

Agricultural Systems And Food Security In Nigeria: The Roles Of Wild Edible Plants

Audu Habu

Anne Sudan Ogieriakhi

Department of Biology, College of Education Akwanga, Nasarawa, Nigeria

Abstract: *This paper examines agricultural systems and food security in Nigeria. It observes wild edible plants and their support to agricultural systems and food security in the country. Despite their support, the expansion of modern day agriculture has led to a greater conversion of land alongside the loss of wild edible plants. The challenge of feeding the growing population of the country should focus on sustainable intensification to mitigate the loss of natural habitats, hence wild edible plants. Ensuring dietary diversity and related food security would depend to a great extent on the prevention of the imminent loss of wild species and important agro-biodiversity through biodiversity-focused approach in food production.*

Keywords: *Farming, wild edible plants, food security, agricultural systems, biodiversity*

I. INTRODUCTION

Farming began around 12,000 years ago and approximately 7,000 plant species and thousands of animal species have been used historically by humans for food and health requirements (Toledo and Burlingame 2006). Today, 98% of world's food needs is provided by 12 plant crops and 14 animal species with wheat, rice and maize alone accounting for more than 50% of the global energy intake (Thrupp 2000). Almost one-third of terrestrial lands have farming or planted pastures as a dominant land use (accounting for at least 30% of total area). Another 10–20% of land is subject to extensive livestock grazing; and approximately 1–5% of food production occurs in natural forests. In Africa alone, land in cereal production is expected to increase from 102.9 M ha in 1997 to 135.3 M ha in 2025 (Rosegrant et al. 2005). Global consumption of livestock products is predicted to rise from 303 million metric tons in 1993 to 654 million tons in 2020 (Delgado et al. 1999).

Agriculture in Nigeria is largely based on traditional technology. Shifting cultivation remains a major farming system among the peasant farmers who produce over 90 percent of total food supplies (Federal Government of Nigeria 2010). It is characterized by small holdings (0.2-2.2

ha), discontinuous farm units, unequal land tenure, low energy input, absence of modern inputs (improved strains of seeds and chemicals), low operating capital, clear-felling of the natural vegetation and application of fire in land preparation (Osemeobo 1988). However, commercial agriculture is rapidly encouraged thereby potentially transforming many subsistence-oriented shifting cultivation systems towards more commercial system, often in accordance with national policies aiming at economic growth and food security (Hall 2011).

Food security is the ability of all people, at all times, to have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (World Food Summit 1996). It includes food access, availability, food use and stability.

Wild edible plants are any uncultivated species of plants which are an important part of many local and traditional food systems (Kuhnlein and Receveur 1996). Rural communities in most cases depend on wild edible plants to meet their food needs in periods of food crisis, especially the most vulnerable groups (Pretty 2002).

II. AGRICULTURAL SYSTEMS IN NIGERIA

According to the National Agricultural Research Project (NARP 1994), more than 70 per cent of the farming population in Nigeria consists of smallholder farmers, each of whom owns or cultivates less than 5 hectares of farmland. Such practice under high population of smallholder farmers is characterized by uncontrolled bush burning, unplanned human interference with the soils and changing land tenure systems (Osemeobo 1988). The need for an extensive agricultural production has increased the total land area dedicated to that sector from 16.5 million ha in 1960 (Agboola 1979) through 21.9 million ha in 1970 (Office of Statistics Nigeria 1972) to 35.3 million ha in 1980. In spite of that, the estimated land requirement for food and cash crops in 1995 is 55.6 million ha (Federal Government of Nigeria 1987). This shows that agricultural production in Nigeria is largely land extensive. By 1995, 56 percent of the land in the country is devoted to agriculture. Before the discovery of oil agriculture has been the foundation of Nigeria's economy providing the means of livelihood for over 70 % of the population and a major source of raw materials for the agro-allied industries and potent source of the much needed foreign exchange. Agricultural sector contributed an average of 57.0% GDP, and generated 64.5% of export earnings (Verter and Becvarova 2016).

