


Review

Land Use, Environmental, and Food Consumption Patterns in Sub-Saharan Africa, 2000–2015: A Review

Jeffrey Chiwukem Chiaka ^{1,2}  and Lin Zhen ^{1,2,*}

¹ Key Laboratory for Resources Use and Environmental Remediation, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing 100101, China; cjchiwukem2019@igsnr.ac.cn

² College of Resources and Environment, University of Chinese Academy of Sciences, Beijing 100049, China

* Correspondence: zhenl@igsnr.ac.cn

Abstract: Sub-Saharan Africa (SSA) land use changes are primarily influenced by agriculture and its population. The region faces various challenges ranging from rainfall variabilities to poverty and insecurities, which further hampered food supply and production. The spatial analysis identified six land uses—agriculture, forest, grassland, wetland, urban, and others (i.e., bare land, water, and sparse vegetation), showing relative percentage changes. Additionally, information collected and analyzed shows that the Millennium Development Goals period witnessed increased agricultural land use changes in the environment to improve food supply, and farmers adopted local methods and native experiences to mitigate environmental particularities facing the region. Farmers' landholdings are fragmented, and food supply per capita is low albeit rich in calories, and nutrition is still unbalanced, while bushmeat consumption is popular and serves as an alternative to animal-sourced protein. Concerted efforts should be made to improve food security and edge closer to the sustainable development goal during this decade.

Keywords: food supply; population; land use and land cover changes; poverty; MDG/SDG; sub-Saharan Africa



Citation: Chiaka, J.C.; Zhen, L. Land Use, Environmental, and Food Consumption Patterns in Sub-Saharan Africa, 2000–2015: A Review. *Sustainability* **2021**, *13*, 8200. <https://doi.org/10.3390/su13158200>

Academic Editor: Mohammad Valipour

Received: 15 June 2021
Accepted: 16 July 2021
Published: 22 July 2021

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Africa relies on agriculture for sustenance, which is the largest employer of labor mostly of its rural population, contributing to the gross domestic product of most countries in the region as well as, the extractive industry [1]. The expansion of land for agriculture has been ongoing in sub-Saharan Africa, and which became expedient due to population growth, per capita income, and food demand [2,3]. There is no gainsaying that the unsustainable manner of farming practice and land uses contributed to the environmental degradation as the luxuriant land cover of Africa's landscape has shown changes over the years due to anthropogenic activities in the bid of exploring its ecosystem for food and nonfood products [4]. Africa is estimated to have 52% of the world's remaining arable lands, and they are not evenly distributed among countries in the region [5]. A further breakdown shows 1% of Africa's rural land area contains 21% of its rural population, while 20% of its rural lands contain 82% of its rural people [5]. Therefore, dwellers in its densely populated rural areas compete for arable land for farming, thereby exerting pressures on the environment.

Researchers have attributed agricultural activities to be the leading causes of loss of biodiversity and natural vegetation [6]. For instance, the northwestern foothills area of Mount Kenya has witnessed an agricultural expansion and land use intensification triggered by population growth, and encroachment on protected areas and natural habitats, thereby exerting pressure on aquifers for irrigation [7]. Ethiopian landscapes are changing as a result of population, agricultural expansion, government land policy, and overgrazing [8]; as an another example, the Otamiri river watershed in Owerri, southeast Nigeria,

which is an urban watershed, faces intense land use conversion into built-up areas due to an increase in population density [9]. Furthermore, the nomadic system of livestock rearing has encouraged overgrazing from pastoralists on grasslands in most parts of Africa, which studies have observed are concomitant to the depletion of soil nutrients as it aids erosion [10], and this pastoral system also brings about communal clashes between farmers and herders due to destruction of their farmlands by these herders' flock.

The United Nations declared the millennium development goals initiative as “the most successful anti-poverty movement in history” as there was a reduction in the people living with less than USD 1.25 in sub-Saharan Africa from 57% to 41% and a decline of 1.9 billion people living in poverty to 800 million worldwide [11]. To further build on the achievements recorded in the MDGs, the United Nations sustainable development framework was launched in 2015 and member nations unanimously agreed on the theme “Leaving No One Behind” as more attention is focused on sub-Saharan Africa (SSA) to consolidate and improve on previous achievements. In the area of food security, Africa's contribution to the global agricultural output is about 10% [12] despite having abundant arable lands [13], and there is low accessibility to food as most people live below the international poverty line [1,14,15], and classified as low-income earners by the World Bank with few exceptions such as Angola, Gabon, South Africa, and Namibia [16], leaving experts concerned as the population continues to increase in the face of low food production. However, many countries have made considerable efforts to meet the MDG targets, especially those related to hunger and poverty reduction. These achievements are reflected in the 2015 Global Hunger Index, which shows that most SSA countries registered improvements in the reduction of their hunger index (see Appendix A).

