The Livestock Sector and its contributions to the Protein and Energy needs of the Nigerian Population

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ABSTRACT

The study was designed to assess the contributions of the livestock sector to the protein and energy needs of the Nigerian population by 2050 using an annual time series data from 1980 to 2010. Projected population figures from 2012 to 2050 were used to estimate the extra amount of protein and energy that will be required by the population in 2050. Energy and protein supply data from animal-derived foods, mainly; cattle meat and milk, sheep meat, goat meat, poultry eggs and meat, from 1980 to 2010 were calculated using animal production data and McCance and Widdowson's composition of foods. The data were analysed using an Excel spreadsheet programme. The result showed that animal-derived foods contributed a total of 47,805,756 MJ/d of energy and 1,027,901 kg/d of protein in 2010. Meanwhile, to meet the additional energy and protein needs of the projected Nigerian population of 389.615 million people by 2050, animal-derived foods would have to supply 37.4% more energy and 9.0% more protein than in 2010. The results thus indicate a gap between current production and expected protein and energy requirement of the population by 2050; which must be closed if food security is to be achieved.

Keywords: Animal production; animal-derived food; energy requirement; livestock sector; Nigerian population; protein needs
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Introduction

Most nations in the world are currently facing an unprecedented increase in population and environmental issues which have posed a threat to food security in the respective countries (Huang & Ukpong, 2019). To feed this growing population, there has to be a corresponding increase in food production (Crentsil & Ukpong, 2014).

Food is a basic necessity for human survival because it supplies major nutrients needed for the overall function of the body. Food and Agriculture Organization (FAO) definition of food includes livestock products, oils, and cereals (FAOSTAT, 2010). However, other products such as sugar, vegetables, fruits, pulses, roots and tubers have been included in this definition (Diaz- Bonilla *et al.*, 2000)**.**

Food insecurity is one of the dimensions of poverty, and it entails access to food (quality and quantity), and availability of food (supply and entitlement) (Young *et al*., 2001). Food poverty can be described as the inability to afford enough food that can be considered adequate to provide the required amount of protein and energy needed by the human body within a particular time, and livestock production is a contributing factor to this quality food needs. The contribution of livestock varies from household to household depending on the income level. Some livestock keepers sell their stocks for money to purchase food grains, cereals and vegetables, while others keep the smaller mammals for food, hence the consumption of livestock protein and other animal products such as milk, meat, and eggs also differ from household to household.

Despite its importance in helping to improve food security and other socioeconomic profiles of the people within an economy, livestock plays an undeniable role in climate change and global warming menace. According to Gerber *et al*. (2013), the livestock sector is responsible for about 14.5% of the total anthropogenic greenhouse gas emissions. Livestock is thus, associated with issues of greenhouse gas emission and with the circumstances of its production, livestock poses a variety of environmental issues leading to environmental degradation. Also, with regards to population increase, this implies that more land space and other resources are required. The implication is that increased livestock production would require a significant amount of natural resources (Grossi *et al*., 2018). For instance, this would increase the competition for water and land meant for human welfare, settlements and crop farming. Nevertheless, in a bid to achieve food security and indeed, the necessary protein

and energy needs of the human population, an improvement in animal production, particularly livestock production, is necessary. Such improvement can be achieved with regards to technologies that would take into consideration the need for environmental sustainability and land/water resource conservation for other important purposes. Also, with regard to environmental concerns, there is a need to ensure a decrease in the intensity of greenhouse gas emissions from the livestock sector (Grossi *et al*., 2018).

On the other hand, before the gap between energy and protein needs and supply are met, there must be a sustainable way of improving the livestock sector in order to supply these nutrients, because imbalances of nutrients due to lack of good quality food result to malnutrition, exposing the body to diseases and poor development. Food insecurity as a global issue results to chronic hunger, malnutrition in children and adults, global food shortages, high food prices, and poverty. The situation can be attributed to poor investment in the agricultural sector in terms of research, rural infrastructure, input supply, irrigation and subsidy, as well as climate change.