However, over the years, the sector has experienced a steady decline in its role and contribution to national growth and development because Nigeria's focus shifted to crude oil exploration. Hence, the rate of increase in food production of 2.5 percent per annum does not keep pace with the annual population growth rate of 2.8 percent per annum (Central Bank of Nigeria 2010) contributing in making Nigeria's domestic food supply far short of the need of the population (Fakiyesi 2001). It contributes an average of 23.5% to GDP, and generated 5.1% of export earnings over the past few years (National Bureau of Statistics, 2016). This condition is worse for consumers, particularly the poor, who cannot afford basic food and bad for farmers (Sasson 2012). The recent launch of the Agriculture Promotion Policy (APP) by the present administration aimed at resolving food production shortages and improving output quality and the Economic Recovery and Growth Plan (ERGP) which prioritizes food security with the aims of achieving self-sufficiency in tomato paste, rice and wheat, by 2017, 2018, and 2019/2020 respectively can potentially expand agriculture in Nigeria. These changing agricultural systems influence local peoples' income levels and possibly the amount of food purchased and the availability of wild edible plants as forest, fallows, and agricultural fields are converted to more intensive agriculture (Padoch and Sunderland 2013).

III. WILD EDIBLE PLANTS

Wild edible plants (WEPs), as defined by the Food and Agriculture Organization (FAO) are "plants that grow spontaneously in self-maintaining populations in natural or semi-natural ecosystems and can exist independently of direct human action" (Heywood 1999). These food systems are defined by environmental, social, economic, and cultural

contexts in which they occur (Kuhnlein 2009). The main features of wild edible plants are:

- ✓ Their use is based on local ecological knowledge and they are locally available (Arenas and Scarpa 2007).
- ✓ Vulnerable populations such as poorer households, women, and children benefit greatly from wild edible plants (Fentahun and Hager 2009).
- ✓ They are a low-input, low-cost option for increasing nutrition and decreasing the need to spend limited cash resources (Jama et al. 2008).
- ✓ They have an "innate resilience to rapid climate change, which is often absent in exotic species" (Fentahun and Hager 2009) and resist water stress more than their cultivated relatives (Addis et al. 2005)
- ✓ They are available during times of drought or famine and contribute to livelihoods (Strauch et al. 2008).

Food security

According to the World Bank, food security is defined as "access by all people at all times to sufficient food for an active, healthy life" (Maxwell and Wiebe 1999). Although, in a simple form, a country is food-secure when most of its population has access to food of adequate quantity and quality compatible with decent existence at all times (Idachaba 2004). At the World Food Summit, the most usually agreed and used definition for food security, agreed upon is as follows: —people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary and food preferences for a healthy and active life" (Pinstrup-Andersen 2009).

These definitions show that food must be available to the people to an extent that will meet some acceptable level of nutritional standards in terms of a calorie, protein and minerals which the body needs; the possession of the means by the people to acquire (i.e. access) and reasonable continuity and consistency in its supply (Davies 2009). If a household has current access to adequate food to meet immediate nutritional demands while depleting the natural capital that would have made available future resources, it cannot be considered food secure (Perrings et al. 2010). Also, some argued that even if food availability is satisfactory, the achievement of human well-being is closely linked to access to broader environmental health such as sanitation, access to clean water and diverse productive ecosystems, hence food security does not always equate to *nutritional* security (Pinstrup-Andersen 2009). According to Semba and Bloem (2001), nutritional security is also dependent on the diverse ecosystem services biodiversity and forests provide which serve to limit infection and disease transmission as a result of the strong cyclical relationships between nutrition and infection.

IV. FOOD SECURITY CHALLENGE IN NIGERIA

Food is useful for maintaining political stability, and insuring peace among people (Helen 2002). However, Africa has more countries with food insecurity challenges than any other continent (FAO 2010), particularly in sub-Saharan Africa where many countries are threatened by food insecurity with food supplies being inadequate to maintain their citizens' per capita consumption (Shala and Stacey 2012).

According to Sanusi et al.(2006), the percentage of food insecure households in Nigeria, was 18% in 1986 and 40% in 2005 and the number of hungry people in the country is over 53 million, which is about 30% of the country's total population of about 160 million (Ayodeji 2010). The Global Food Security Index (GFSI 2017) of the Economist Intelligence Unit ranked Nigeria as the 92th among 113 countries with food affordability, availability and quality. Also, Nigeria records weak scores in the areas of Public expenditure on agricultural research and development, (0.0); Gross domestic product per capita (3.6); Proportion of population under global poverty line (17) and Food consumption as a share of household expenditure (18.4). Most nations have invested in agriculture and its related institutions (Isife and Abert 2009) in an attempt to be food secured. However, in Nigeria, the government had to spend on importation to meet the food requirement of her teeming population due to the inability of the domestic agricultural system to meet up with the increasing demand for food. Food importation, for instance have increased from 19.9% in 2000 to 30.6% and 22.7% in 2011 and 2012 respectively while food export is barely 5.3% of merchandise (World Development Indicator 2016).