Sub-Saharan Africa has natural vegetation ranging from tropical humid forests, dry forests, and savannah in the West African region [17] to the second-largest rainforest in the world located in the Central African region. Aside from the abundant arable lands, forests, and wildlife, SSA has 8% of the world's natural gas, 12% of the world's oil reserves, and 30% of the world's mineral reserves—the largest reserves of cobalt, diamonds, platinum, and uranium in the world [18]. In terms of socioeconomic indices, sub-Saharan Africa's GDP per capita ranges from USD 275 to USD 8030 (as of 2015), the literacy level of 22–89%, and a median age of 16.4 to 26.1 years, making SSA a growing young population with economic potentials (see Appendix A).

Studies on food consumption observed staple foods are common among developing countries. For instance, cassava, maize, wheat, and rice are very popular staple foods in sub-Saharan African countries [1,19–21], while developed countries such as the USA, United Kingdom, Australia, Spain, Mexico, etc., consume fewer staple foods and are changing consumption patterns to more meat, processed foods, and dairy products [20,22–24]. These observable changes in food consumption patterns, according to research, are influenced by increasing population, income per capita, lifestyle/preference, urbanization, economic development, etc., [20,25–33], which place a significant demand on land resources [32] to accommodate the diverse food consumption patterns.

Therefore, this review contributes to the global discourse on food supply, especially in sub-Saharan Africa, by considering agricultural land use, climate impact on the environment, and food consumption patterns in sub-Saharan Africa during the 2000–2015 period of the MDGs; taking into account the particularities facing the region, the study suggests strategies to meet one of the key objectives of the SDG framework for sub-Saharan Africa, which is the zero hunger policy during the decade 2020–2030.

2. Methodology

This paper presents an overview of the extent of land use changes in the environment and food supply from food consumption patterns in SSA during the MDG period (2000–2015). We identified relevant papers for our review by using the Web of Science, Science Direct, and Google Scholar to search for peer-reviewed papers. The search was based on keyword search (food supply, population, land use and land cover changes,

poverty, MDG, sub-Saharan Africa), and papers were reviewed by reading the introduction and conclusion, and finally, critical evaluation of the selected article.

Remotely sensed data from the European Space Agency Climate Change Initiative 300 m land cover were utilized to define the land use types of sub-Saharan Africa, and percentage changes for the years 2000, 2010, and 2015 were analyzed using ArcGIS 10.6 software. (ESA Land Cover CCI Product, available at: maps.elie.ucl.ac.be/CCI/viewer/download/ESACCI-LC-Ph2-PUGv2_2.0.pdf, accessed on 27 January 2021).

Socioeconomic data were collated from the Human Development Index of the United Nations Development Program (UNDP), and the Global Hunger Index data of the International Food Policy Research Institute (IFPRI) was assessed as a tool to measure and track hunger at the country level. National reports on SSA countries aided our review. To analyze the food supply available in our region of interest, statistical data from the Food and Agricultural Organization (FAO) food balance sheets were utilized (available at <http://www.fao.org/faostat/en/#data/FBSH>, accessed on 27 January 2021). Food groups under consideration were cereals, starchy roots, pulses, meats, fish and seafood, and fruits and vegetables, which research has observed are consumed in developing regions [1,19–21]. Based on the availability of references and paucity of data, this study reviewed 45 SSA countries socioeconomic indices, and 13 representative countries (Ghana, South Africa, Mali, Cote d'Ivoire, Kenya, Angola, Malawi, Zimbabwe, Rwanda, Lesotho, Senegal, Nigeria, Ethiopia, and Tanzania) were selected to analyze their food supply from food consumption patterns in the period under review. Additionally, the selected countries represent a cross section of the varying conditions in sub-Saharan Africa.

3. Results

3.1. Land Use and Land Cover Changes in Sub-Saharan Africa

Sub-Saharan Africa is engaged in agriculture as a major means of sustenance, and most of the farmers fall below the low-income quantile or are considered poor because of the subsistence nature of their agricultural practice. They are mostly semiskilled or unskilled to adopt new modern-day farming such as mechanization and appropriate fertilizer application to boost production. Therefore, they rely entirely on the environment for food and income by engaging in intensive farming, unknowingly degrading the environment and undermining life on land and water. For instance, population increase and an influx of migrants in southern Burkina Faso led to more conversion of forest land covers to croplands [34]; the cropland area in northeastern Kita in Mali increased from 8500 ha in 1976 to 25,000 ha in 2003 and due to their intensification of farming, the fallow periods have reduced [35]. Furthermore, the Binah River watershed that serves Togo and Benin has undergone land cover changes since the 1970s. Their exigency for food and fuelwood for energy affected the decrease in the vegetative cover of the Binah River watershed, in addition to population growth and increased settlements in the area [36].

The farming practice on the watershed includes are subsistence in nature, using the old tradition of slash and burn system, livestock farming, and cultivation of cash crops. This resulted in increased conversion of savannah and forest to agricultural lands from 1972 to 2013 [36]. In Ekiti State southwestern Nigeria, the declining rate of its forest was found to be due to increasing agriculture, artisan mining, migration, and urbanization [37–39]. Additionally, the Otamiri river watershed in Owerri, southeast Nigeria, which is an urban watershed, faced intense land use conversion to built-up areas due to an increase in population density [9]. About 70% of Ghana's lands are engaged in agriculture where cash crops are cultivated, and large-scale commercial farming practices are undertaken by foreign and national biofuels companies, cultivating crops such as jatropha and sunflowers, which are exported [40], and according to Ghana's 2015 MDG report, mining activities deprived productive lands for cultivation. Another reason for the intensive cultivation of farmland in SSA is due to the limited potential availability of farmlands [41], and farmers make up the large rural population; hence, available farmlands are further fragmented, and cultivation is intensified to meet food demand.