To achieve food security is significant especially in the developing countries, being that health, education and ability to work by certain groups of people are attributed to food security status. Meanwhile, women and children are the most vulnerable to food insecurity because they have less access to resources than men (CIDA, 2011). Sen (1981), stated that the main reason for food insecurity was access to food rather than poverty and poor income. This conforms with the definition of food security by FAO (1996), which states that food security exists when all people, at all times, have physical and economic access

to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life.

A recent report by the Food and Agriculture Organisation (FAO) on the food insecurity state in the world reveals that access and availability of food can be a link to age and gender structures as well as the income distribution of the country (FAO, 1999). To analyse food insecurity and access to food at the household level, there is need to consider the level of access to inputs, and financial services given to farm families, as well as rural infrastructure being established, these are the primary elements of rural food insecurity (Omonona & Adetokunbo, 2007)**.** Upon the estimates by FAO by 2050, food insecurity will still persist, hence there is need to strengthen research institutions if global food production must increase by 70% as proposed by FAO (CIDA, 2011).

Despite improvements in agricultural production in some countries over the years, there is still insufficient food to take care of all human races, while lack of adequate food supply to all people is still a problem. A further report by Action Aid; a non-governmental organisation estimates that about US$ 450bn is the cost of loses to GDP yearly from food insecurity in developing countries (EIU, 2012). Food demand in Nigeria is increasing with respect to population, leading to increased need for cereals such as rice and wheat, hence most food demand is met through food imports (Ukpong *et al.*, 2013). The energy intake per person per day is about 2710 kcal (FAOSTAT, 2010), that an average family size of five people needs about 1.5 tonnes of grain per year to meet their energy requirement. The most consumable food crops are cereals and tubers, which are produced under rain-fed agriculture,

and their production has been limited by lack of water availability and poor soil fertility among others. This confirms the projections by the World Bank that Nigeria will experience increased food demand between 2000 and 2025 (NINCID, 2009).

Nigeria is the most populated black nation in the world with an estimated population of 166.63 million people in 2012, with population growth rate of 2.55% per year (FAO, 2012). Out of this population, majority of the people live on less than £1 a day, about 20% of the population are malnourished, and almost a million die of hunger-related issues every year (FAO, 2012). The country has a land area of 98.3 million hectares, about 74 million hectares is used for arable farming (FAO, 2005), with a human development index of 0.423, unemployment rate of 23.9%, and life expectancy at birth of 52.05 years (NBS, 2012). 80% of the population are poor, living in rural areas, depending on agriculture for livelihood (Bello & Raslan, 2010).

Agricultural sector seems to have been abandoned to the elderly people, as most young people prefer to migrate to urban cities in search of white-collar jobs, there is shortage of domestic staple food supplies in the local markets, while few ones produced are highly-priced, and there are few hires paid labourers to work in the farms. Food insecurity is definitely at an alarming rate as the population goes higher, meanwhile, the elderly population will not be able to produce enough food to cater for the teeming population, and the international market. Moreover, issue of extension agents to start demonstration farms for the local people is far gone, there are no new ideas of farming practices in the rural areas, hence, farmers still continue with the olden systems of farming that started in ages, no doubt, there is intense

poverty in the country especially in the rural areas where a high percentage of the farmers live.

The livestock sector in Nigeria also depends mainly on native pasture, browse materials and plant residues in the different agro-ecological zones. There is no improved system to provide adequate feeding and balanced ration for the animals, yet these animals provide a variety of functions such as farm power, transport, income from meat and milk, food for human consumption, helping to enhance growth in the economy (Shiawoya & Tsado, 2011). The rise in food import in Nigeria is so glaring and worrisome, hence this study will attempt to justify if the livestock sector has the potential of improving the protein and energy supply to meet the needs of the population, as well as alleviating food insecurity in Nigeria by 2050.

Thus, the main objective of this study is to assess the contribution of livestock to meeting the protein and energy needs of the Nigerian population. The specific objectives are:
1. To estimate energy and protein requirements for the Nigerian population using projected figures from 2012 to 2050.
2. To assess the potentials of animal-derived food to meet the needs of the population by 2050.