In a quest to address food insecurity, related approaches have been developed and modified over times in accordance with the common understanding of the nature of the food problem and the evolution of the global food system (Maxwell and Slater 2003). A broad range of policies have been proposed to reduce the vulnerability of Nigerians to food insecurity. These policies include National Accelerated Food Production Programme (NAFPP), launched in 1972 during Yakubu Gowon's regime; Operation Feed the Nation, launched in 1976 by Murtala/Obasanjo government; River Basin and Rural Development Authorities, established in 1976; Green Revolution Programme, inaugurated in 1980 by Shehu Shagari administration and Ibrahim Babangida's Nigerian Agricultural Land Development Authority (NALDA), established in 1992. Also, some selected policy and legislative frameworks related to wild biodiversity and food security which Nigeria has ratified are as follows:

CONVENTION OF BIOLOGICAL DIVERSITY: "Biodiversity is essential for food security and nutrition and offers key options for sustainable livelihoods. Existing knowledge warrants the sustainable use of biodiversity in food security and nutrition programmes, as a contribution to the achievement of the Millennium Development Goals". <http://www.cbd.int/agro/food-nutrition/>.

UNIVERSAL DECLARATION ON HUMAN RIGHTS ARTICLE 25(1): "Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food" which is a main cross-cutting initiative on biodiversity for food and nutrition. <http://www.un.org/en/documents/udhr/index.shtml>.

MILLENNIUM DEVELOPMENT GOALS 7A: which aims to "Integrate the principles of sustainable development and reverse the loss of environmental resources". Also 1C: "reduce by half, by 2015, the proportion of people who suffer from hunger" which is particularly expected to contribute to achieving the MDGs when connecting biodiversity, food and nutrition issues. <http://www.un.org/millenniumgoals/>.

ROME DECLARATION ON WORLD FOOD SECURITY- 1998 stipulates that "Agricultural production increases need to be achieved while ensuring both productive capacity, sustainable management of natural resources and protection of the environment." <http://www.fao.org/DOCREP/003/W3613E/W3613E00.HTM>

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE (IFPRI) 2020 VISION: "is a world where every person has access to sufficient food to sustain a healthy and productive life, where malnutrition is absent and where food originates from effective, efficient and low-cost food systems that are compatible with the sustainable use of natural resources". <http://www.ifpri.org/book-753/ourwork/program/2020-vision-food-agricultureand-environment>.

The main challenge is that increasing revenues from intensive farming alone will not necessarily lead to reduced hunger or improved nutrition because many people, especially those with limited land, capital, and food market-access, may be unable to move to reliance on markets for suitable and affordable food, and instead continue to rely on access to a diversity of local resources (Powell et al. 2015). Hence, wild edible plants continue to contribute in many ways to local diets (Paumgarten and Shackleton 2011), even though it is often ignored in development efforts, particularly when the contribution is reducing in the face of widespread, rapid land-use changes and related modifications in the access and control over food resources (Shackleton et al. 2015).

This paper outlines agricultural systems and food security in Nigeria. It looks at the contribution of agriculture to food security in Nigeria. Most importantly, it looks at the contributions of wild edible plants to agriculture and food security in the country.

V. IMPORTANT OF WILD FOODS TO AGRICULTURAL SYSTEMS AND FOOD SECURITY IN NIGERIA

According to the Food and Agricultural Organization (FAO 2009), there are about 30,000 plant species around the world that are edible, but of these, only 7,000 are used as human food resources. Forests provide livelihoods and food for some 300 million people in the form of non-timber forest products (NTFPs). Food security and NTFPs in general, are strongly interlinked in rural communities, particularly for the most vulnerable groups (Belcher et al. 2005), even among agricultural communities (Vincetti et al. 2008). In some agricultural communities in African, wild edible plants provide vitamins and minerals to characteristically grain-dominated diets (Ahmed 2006). Wild edible plants can also contribute significantly to micronutrient intakes (Ogle et al.2001), and have been noted particularly, as an important way that households in rural Africa can mitigate their sensitivity to environmental change while also adapting to less favourable conditions (Heywood 1999).