In the Central African subregion, commercial plantations, logging, mining, and subsistence agriculture altered the land cover of the Democratic Republic of Congo [42]. Mining, provides a means of livelihood in DRC especially the local gold mining which is termed informal as its exported oftentimes without due process [43]. Additionally, logging has a huge market value in the subregion as USD 995 million was generated from its exports of primary wood products from the Republic of Congo, Gabon, Cameroon, Central African Republic, and DR Congo in 2003 [44].

The countries within the Greater Horn of Africa that constitute East Africa are Djibouti, Eritrea, Ethiopia, Kenya, Somalia, Sudan, and Uganda, which have experienced land cover changes due to population growth, shifting cultivation, and pastoralism [4,45]. The Intergovernmental Authority on Development in Eastern Africa (IGAD) survey on the land use and land cover of the region with the aid of satellite imagery from 1990 to 2010 observed extensive cropland in Ethiopia, Sudan, Kenya, and Uganda, where the River Nile played a role for irrigation purposes, while minor agricultural activities were identified in Somalia, Djibouti, and Eritrea [45]. In Djibouti, most lands are used for pasture, while some smaller areas are used for vegetables and fruits. Similar to Djibouti, agricultural land covers 74% of the total land area in Eritrea, largely for grazing. Eritreans cultivate sesame seed, sorghum, roots and tubers, pulses, oilseeds, and vegetables [46]. Sudan also uses most of its lands for pasture leaving out a small percentage for planting sorghum, groundnuts, cereals, vegetables, and fruits while adopting the traditional rain-fed system of farming. Somalia has many pastoralists concentrated in the north and central areas of the country, while the people living in the south engage in mixed farming [46]. The land use and land cover types in Mt. Elgon forest in Kenya from Landsat imagery are classified as mixed farming, natural forests, fallow land, tea plantation. The natural forest, other types of forest cover have declined and there was an increase in mixed farming areas between 1973 and 2019 [47].

The land uses in southern Zambia and southwestern Zimbabwe of the southern Africa subregion are livestock breeding and subsistence agriculture. Its location in the semi-arid zone led to the use of shallow wells and small dams for irrigation [48]. In South Africa, most lands are used for pasture, rangelands due to the unsuitability of most croplands for crop production [49]. The land cover of Namibia from 2000 to 2010 showed logging activities have reduced forested areas as the country consumes around 1.8 million hectares of wood every year, mostly used for construction and fuelwood, while croplands increased due to shifting cultivation [50]. Therefore, as the population increases, it is necessary to ensure food security [51], with sustainable consumption and production.

3.2. The Climate and Environmental Conditions in Sub-Saharan Africa

Droughts, rainfall variability, and rising temperature are Africa's challenges in food production as agrarian communities risk starvation if rain fails [52]. This is because the agricultural system is rainfall dependent, leading to low yield when encountered with rainfall variability and sensitive temperature. The Intergovernmental Panel on Climate Change (IPCC) model used by researchers has shown yield losses due to these challenges in southern Africa (18%) and a combined 22% across countries in the sub-Saharan Africa region [52,53].

The land use changes make the environment vulnerable to climate change and influence low soil fertility [54]. However, sub-Saharan African farmers adopted ways of mitigating against rainfall variability by relying on years of farming experience, local knowledge, and traditional methods passed down from generations even though their approach is becoming obsolete [55]. Most communities from northern Burkina Faso complained of fluctuating rainfall affecting crop growth [56] and small-scale farmers in the Tougou community in northern Burkina Faso use native methods to mitigate rainfall variability and poor soil properties by increased use of organic manure called the "Zai technique" to improve the soil humidity and fertility, while others use stone bounds to stop surface runoffs and reduce erosion on their farms. Other local methods include the "half-moon"

technique, which is performed by digging large holes to let runoffs accumulate and crops are planted [56]. The idea of corralling became popular among farmers who lack access to fertilizers as they benefit from its droppings. Farmers now prefer keeping their livestock on their farms during dry seasons instead of an enclosure as their droppings will serve as manure and increase soil fertility before planting season [56]. In southeast Angola, the effect of rainfall variability and low soil fertility affected food productivity. To overcome this challenge, the farmers practiced shifting cultivation as they have little or no access to better soil conservation methods [57]. The Kebribeyah district in the Somali region of Ethiopia, in the past, was known for its pastoralism. However, due to climate changes and population pressure, the herders have adopted agropastoralism as a means of sustenance to cope with the harshness of drought [58]. Excessive logging of trees and the use of fossil fuels to cook in SSA are some of the anthropogenic activities contributing to climate change. In Ghana, to reduce GHG emissions, largely from cooking since most homes do not have access to clean cooking energy, initiated the cultivation of *Jatropha* in 2005 to be used as biofuels [59]. This initiative provided a means of income for farmers engaged in *Jatropha* planting because the seeds are sold to biofuel companies.

