	51.02	139.65	88.63	173.70
19	Major urban	1,102.58	1,362.37	259.79	23.60
20	Mangrove forest	10,157.12	10,067.31	-89.81	-0.90
21	Minor urban	958.69	4,022.98	3,064.29	319.60
22	Montane forest	7,900.02	8,053.76	153.74	1.90
23	Montane grassland	2,502.27	3,898.15	1,395.88	55.80
24	Natural water bodies/ocean	6,766.53	10,588.36	8,821.83	130.40
25	Rainfed arable crop plantation	15.92	521.39	505.46	3,175.00
26	Reservoir	1,331.41	2,901.16	1,569.75	117.90
27	Riparian forest	7,506.46	5,330.46	-2,176.01	-29.00
28	Rock outcrop	1,445.15	2,647.96	1,202.81	83.20
29	Salt marsh/tidal flat	18.84	596.92	578.08	3,068.37
30	Sand dunes/aeolian	1,032.77	5,428.30	4,395.53	425.60
31	Shrub/Sedge Graminoid freshwater Marsh/Swamp	17,749.63	10,251.68	-7,497.95	-42.24
32	Teak/Gmelina plantation	624.44	1,156.43	531.99	85.19
33	Undisturbed forest	28,022.42	13,477.90	-14,544.52	-51.90
34	Canal		30.76	3,076.00	
35	Mining areas		61.15	61.15	
	Total	927,494.6	927,494.6	10611.31	

Source: Abbas, 2009.