Materials and methods

Secondary data were used for the study. The annual time series data sets of estimated and projected population and animal-derived food production for Nigeria were collected from recognised research institutions and corporate organizations such as the Food and Agricultural Organisation (FAO), World Bank, and the Central Bank of Nigeria. The annual time series data sets for ruminant and non-ruminant livestock production were mainly for the period between 1980 and 2010. The data include cattle milk and meat production in Nigeria, meat production from sheep and goats, poultry eggs and meat production, meat production from pigs, as well as the estimated and projected population data for Nigeria. The projected population figures were for the period between 2012 and 2050. However, data on cheese and butter were not considered, as the data on milk production included that which will go into products.

To achieve the main aim of the study, the research started with a review on global food insecurity and food insecurity trend in Nigeria, how it affected the global population, having a greater impact on developing countries.

Method of Data Analysis

Analyses were made, using available data between 1980 and 2010; to calculate the estimated energy and protein needs of the Nigerian population by 2050. The extent to which animal-derived food can contribute to the protein and energy requirements of the people was also calculated. Moreover, simple graphs and tables were used to present data and results for the animal-derived food production and the population figures.

The energy and protein values of foods (cattle meat and milk, goat and sheep meat, pig meat, eggs and meat from poultry) were values given in the McCance and Widdowson's composition of foods base on the UK recommendations (Food Standards Agency, 2002).

McCance and Widdowson's composition is important for estimating the nutrient content of food and provides the established and accepted source of information required for nutritional labelling (Church, 2015). As

also noted by Robertson (2003), McCance and Widdowson's composition of foods has been extensively developed and composes a valuable reference tool for studies on food and nutrient consumption. The composition which was first published in the 1930s has been extended to incorporate information on a wide range of food items and to update the nutrient composition of traditional items. According to Church (2012), the McCance and Widdowson's composition provides authoritative and comprehensive nutrient data for over 1200 of the most commonly consumed foods, thus remains an essential reference compendium for studies on the nutritional value of foods especially those consumed in the UK. Of a fact, no nutrient database can be completely accurate (Robertson, 2003), however, the McCance and Widdowson's model complements the discourse on the subject matter of this research.

Results and discussion

The McCance & Widdowson's food composition database provides a wide range of information on varieties of food; the actual type of food that was used in the study based on the judgement of the food code number that best suited is represented in Table 1. The protein and energy values used for the calculation are also represented.

TABLE 1
Food composition data used

Food variable	Cattle meat	Goat meat	Sheep meat	Cow milk	Poultry eggs	Poultry meat	Pig meat
Food code number	18-469	18-187	18-187	12-318	12-918	18-331	18-258
Energy value (MJ/Kg)	9.34	11.59	11.59	2.79	6.27	7.42	10.24
Protein content (g/kg)	197	244	244	33	125	273	193

Based on the assumptions for the energy and protein requirement calculations, children were represented by the population in the age range of 0 -14 years while adults were identified to be 15 years and above. Productivity and expected energy and protein requirements per person per day were calculated based on the Dietary Reference Values for energy and protein given by the Scientific Advisory Committee on Nutrition (2012), which are represented in Table 2.

TABLE 2
Protein and energy requirements used based on the
Scientific Advisory Committee on Nutrition (2012)

Population	Men	Male children	Women	Female children
Energy (MJ/d)	10.9	4.9	8.7	4.6
Protein (g/d)	55.5	26.2	45	24.6

The projected population figures were used to calculate the expected energy and protein requirements of adult females and children as well as adult males and children. The result from the developed Excel spreadsheet programme is represented in Table 3.