Government intervention and support alleviated the environmental conditions encountered by farmers. For instance, the Ghanaian government initiated a food security and emergency preparedness program of fertilizer subsidies, established an effective early warning system, and promoted modernized agriculture; nearly 30% of small-scale farmers in Ghana are now able to irrigate their farms [60]. Additionally, the Kenyan government and Japan built a concrete dam in 2008–2011 in Marsabit County to alleviate the water crisis of the county for their use and livestock during drought [61] since before this time, farmers used the alternative of harvesting flood flows.

3.3. Scenario of Food Supply from Food Consumption Patterns in Sub-Saharan Africa and Impacts in Changing Food Consumption Patterns

There are reported improvements in calorie consumption per capita in sub-Saharan Africa from 2194 kcal per capita in 2000 to 2420 kcal per capita in 2015, albeit low compared to the rest of the world [62]. According to the average dietary energy requirement (ADER), which differentiates countries with sufficient food consumption, a country with a dietary food supply of less than 2000 kcal/cap/day has a critically low supply, between 2000–2500 kcal/cap/day is termed as low supply, an average supply ranges from 2500–3000 kcal/cap/day and a high supply is over 3000 kcal/cap/day [62]. However, from our analysis, SSA have low food supply per capita per year (kg) when compared with its population and the 13 countries assessed further proves insufficiency in their food supply per capita (see Figures 1 and 2). To analyze the food supply per capita, we provide an overview of the scenarios within the 13 countries representing SSA from the MDG period (2000–2015).

Ghana was the first country to meet the MDG of poverty reduction by 50% in SSA. The 2015 GDP per capita of Ghana and South Africa shows that more households have moved up to the middle-income category, and purchasing power has improved; therefore, people can afford diversified foods.

Ghana's major food consumptions are maize, rice, yam, cassava, etc., and they harnessed the potential of being geographically positioned along the coastal region to consume more fish and seafood [63]. Additionally, an estimated 60% of rural households in South Africa consume bushmeat as an alternative source of protein [64], while starchy staple also supplies energy needs and their food is becoming westernized [65].

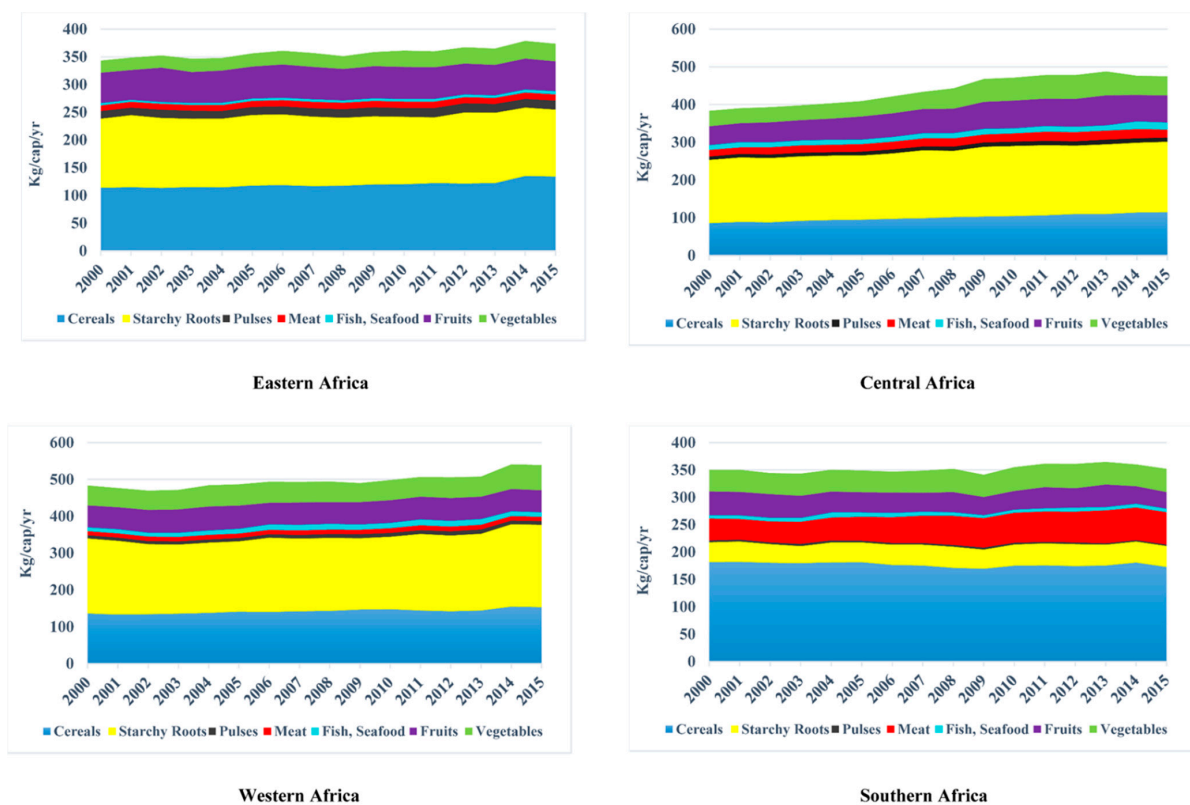


Figure 1. Food supply per capita per year in sub-Saharan Africa regions (2000–2015).