In Nigeria, forests serves as a source of ripe fruits, vegetables, and different types of leaves that can be used as dietary supplements. For instance, the leaves of baobab tree (*Adansonia digitata*) are used in the preparation of soup. The flower is eaten raw, the seed also provide flour which is very rich in vitamin B and protein and can be used as baby food

(Gabeur et al. 2002), while the seeds of *Pakia biglobosa* are used for making delicious sauce in Northern part of the country. Some wild plants that are used as food in Nigeria are listed in table 1 below.

Botanical name	Family name	Common name	Indigenous uses
<i>Adansonia digitata</i>	Bombaceae	Baobab	Fresh leaves and dry leaves powder are used for soup
<i>Annona senegalensis</i>	Annonaceae	Wild custard	Ripe fruits, edible
<i>Ficus sycomorus</i>	Moraceae	Sicamore fig	Leaves use for soup, ripe fruits edible
<i>Naudea latifolia</i>	Rubiaceae	African peach	Ripe fruits, edible
<i>Detarium microcapum</i>	Leguminosea	Dattock	Ripe fruits are edible, seeds are used for soup
<i>Strychnos spinosa</i>	Strychnaceae	Monkey orange	Ripe fruits, edible
<i>Tamarindus indica</i>	Caesalpinioideae	Tamarind	Ripe fruits, edible Fruits/seeds used in preparing porridge or gruel
<i>Vitex doniana</i>	Verbenaceae	Black pulm	Ripe fruits, edible Young immature leaves, edible
<i>Vitellaria paradoxum</i>	Sapotaceae	Sheabutter	Ripe fruits, edible

Table 1: some wild edible plants used in Nigeria: Nodza et al. (2013); Vatieer et al. (2007); Hoet et al. (2007)

Many studies have also found that wild foods are important sources of micronutrients even though their energy-density is generally low (McMichael et al. 2007). Many edible desert plants in the Sahel region are sources of essential fatty acids, iron, zinc and calcium (Glew et al. 1997). Some of the wild edible plants that are commonly consumed in Nigeria are important sources of vitamin C, oil-soluble vitamins, protein and crude fibre (John et al. 2016) and among the plants used by the Fulani in Nigeria, those available during the dry season were found to be more in energy and micronutrient content compared with those from the wet season (Lockett et al. 2000).

Most of today's modern crop species are derived from their wild relatives and it is estimated that products derived from genetic resources (including agriculture, pharmaceuticals etc.) is worth \$500 billion per annum (ten Kate and Laird 1999). In Nigeria, wild species of rice such as *Oryza perennis*, *Oryza longistaminata*, *Oryza punctata* and *Oryza tissenantus* form part of the genetic diversity in the genus *Oryza* (Sarumi et al. 1996). Six species of the edible yams in Nigeria i.e.

Dioscorea alata, *Dioscorea bulbifera*, *Dioscorea cayensis*, *Dioscorea dumentorum*, *Dioscorea esculenta* and *Dioscorea rotundata* occur naturally with each having wild types and significant genetic diversity. However, *Dioscorea cayensis*, *Dioscorea esculenta*, and *Dioscorea rotundata* are the only popularly cultivated species and gained more attention from both the researchers and the farmers (Sarumi et al. 1996).

Considering the contribution of wild edible plants to food security and agriculture they are however, declining in many agricultural landscapes (MEA 2005).

VI. CAUSES OF CHANGE IN WILD EDIBLE PLANTS AVAILABILITY AND USE IN NIGERIA

If the challenge of feeding a growing world population does not focus on sustainable intensification (Royal Society 2009), it will further threaten naturally biodiverse landscapes. According to Food and Agricultural Organization (FAO 2001), the population of Nigeria is expected to increase by more than 50 percent in the coming two decades. During this 20 year period, the rural population is expected to rise by 25 percent and the agricultural component is expected to also grow. Agricultural expansion and other human-related activities such as logging, illegal exploitation, and collection of fuel wood as a result of population pressure have continued to pose serious threats to the country's biodiversity (Federal Government of Nigeria 2001), hence limiting the capacity of ecosystems to sustain food production and maintain the habitat of wild food species (Foley et al. 2005). This increasingly limits the availability and use of wild edible plants to agricultural communities particularly the landless poor and other vulnerable groups (Pretty 2002).