TABLE 3
Historical and projected population with energy and protein
requirement by 2050

Year	Total Population	Energy required MJ/d	Protein required kg/d
2010	158423	1226096872	6354284
2011	162471	1257448027	6516751
2012	166629	1289666415	6683713
2013	170901	1322767499	6855249
2014	175288	1356742844	7031316
2015	179791	1391624779	7212081
2016	184411	1427404870	7397501
2017	189144	1464074684	7587532
2018	193976	1501503504	7781496
2019	198889	1539559206	7978709
2020	203869	1578132154	8178604
2021	208911	1617185806	8380989
2022	214018	1656741244	8585975
2023	219196	1696837824	8793766
2024	224453	1737559880	9004799
2025	229796	1778938332	9219234
2026	235227	1820995671	9437189
2027	240742	1863702380	9658509
2028	246345	1907079542	9883305
2029	252035	1951144023	10111663
2030	257815	1995894417	10343577
2031	263684	2041332132	10579054

2032	269641	2087448732	10818050
2033	275687	2134251246	11060602
2034	281819	2181717184	11306593
2035	288038	2229853574	11556059
2036	294340	2278630901	11808848
2037	300725	2328046351	12064945
2038	307189	2378071814	12324204
2039	313729	2428681990	12586495
2040	320341	2479847362	12851663
2041	327023	2531551062	13119623
2042	333772	2583770603	13390258
2043	340583	2636458193	13663319
2044	347450	2689592751	13938697
2045	354369	2743118052	14216102
2046	361336	2797004582	14495380
2047	368348	2851243906	14776488
2048	375401	2905805101	15059265
2049	382491	2960643191	15343477
2050	389615	3015732874	15628995

Animal Derived Food Production, and Energy and Protein Supply
Based on the Excel spreadsheet programme developed, Table 4 shows the productivity of animal-derived food from 1980 to 2010 and the energy and protein supplied by these foods.

TABLE 4
*Animal-derived food production, and energy and
protein supply for Nigeria*

Year	Cattle meat (t/y)	Goat Meat (t/y)	Sheep Meat (t/y)	Cow Milk (t/y)	Eggs (t/y)	Poultry meat (t/y)	Pig meat (t/y)	Energy supplied (MJ/y)	Protein supplied (kg/y)	Energy supplied (MJ/d)	Protein supplied (kg/d)
1980	370216	59055	28050	290000	200000	118000	38250	7797704390	168352422	21363574	461240
1981	329125	64135	30800	292000	205000	131000	38250	7638054150	166408015	20926176	455912
1982	364231	71120	31350	297000	220000	122000	38250	8094494840	174745437	22176698	478755
1983	411797	76835	32450	301000	225000	135000	38250	8756717130	190084799	23991006	520780
1984	425918	82550	34650	304000	235000	128000	49500	9114672120	196407146	24971704	538102
1985	437724	87630	36300	309000	250000	137000	60750	9592920860	207043298	26281975	567242
1986	283478	99060	37400	315000	260000	141000	76500	8567885920	185293906	23473660	507655
1987	266734	104140	38500	321000	280000	152000	92250	8868163160	192244008	24296337	526696
1988	236049	110490	39600	329000	260000	160000	99000	8693310760	189267613	23817290	518541
1989	217530	120650	41800	339000	243000	169000	114750	8812965700	192336960	24145112	526951
1990	204273	120650	44000	351000	337000	174000	106886	9294075960	202255379	25463222	554124
1991	205000	123190	47300	360000	359000	165000	106277	9458585580	204296021	25913933	559715
1992	210000	125730	48400	370000	378000	162000	112500	9735966700	209256220	26673881	573305
1993	244378	130556	50600	380000	397000	165000	117000	10353858560	222135530	28366736	608590
1994	264319	143637	62040	387826	418000	168000	121500	11046150430	236617789	30263426	648268
1995	266861	156337	65890	394008	390000	169000	130500	11202974990	239870769	30693082	657180
1996	280000	169545	68750	406771	325000	170000	135000	11193480140	239817423	30667069	657034
1997	294000	182527	87010	350000	279000	171000	139500	11293023830	243716528	30939791	667717
1998	297000	194691	95205	367500	419000	172000	144000	12537129640	268494124	34348300	735600
1999	298000	206502	105490	385875	435000	172000	153000	13046308530	278425923	35743311	762811
2000	279000	221234	115390	389000	400000	160000	157500	12900642160	274013756	35344225	750723
2001	283432	238618	127820	389300	440000	183500	165375	13794228300	295106751	37792406	808512
2002	279500	242264	129943	408200	450000	190000	192524	14266032890	304627740	39085022	834597
2003	267270	245373	131271	408700	460000	201000	178875	14209178760	304936301	38929257	835442
2004	280000	251841	143332	423000	476000	211000	186165	14831894670	318574057	40635328	872806
2005	260850	256746	137302	438500	500400	218750	193455	14968382520	321611227	41009267	881127
2006	284050	264318	141438	462700	526400	232100	201285	15730540440	338242719	43097371	926692
2007	287450	270662	144722	468240	552800	243300	209250	16219535160	349339416	44437083	957094
2008	293800	277433	145321	469250	581000	243250	217602	16629047840	357545262	45559035	979576
2009	298350	284266	148809	472320	612600	256500	226307	17185316730	370308561	47083060	1014544
2010	303600	291300	148809	495800	623400	256500	226307	17449100990	375183947	47,805,756	1,027,901