Ghana and South Africa HDI ranks them as upper-middle-income countries, and their citizens also consume higher-value food items.

Mali's calorie gains were made possible by the government investment in irrigation schemes to boost cereals production, especially rice, which contributes to 80% of their caloric needs, and being located in the Sahel region, which is suitable for cattle rearing may have contributed to an increase in meat consumption [66].

Côte d'Ivoire is known as primarily a food exporting country. The north cultivates more of the food crops, while the southern forest region cultivates cash crops [67]. During the civil conflict of 2002, food supply was truncated and as a coping strategy, the south engaged in crop diversification to achieve self-sufficiency [67].

Foods consumed in the country are rice, maize, yam, plantain, and millet [68], and the country's GHI score showed a decline from 31.4 in 2000 to 26.3 in 2015.

Cereals consumption is very common in most Kenyan households including beans, vegetables, cassava, and potatoes. However, due to erratic weather conditions that affect crop productivity, the Kenyan government endeavor to subsidize staple food consumption for the poorer population [69].

Angola has shown perseverance and determination after the civil war ended in 2002, which affected their food security. During the post-civil war, many feared engaging in farming due to landmines [70]. The government has made tremendous efforts in steering the country back to the path of agriculture, which has resulted in a 19.3%, 27.2%, 3.1%, 9.7%, and 22.7% increase in the production of cereals, pulses, oilseeds, roots and tubers, and vegetables and fruits, respectively, in the 2011 agricultural season, according to the FAO in Angola Country Programming Framework.

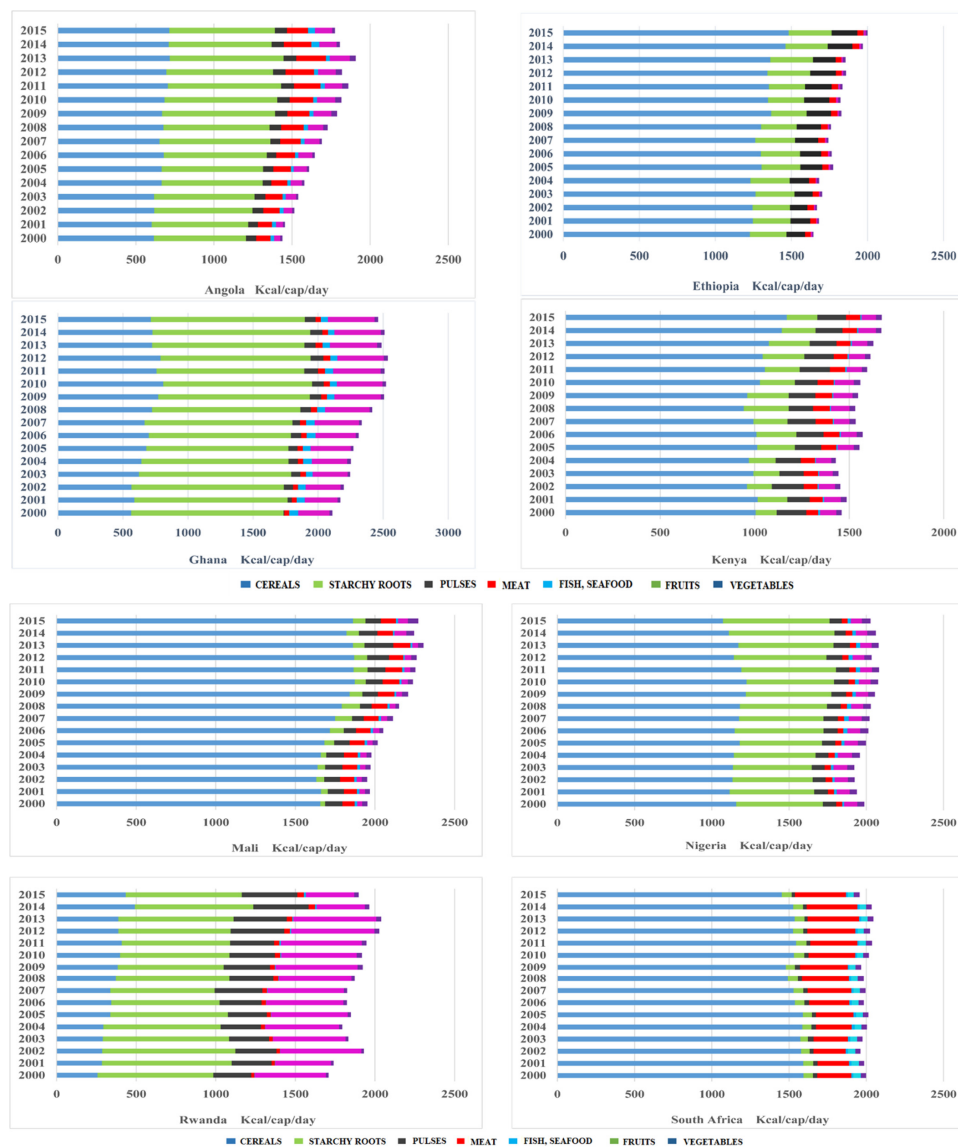


Figure 2. Food supply of eight selected SSA countries (kcal/capita/day).