VII. SECURING THE FEATURE OF WILD EDIBLE PLANTS IN NIGERIA

Fundamental to conservation of species and local ecological knowledge is policy support implementation. For instance, support for agroforestry systems have potentially ensured sustainable harvests from indigenous trees species in areas otherwise prone to deforestation (Sileshi et al. 2007). In Nigeria, protection of habitats and species has long been practice by various cultures, through preservation and other distinctive habitats for religious, ceremonial and or hunting purposes (Aminu-Kano and Marguba 2002). The protected-area system approach of biodiversity conservation in Nigeria has categorized areas designated for biodiversity conservation into four: National parks, Game reserve, Forest reserve and sacred groves. Nigeria present network of protected areas include 7 national Parks, 15 game reserves (Usman and Adefalu 2002) and 36 forest reserves which are found in almost every state (Ezealor 2001). Governmental agencies like ministry of environment and National park service in collaboration with non-governmental organizations (NGOs) such as Nigerian conservation foundation, worldwide fund for nature (WWF), and royal society for the protection of birds (RSPB) embarked on various projects to help in the conservation of the nation's biodiversity (Ezealor 2001), with

the ultimate goal of potentially increasing the role of ecosystems to sustain food production and maintain the habitat of wild edible species (Foley et al. 2005) among other reasons of biodiversity conservation. However, biodiversity management strategies in Nigeria are being challenged by poor implementation (Ezealor 2001) among other woes.

Conservation of species and their local knowledge basically requires the translation of policy into action on ground. Hence, wild edible plants resource use in the future will depend on long-term policies that are properly implemented and take into account the needs of user groups in scientific research, development policy, and extension activities (Feyssa et al. 2011).

VIII. CONCLUSION

Wild edible plants constitute a reasonable part of agricultural systems and food security in Nigeria, however, the expansion of agriculture and other related activities continue to undermine this contribution. Our opinion is that the challenge of feeding the population of Nigeria should focus on sustainable intensification (Royal Society 2009) to prevent the loss natural biodiversity hence edible wild plants. According to the Food and Agricultural Organization, wild species and intraspecies biodiversity have key roles in global food security and that nutrition and biodiversity meat at a common place leading to food security and sustainable development (Food and Agricultural Organization 2009). Hence, dietary diversity and related food security would rely on ensuring the prevention of the imminent loss of wild species and important agro-biodiversity through biodiversity-focused food production, public health and poverty alleviation policies (Johns and Sthapit 2004).

ACKNOWLEDGEMENT

We are thankful to Imran Omadefu for commenting on the article.