As indicated in Table 4, from the Excel programme, total energy and protein production from animal-derived food for 2010 were 47,805,756MJ/d and 1,027,901kg/d respectively. This indicates an obvious increase in total energy and protein supplied from animal-derived food from 1980. The results also indicate an increase in energy supplied per year from 7,797,704,390 MJ/y in 1980 to 17,449,100,990 MJ/y in 2010, and that of protein supplied per year from 168,352,422 kg/y in 1980 to 375,183,947 kg/y in 2010.

Protein requirement for the projected population between 2010 and 2050

From the result in Table 3, *the protein requirement in 2010* was subtracted from the expected protein requirement per day by the projected Nigerian population in 2050; as indicated in equation 1.

$$[(15628995 - 6354284 \, kg/d) = 9274712 kg/d]$$ [1]

Hence, the estimated extra protein required by the Nigerian population by 2050 is 9,274,712 kg/day. The amount that will be required by adults and children is 6,868,504 kg/d and 2,406,207 kg/d respectively. However, the percentage (%) extra animal-derived foods that would be needed to provide the additional protein required by the projected population by 2050 equals the ratio of total estimated protein required by the population between 2010 and 2050, and the current protein production from animal-derived food in 2010;

The percentage (%) extra animal-derived foods that would be needed to provide the additional protein (kg/d) is calculated in equation 2:

$$[(2010 - 2050) = \frac{9274712}{1072901} \, x \, 100 = 9.0\%]$$ [2]

Energy requirement for the projected population between 2010 and 2050

The energy requirement in 2010 was subtracted from the extra energy requirement by the projected Nigerian population for 2050 to get the extra energy required for the Nigerian population as shown in equation 3:

$$[(3015732874 - 1226096872 \, MJ/d) = 1789636001 \, MJ/d]$$ [3]

Therefore, the estimated extra energy required by the Nigerian population by 2050 is 1,789,636,001 MJ/d, out of this number, 1,339655,588 MJ/d and 449,980,413 MJ/d will be required by adult and children respectively.

Hence, the percentage increase in animal-derived food needed to provide the extra energy, required by the projected population by 2050 equals the ratio of total estimated energy required by the population between 2010 and 2050, and the energy production from animal-derived food by 2010;

Thus, the percentage (%) extra animal-derived foods that would be needed to provide the additional energy can be estimated as follows:

$$[(MJ/d)(2010 - 2050) = \frac{1789636001}{47805756} \, X \, 100 = 37.4\%]$$

Total energy and protein requirement by the Nigerian population; current production as well as extra increase in production needed for 2050 as calculated using the Excel programme and as indicated in equation 4, are summarised in Table 5.