Malawi was ranked the third poorest country in the world in 2010 but was able to improve food security and reduce poverty by the introduction of the Farm Input Subsidy Program (FISP) [71], which increased their GDP in agriculture. The subsidy boosted maize production as it became the new source of dietary energy.

The Zimbabwean government instituted a land reform program in 2002 to reallocate lands from foreigners so the locals can have more access to farming. This land policy failed to give the desired results as local farmers lacked farm inputs, which plunged the country deep into a food crisis [72]. The country known for food exports became dependent on humanitarian and food aids from the international community, and political tension contributed to destabilizing food security [72]. However, the sale of mineral resources aided in restoring the rising food insecurity in 2009 [72].

Rwanda is a landlocked country that made economic progress after the 1994 genocide [73]. The country has 1.78 million ha of arable lands and an average landholding per person of 0.6 ha [74]. This limited arable land for agriculture poses a challenge to the idea of agriculture extensification.

Rwanda has over 80% of its citizens' food secured, and they scored a 6.1/10 implementation score on the Maputo declaration minimum requirements of 3.9 [75]. Rwandese consume staples and vegetables, with intermittent consumption of meat, fruits, and milk.

Most of the foods consumed are produced within the country, and they still import cereals from other countries [74].

Lesotho is faced with low food productivity, and aside from the effects of rainfall variability and droughts, arable lands are limited. Most parts of the country are mountainous; hence, the country is not food self-sufficient and relies on imports [76]. GHI score was 32.7 in 2000 and reduced to 23.5 in 2015.

Senegalese diet quality and average protein supply are low, compared to other countries in sub-Saharan Africa, which indicates the country's state of food insecurity [77]. The reason for poor food access in most parts of the country is due to the highly volatile nature of the areas to conflict, which hampers agricultural activities, and they also depend on food imports to meet up food demands [77]. However, traditional diets rice, bread, fruits, and vegetables are commonly consumed in the country [78].

Nigeria is a huge importer of rice [79] and other food types such as fish, meat, fruits, and vegetables constitute the lowest percentages of food items consumed. An estimated 53% of its population lives below the international poverty line per day [80]; hence, more individuals lack the financial capacity to assess diversified food options. This is a plausible reason why many households may suffer from malnutrition and food insecurity [81].

Ethiopia has the largest population in East Africa and the second-largest in Africa after Nigeria. The Ethiopian Government leased about one million hectares of land for agricultural investments from 2005 to 2012 to encourage food production.

This strategy by the Ethiopian government was as part of their five-year growth and transformation plan to be a food secure and middle-income country by 2025 [82]. Ethiopians calories consumption is more from cereals and dairy products; meat consumption is low [83] due to drought that causes an increased mortality rate of livestock [1].

Some regions in Tanzania have poor access to food, as less than 50% of the population live below the poverty line [84], which further influenced their consumption pattern due to the inability to afford diversified foods because of food prices [85]. However, to mitigate against this shock and sustain access to food, the people had home gardens to support their food consumption [85]. Cereals, roots, tubers, and plantain are popular foods.

3.4. Impact of Food Consumption Patterns on Land, Water, and Nutritional Health

The environmental impact of increasing demand for animal-sourced protein leads to increased GHG emissions, and for meat production to be available all year round, more lands are required [86], which may not be readily available for most countries. For brevity, Europe uses two-thirds of its total agricultural area for livestock production [87].

In the case of water resources, beef production consumes about one-third of the total water footprint of agriculture [88], and irrigation schemes impact underground water availability. Malian and Egyptian governments' investment in irrigation schemes to boost cereals production [66,89] are good examples of agricultural projects that pose a risk to water resources and food safety. Additionally, the shift in diets to more processed and sugary foods has occasioned the rise in sugar factories and plantations, which can result in environmental pollution. For instance, Zambia Sugar Limited in Mazabuka irrigates its sugarcane plantation from Kafue River, which is gradually been depleted, and the byproduct of the sugarcane production of ethanol known as Vinasse often finds its way into the river channels, streams, and soils, hence polluting the water and posing danger to aquatic life and the soil [90].

Nutritionally, changes in food consumption patterns within similar food groups, such as rice to wheat or maize to cassava will only amount to calorie gains and lack essential micronutrients for bodily functions, and such consumption patterns are prevalent in SSA. Alternatively, African countries consume bushmeat as a source of animal protein. However, it has been estimated that three-quarters of emerging infectious diseases in humans are caused by zoonotic pathogens from bushmeat consumption [91].