REFERENCES

- [1] Addis, G., Urga, K. Dikasso, D., (2005). Ethnobotanical study of edible wild plants in some selected districts of Ethiopia. *Human Ecology*, 33(1), 83-118. [Online] Available: <http://dx.doi.org/10.1007/s10745-005-1656-0> (October 12, 2018).
- [2] Aminu-Kano, M. and Marguba, L.B., (2002). History of Conservation in Nigeria. In A.U Ezealor (Ed.), *Critical Sites for Biodiversity Conservation in Nigeria* (pp. 3-11). Nigerian Conservation Foundation, Lagos.
- [3] Agboola, S. (1979). *Agricultural Atlas of Nigeria*.
- [4] Arenas, P., and Scarpa, G. F., (2007). Edible wild plants of the Chorote Indians, Gran Chaco, Argentina. *Botanical Journal of the Linnean Society*, 153(1), 73-85. [Online] Available: <http://dx.doi.org/10.1111/j.1095-8339.2007.00576.x> (November 12, 2018).
- [5] Ahmed, I. (2006). Wildlife as a nutritional source: Priorities for development. *Tanzania Wildlife Journal*, 2(1), 85-95.
- [6] Ayodeji, A. (2010). Concerning food security in Nigeria. *West Africa Insight*. [Online] Available: <http://www.westafricainsight.org/articles/PDF/81> (October 15, 2018).
- [7] Belcher, B., Ruiz-Perez, M. & Achidiawan, R. (2005). Global patterns and trends in the use and management of commercial NTFPs. *World Development*, 33, 1435-1452. [Online] Available: doi:10.1016/j.worlddev.2004.10.007 (1 October 1, 2018).
- [8] Davies, A.E. (2009). "Food Security Initiatives in Nigeria: Prospects and Challenges" Monograph, Department of Political Science, University of Ilorin, Nigeria.
- [9] Delgado, C., Rosegrant, M., Steinfeld, H., Ehui, S. and Courbois, C., (1999). *Livestock to 2020: the next food revolution*. 2020 Vision Discussion paper no. 28. Washington, DC: International Food Policy Research Institute.
- [10] Ezealor A.U. (2001). In L.C.D. Fishpool and M.I. Evans (Ed.), *The Important Bird Areas in Africa and Associated islands: Priority sites for conservation*, (pp. 673-692). Pisces Publications and BirdLife International, Newbury and Cambridge, UK.
- [11] FAO, (2009). *The State of Food Insecurity in the World*, Rome, Italy: Food and Agriculture Organization.
- [12] Feyssa, D. H., Njoka, J., Asfaw, T. Z. and M. M. Nyangito., (2011). Seasonal availability and consumption of wild edible plants in semiarid Ethiopia: implications to food security and climate change adaptation. *Journal of Horticulture and Forestry*, 3(5), 138-149. [Online] Available: <http://www.academicjournals.org/journal/JHF/article-abstract/36F5B971295>. (October 11, 2018).
- [13] Food and Agricultural Organization (2006). "Documenting traditional food systems of indigenous peoples: International case studies – Guidelines for Procedures".
- [14] Federal Government of Nigeria. (2010). *Fourth National Biodiversity Report*.
- [15] Federal Office of Statistics Nigeria. (1972). *Results of Crop Estimation Survey 1968-1971: Rural Economic Survey of Nigeria*.
- [16] Food and Agricultural Organization (2009). *The state of food insecurity in the world*. Rome, Italy: FAO.
- [17] Food and Agricultural organization (2010). *The state of food insecurity in the world*. FAO Report. Rome.
- [18] Federal Government of Nigeria. (1987). *Agricultural Policy for Nigeria: Strategies for Implementation*.
- [19] Food and Agricultural Organization (2001). *Farming system and poverty: improving farmers livelihoods in a challenging world*. FAO, Rome, Italy.
- [20] Foley, J. A. et al., (2005). Global consequences of land use. *Science*, 309, 570-574. [Online] Available: (doi:10.1126/science.1111772). (September 11, 2018).
- [21] Federal Government of Nigeria. (2001). *First National Biodiversity Report*.
- [22] Fentahun, M. T., and H. Hager., (2009). Exploiting locally available resources for food and nutritional