TABLE 5

Energy and protein requirement, current production, and extra increase in production for Nigeria by 2050

Population	Energy (MJ/d)	Protein (kg/d)
Adults (15 years and above)	1,339,655,588	6,868,504
Children (0 -14years)	449,980,413	2,406,207
Total	1,789,636,001	9,274,712
Current production	47,805,756	1,027,901
% requirement	3.71	15.38
Extra increase in production needed for 2050 (%)	37.4	9.0

The result in Table 5 indicates that the total energy and protein requirements per day by the projected Nigerian population by 2050 would be 1,789,636,001 MJ/d and 9,274,712kg/d respectively, with projected requirements for adults (15 years and above) indicated as 1,339,655,588 MJ/d of energy and 6,868,504 kg/d of protein, while those of Children (0 – 14years) would be 449,980,413 MJ/d of energy and 2,406,207 kg/d of protein. The percentage (%) requirements are indicated as 3.71% and 15.38% of energy and protein respectively, with an extra increase in production needed by 2050 projected at 37.4% and 9.0% of energy and protein respectively.

Conclusion

The cumulative population growth in the world has raised debatable concerns as it results in food security issues including inefficient nutritional balance, geometrically increasing food demand and high food prices.

In particular, livestock production is one of the major sources of livelihood for the poor farm families in Africa and other developing countries in the world. Livestock contributes to the provision of food and income, and reduces unemployment rate, reduces hunger and malnutrition. It provides protein and other nutrients for the human body, serves as a source of wealth creation, provides transport, and enhances the livelihood of resource-poor farmers.

By inferences, the study has shown a relationship between the livestock sector and food security, having indicated the sector's contributions to the energy and protein requirements of the Nigerian population, hence an improvement in the livestock sector could lead to a substantial improvement in food security in the country.

In particular, the result of this study indicates a gap between current production and expected protein and energy requirement of the Nigerian population by 2050 and suggests that animal-derived foods would have to supply 37.4% more energy and 9.0% more protein than in 2010 to meet the additional energy and protein needs of the projected Nigerian population of 389.615 million people by 2050. To ensure the certainty of the contributions of the livestock sector to the protein and energy requirements of the increasing population, there is a need to achieve greater productivity in livestock production.

The study suggests the need for the government, research institutions and the private sector to encourage livestock farmers towards achieving increased productivity by providing enabling policies, collaborative research, innovations and financial support as the case may be. In particular, there is a need for increased investment in the livestock sector to help improve the quality and availability of feed materials; a prospect that requires consistent investment and support from the government and other stakeholders in the economy. Also, there is a need for suitable policies to support livestock farmers especially the small-scale farmers through the provision of incentives, subsidies, good veterinary care, and good breeding programmes. There is also the need to enhance productivity from other sectors of the economy such as crop production; to ensure adequate food production and supply in the country to meet up the extra protein and energy needs of the population by 2050.

More so, agricultural policies should be made to address issues of subsistence agriculture whereby people produce food only to take care of their family needs, without any remains for the markets, hence could not

generate enough income to take care of their basic needs, leading to increased poverty. Since agriculture has a greater role to play in sustaining the general economy of the country as the population increases, there is a need for the government to look into other food insecurity coping mechanism, while making effort to restore the livestock sector, to ensure sustainability and general development of the overall economy of Nigeria.

On the whole, the study encourages a consistent commitment to livestock production to help enhance productivity, improve food security and better the wellbeing of farmers, as well as improve economic development in the country. On the other hand, the study reiterates the need to encourage improved technology and innovation that would particularly promote environmental sustainability by helping to reduce greenhouse gas emissions and other environmental impacts associated with livestock production.

More so, having considered a wide range of data spanning over 30 years (1980-2010), this study thus creates a significant reference background for further research and comparison with regards to the subject matter.

Conflict of interest

Authors do not have any conflict of interest.

REFERENCES

Bello, M. A. & Roslan, A. H. (2010) Has poverty reduced in Nigeria. *European Journal of Science* **15** (1), 7 – 17.

Church, S. M. (2015) The importance of food composition data in recipe analysis. *Nutritional Bulletin* **40** (1). DOI: 10.1111/nbn.12125.