4. Discussion

This study has shown that agriculture and population contributed to SSA land use changes. In addition, rainfall variabilities, poverty, low diet diversity, and conflicts posed a great challenge to food security, sustainable environment, and curbing malnutrition burden in the region. As an agrarian region with a high percentage of farmers from the populated rural extraction, SSA experienced fragmentation of potential, available farmlands, and food production are suboptimal due to the lack of farm inputs and obsolete farming methods. Therefore, farmers continue to expand farmlands to ensure food production. As shown in Figure 3, cropland expansion had a relative percentage change of 1.45% in 10 years (2000–2010) and 1.25% in 5 years (2010–2015). The land use/land cover map shows that untapped lands for expansion are available.

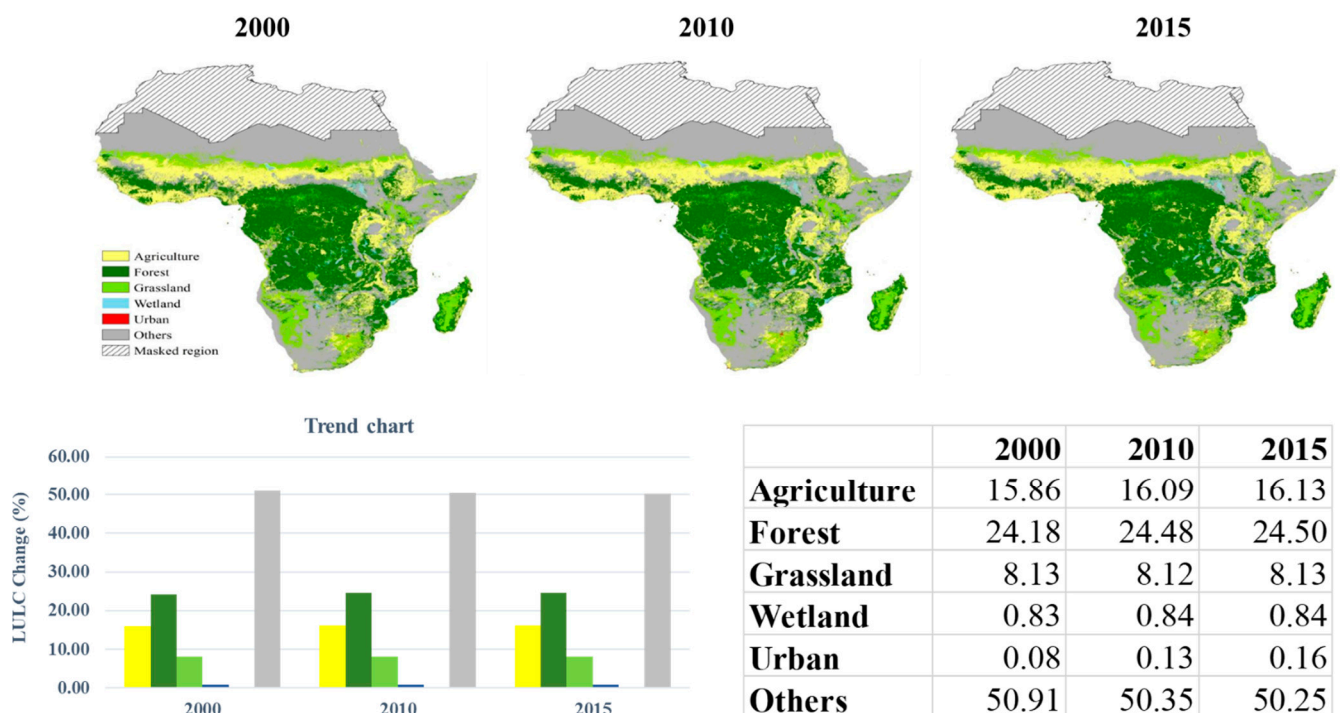


Figure 3. ESA CCI Land use and land cover classification map of sub-Saharan Africa and percentage change (2000, 2010, and 2015).

SSA Farmers adopted ways of mitigating against rainfall variability by relying on their years of farming experience, local knowledge, and traditional methods that are not sufficient, and increasing youthful population, along with the poor economy in SSA countries, influences the ability to provide and fend for themselves. The poor who cannot afford a decent nutritious meal a day will have no other option than to diversify their income sources such as engaging in intensive farming and local artisan mining activities to survive. This leads to unsafe and unwholesome practices that leave the environment vulnerable to degradation. Similarly, this also suggests that poverty can lead to environmental degradation.

From the food supply analysis (Figures 1 and 2), we also observed that the calories gained per capita and per kg in a year are low in the countries assessed. This further shows that yield per hectare is low plausibly due to overcropping, farmers' landholding size, availability of potentially arable cropland, rainfall variabilities, and little to no farm inputs to increase production. From a nutrition point of view, diversity in the diet is more in staple foods and, aside from the calories gained, lacked sufficient essential micronutrients to maintain a healthy body.