- security enhancement: wild fruits diversity, potential and state of exploitation in the Amhara region of Ethiopia. *Food Security*, 1(2), 207-219. [Online] Available: <http://dx.doi.org/10.1007/s12571-009-0017-z> (September 28 2018).
- [23] Global Food Security Index of the Economist Intelligence Unit (2017). Measuring food security and the impact of resource risks. [Online] Available: URL:<http://www.foodsecurityindex.eiu.com/Resources> (August 28, 2018).
- [24] Gebaur, K., El-Saddiq and Ebert, G. (2002). Baobab (*Adansonia digitata*): A review on Multipurpose Tree with promising Future in the Sudan. [Online] Available: <http://www.Gartebauwissenschaft.org>. (September 20, 2018).
- [25] Hall, D. (2011). Land grabs, land control, and southeast Asia crops booms. *Journal of Peasant Studies*, 38(4), 837-857.
- [26] Heywood, V. (1999). Use and potential of wild plants in farm households. FAO Farm Systems Management Series. Food and Agriculture Organization, Rome, Italy. [Online] Available: URL: <http://www.fao.org/docrep/003/w8801e/w8801e00.htm>. [August 20, 2018].
- [27] Hoet, S., Pieters, L, and Muccioli, G.G. (2007). "Antitripanosomal activity of triterpenoids and sterols from the leaves of *Strychnos spynosa* and related compounds". *Journal of Natural Products*, 70, 1360-1363.
- [28] Helen, H. J. (2002): Food Insecurity and the food stamp Programme. *American Journal of Agricultural Economics*, 84, (5), 1215 – 1218.
- [29] Idachaba, F.S. (2009). "The Looming Food Crisis", Newswatch, Lagos, Special Colloquium Edition.
- [30] Isife, B.I and Abert, C.O. (2009). Issues in developing a natural policy on agricultural extension services in Nigeria: The perception of extension professionals. *Agric Journal*, 4, 22-26.
- [31] John, O.J., Abdullahi, M., Olarenwaju, I.A., and Mohammed, M.N. (2016). Nutritional Composition of Selected Wild Fruits from Minna Area of Niger State, Nigeria. *International Journal of Nutrition and Food Engineering*, 10 (1), 37-42.
- [32] Johns, T. and Sthapit, B. R. (2004) Biocultural diversity in the sustainability of developing-country food systems. *Food Nutrition Bulletin*, 25, 143–155.
- [33] Jama, B. A., Mohamed, A. M., Mulatya, J. and Njui, A. N. (2008). Comparing the "big five": a framework for the sustainable management of indigenous fruit trees in the drylands of East and Central Africa. *Ecological Indicators*, 8(2), 170-179. [Online] Available: <http://dx.doi.org/10.1016/j.ecolind.2006.11.009> (November 20, 2018).
- [34] Kuhnlein, H. V., and Receveur, O. (1996). Dietary change and traditional food systems of indigenous peoples. *Annual Review of Nutrition*, 16, 417–442.
- [35] Kuhnlein, H. V. (2009). Introduction: In H. V. Kuhnlein, B. Erasmus, and D. Spigelski (Ed.), *Why are indigenous peoples' food systems important and why do they need documentation? Indigenous peoples' food systems: The many dimensions of culture, diversity and environment for nutrition and health*, (pp. 1-8). Rome and Montreal: Food and Agriculture Organization of the United Nations and the Center for Indigenous Peoples' Nutrition and Environment.
- [36] Maxwell, D. and Wiebe, K. (1999). Land tenure and food security: exploring dynamic linkages. *Development and Change*, 30, 825–849.
- [37] Maxwell, S., and Slater, R. (2003). Food Policy Old and New. *Development Policy Review*, 21 (6), 531–553.
- [38] Millenium Assessment (MEA) (2005). Current state and trends. Washington, DC.
- [39] McMichael, A. J., Powles, J. W., Butler, C. D. and Uauy, R. (2007). Food, livestock production, energy, climate change, and health. *The Lancet*, 370, pp.1253–1263. [Online] Available: doi:10.1016/S0140-6736(07)61256-2 (November 28, 2018).
- [40] Nodza, I.G., Abdulhammed, A., and Abdullahi, M.B. (2013). A Checklist and Ethnobotanical Assessment of Trees Species of Abubakar Tafawa Balewa University, Yelwa Campus Bauchi, Nigeria. *International Journal of Botany*, 9(2), pp.55-63. [Online] Available at: DOI:10.3923/ijb.2013.55.63 (November 30, 2018).
- [41] National Bureau of Statistics (2016) Quarter 4 GDP Report. [Online] Available: <http://www.nigerianstat.gov.ng/report/518/> (September 28, 2018).
- [42] National Agricultural Research Project (1994). National agricultural research strategy plan: Draft report on North West Zone. Ibadan, Nigeria: NARP Press.
- [43] Ogle, B., Hung, P., and Tuyet, H. (2001). Significance of wild vegetables in micronutrient intakes of women in Vietnam: An analysis of food variety. *Asia Pacific Journal of Clinical Nutrition*, 10 (1), 21–30.
- [44] Osemeobo, G. (1988). The Human Causes of Forest Depletion in Nigeria. *Environmental Conservation*, 24, 120-121.
- [45] Padoch, C., and Sunderland, T., (2013). Managing landscapes for greater food security and improved livelihoods. *Unasylva*, 214 (64), 3–13.
- [46] Pretty, J. (2002). *Agric-Culture*. London, UK: Earthscan.
- [47] Pinstrup-Andersen, P. (2006). Agricultural research and policy to achieve nutrition goals. *Poverty, Inequality and Development*, 1, 353–370.
- [48] Perrings, C., Jackson, L., Bawa, K., Brussard, L., Brush, S., Gavin, T., Papa, R., Pascual, U. and De Ruiter, P. (2010). Biodiversity in agricultural landscapes: saving natural capital without losing interest. *Conservation Biology*, 20, 263–264.
- [49] Pinstrup-Andersen, P. (2009). Agricultural research and policy to achieve nutrition goals. *Poverty, Inequality and Development*, 1, 353–370.
- [50] Powell, B., Thilsted, S., Ickowitz, A., Termote, C., Sunderland, T., Herforth, A., (2015). Improving diets with wild and cultivated biodiversity from across the landscape. *Food Security*. 7 (3), 535–554.
- [51] Paumgarten, F., Shackleton, C.M., (2011). The role of non-timber forest products in household coping strategies in South Africa: the influence of household wealth and gender. *Population and Environment*, 33 (1), 108–131.
- [52] Royal Society. (2009). *Reaping the benefits*. London, UK: Royal Society.