Church, S. M. (2012) McMance and Widdowson's the composition of foods. *Royal Society of Chemistry* **31** (6), pp. 554.

CIDA (2011) Increasing food security: CIDA's food security strategy. Canada: Canadian International Development Agency.

Crentsil, C. & Ukpong, I. G. (2014) Production function analysis of fish production in Amansie-West District of Ghana, West Africa. *American Journal of Experimental Agriculture* **4** (7), 817 – 835. DOI: 10.9734/AJEA/2014/8625.

Diaz- Bonilla, E., Thomas, M. & Robinson, S. (2000) *Food Security And Trade Negotiations In The World Trade Organisation: A cluster analysis of country groups.* Washington, D.C: International Food Policy Research Institute.

EIU (2012) Global Food Security Index 2012: An assessment of food affordability, availability and quality. London, United Kingdom: Economist Intelligence Units.

FAO (1996) Rome declaration on world food security and world food summit plan of action. World Food Summit. Rome, Italy: Food and Agricultural Organization of the United Nations.

FAO (2005) Nigeria's agricultural and food security challenges. Retrieved April 20, 2012, from Food and Agricultural Organization: *www.fao. org.*

FAO (2012) Food Security Portal. Food and Agricultural Organization. Available: http://www. foodsecurityportal.org/nigeria.

FAOSTAT (2010) Food Balance Sheets. Rome, Italy: Food and Agricultural Organization of the United Nations. Available: http://www.fao. org/faostat/en/#data/FBS/report .

Food Standards Agency (2002) McCance and Widdowson's The Composition of Foods, Sixth Summary Edition. Cambridge: Royal Society of Chemistry.

Gerber, P.J., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J., Falcucci, A., & Tempio, G. (2013) Tackling climate change through livestock: A global assessment of emissions mitigation opportunities. Food and Agricultural Organization of the United Nations (FAO), Rome, Italy. Available: http://agris.fao.org/agris-search/search.do?recordID=XF2016016977.

Grossi, G., Goglio, P., Vitali, A. & Williams, A. G. (2018) Livestock and climate change: Impact of livestock on climate and mitigation strategies. *Animal Frontiers* **9** (1), 69 – 76.

Huang, Y. & Ukpong, I.G. (2019) Issues of water resource management in China: Implications on agriculture and food security in the Guangxi Province of South China. *Journal of Asian Rural Studies* **3** (1), 70 – 84.

NBS (2012) Agricultural statistics. Nigeria: Nigeria National Bureau of Statistics.

NINCID (2009) Nigeria. Nigeria National Committee of ICID (NINCID.

Omonona, B. T. & Adetokunbo, A. G. (2007) An analysis of food security situation among Nigerian urban households: Evidence from Lagos State, Nigeria. *Journal of Central Agriculture* **8** (3), 397 – 406.

Robertson, C. (2003) McMance and Widdowson's the composition of foods-sixth edition. *Nutrition Bulletin* **28** (1). DOI: 10.1046/j.1467-3010.2003.00292.x.

Scientific Advisory Committee on Nutrition (2012) The Scientific Advisory Committee on Nutrition annual report for the calendar year 2012. Available:https://www.gov.uk/government/publications/sacn-annual-report-2012.

Sen, A. (1981) Poverty and famines: An essay on entitlement and deprivation. Oxford: Clarendon Press.

Shiawoya, E. L., Fasanya, O. O. A. & Ikhatua, U. J. (2001) Feedlot performance of yankasa rams fed a year-round diet of groundnut haulms, gmelina leaves and concentrates **4** (2), 134 – 149.

Ukpong, I. G., Ekpebu, I. D. & Ofem, N. I. (2013) Cointegration inferences on issues of poverty and population growth in Nigeria. *Journal of Development and Agricultural Economics,* USA. **5** (7), 227 – 283.

Young, H., Jaspars, S., Brown, R., Frize, J. & Khogali, H. (2001) Food security assessments in emergencies: A livelihoods a pproach. Rome: Food and Agricultural Organization.