- [53] Rosegrant, M. W. and Clein, S. A. (2003). Global food security: challenges and policies. *Science*, 302, 1917–1919. [Online] Available: doi:10.1126/science.1092958 (October 5, 2018).
- [54] Strauch, A. M., Muller, J. M. and Almedom, A. M. (2008). Exploring the dynamics of social-ecological resilience in East and West Africa: preliminary evidence from Tanzania and Niger. *African Health Sciences*, 8(3), 528-525.
- [55] Semba, R.D. and Bloem, M.W. (2001). *Nutrition and Health in Developing Countries*. Humana Press. New York.
- [56] Sarumi, M.B., Ladipo, D.O., Denton, L., Olapade, E.O., Badaru, K. and Ughasaro, C. (1996). Report of Nigeria's Plant Genetic Resources to the Food and Agricultural Organization (FAO) International Conference. [Online] Available: <http://www.fao.org/fileadmin/templates/agphome/documents/PGRSoW1...NIGERIA.pdf> (September 12, 2018).
- [57] Sanusi, R.A., Badejo, C.A., and Yusuf, B.O. (2006). Measuring Household Food Insecurity in Selected Local Government Areas of Lagos and Ibadan, Nigeria. *Pakistan Journal of Nutrition*, 5 (1), 62-67.
- [58] Shackleton, C.M., Hamer, N., Swallow, B., Ncube, K., (2015). Addressing local level food insecurity amongst small-holder communities in transition. Policy Brief 12–2015. Department of Environmental Science, Rhodes University. [Online] Available: <http://www.ru.ac.za/media/rhodesuniversity/content/environmentalscience/documents/Policy%20Brief%2012.pdf>. (September 29, 2018).
- [59] Shala and Stacey, (2012): United States Department of Agriculture: Economic Research Service. Food Security Assessment, Regional Overview Information Bulletin.
- [60] Toledo, A. and Burlingame, B. (2006). Biodiversity and nutrition; a common path toward global food security and sustainable development. *Journal of Food Composition and Analysis*, 19, 477–483.
- [61] Ten Kate, K. and Laird, S.A. (1999). *The commercial use of biodiversity* Earthscan, London.
- [62] Thrupp, L.A. (2000). Linking agricultural biodiversity and food security: the valuable role of agrobiodiversity for sustainable agriculture. *International Affairs*, 76, 265–281.
- [63] Usman, B. A. and Adefalu, L. L. (2010). “Nigerian forestry, wildlife and protected areas: Status report”. *Tropical Conservancy Biodiversity*, 11(3), 44-52.
- [64] Verter, N., and V. Becvarova, (2016) “The Impact of Agricultural Exports on Economic Growth in Nigeria” [Online] Available: https://acta.mendelu.cz/media/pdf/actaun_2016064020691.pdf (10 December 10, 2017).
- [65] Vincetti, B., Eyzaguirre, P. and Johns, T. (2008). The nutritional role of forest plant foods for rural communities, pp. 63–96 in *Human health and forests: a global overview of issues practice and policy*, edited by C. J. P. Coler. London, UK: Earthscan
- [66] Vautier, H., Sanon, M. and Sacande, M. (2007). “Detarium microcarpum” Guill. & Perr. Seed leaflet 122, Forest and Landscape Denmark.
- [67] World Development Indicator, Various Years (2016). [Online] Available: www.knoema.com (12 December 12, 2018).