Political instabilities and conflicts are major setbacks for most SSA countries as they undermine the actualization of food production potentials, economic investments, and food consumption. Most African countries are faced with conflicts and insurgency ranging from violent clashes between herders and farmers to political uprising and terrorism in regions that have agricultural potential. These have disrupted farming seasons and halted the implementation of agricultural programs, thereby leading to food shortages, food price hikes, and low productivity. For instance, northeastern Nigeria, known for cereals production and nomadic cattle rearing that supplies the country with cereals and meat, is currently under siege by Boko Haram insurgents.

5. Conclusions

Despite continued land use for food production, sub-Saharan African countries are faced with the challenge of meeting the goal of reducing hunger and malnutrition. This can mean low food production per area, minimal farm inputs, availability of potentially arable cropland, and farmers' landholding size.

Population growth and poverty are catalysts of land use in SSA and food consumption patterns are still centered around energy-giving foods and low micronutrients intake. This is a plausible reason why most suffer from malnutrition. The region has arable lands for diversified crop cultivation but is constrained by the vulnerable environment from anthropogenic activities and climate change, and although different countries are using different strategies to mitigate the situation, more sustainable solutions are required.

Countries with improved standards of living (GDP and HDI) gained more nutrition through diversified foods, and bushmeat serves as an alternative source of protein and revenue for many households irrespective of reports of possible transmission of zoonotic diseases. Therefore, the SSA government at all levels should encourage developing bushmeat farms with good animal health, veterinary facilities, and proper management practices to be acceptable in the eyes of biodiversity conservationists by raising nonendangered species as this could be a way to address hidden hunger concerns.

Sub-Saharan Africa can be considered to be calorie secured as the bulk of food consumed supplies the needed calories for energy. Therefore, governments need to look into the science of stable food fortification with essential micronutrients. This will significantly contribute to reducing anemia and stunted growth, strengthening research and development institutions to address improved crop varieties to tackle climate change impacts, and addressing the rising insecurities to provide a conducive environment for agricultural activities.

Furthermore, concerted efforts should be made to strengthen the implementation of the Maputo declaration of 2003, which plausibly influenced the improvement in calorie gains and reduction in GHI during the MDG period.

6. Limitations

To profile and analyze food consumption patterns, and to be able to draw an inference, researchers have used structured questionnaires, individual dietary surveys, food consumption, dietary diversity scores, and countries' household income expenditure surveys, with the aid of statistics and modeling. However, most African countries lack adequate and updated datasets for a robust analysis. Additionally, due to the influence of the worldwide COVID-19 coronavirus pandemic, we were not able to travel to any of the countries in sub-Saharan Africa for field surveys or to obtain on-site information and data from researchers' resident over there due to movement restriction and lockdown in place. We, therefore, used datasets from international organizations for this research.

Similarly, data on environmental parameters in line with food production and consumption are inadequate, datasets for land use and cover changes associated with specific food production at different spatial scales are not sufficient and present many uncertainties on the African continent especially with regard to specific land cover types. (i.e., cropland and short vegetated types) based on inappropriate cropland management and traditional agriculture practices, which hindered the ability to draw more dynamic and comprehensive results.

Further studies are needed to investigate the impact of changes in land use cover on food production and consumption patterns; meanwhile, the impact of government policies needs to be estimated in line with the sustainable development goals on rural transformation and food security.

Author Contributions: Manuscript writing: J.C.C. initiated the manuscript preparation (e.g., data analyses, literature review), wrote the manuscript, and approved the final version; L.Z. significantly contributed to the study, revised the manuscript, and gave her constructive comments on manuscript drafting, and approved the final version. All authors have read and agreed to the published version of the manuscript.

Funding: This research received funding from the Strategic Priority Research Program of the Chinese Academy of Sciences (XDA20010202), the National Key Research and Development Program of China (2016YFC0503700), and the Chinese Scholarship Council (CSC).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The statistical data from the Food and Agricultural Organization (FAO) food balance sheet are available on the FAOSTAT database and free to download at <http://www.fao.org/faostat/en/#data/FBSH> (accessed on 27 January 2021). The data for the land use land cover were downloaded from the European Space Agency Climate Change Initiative 300m (ESA Land Cover CCI Product) and are available at: http://maps.elie.ucl.ac.be/CCI/viewer/download/ESACCI-LC-Ph2-PUGv2_2.0.pdf, accessed on 27 January 2021). The Human Development Index of the United Nations Development Program (UNDP) can be downloaded freely at <http://hdr.undp.org/en/content/download-data> (accessed on 10 February 2021). The Global Hunger Index data of the International Food Policy Research Institute (IFPRI) are available at <https://www.globalhungerindex.org/> (accessed on 10 February 2021).

Acknowledgments: This work was supported by the Strategic Priority Research Program of the Chinese Academy of Sciences (XDA20010202), the National Key Research and Development Program of China (2016YFC0503700), and the Chinese Scholarship Council (CSC).

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

| S/N | Country | Population (2015) Million | Urban Pop. | Rural Pop. | Land Area (km ²) | Median Age | GDP/Capita (USD) 2015 | Literacy Level (%) | GHI Scores 2000/2015 | HDI Ranking (2018) |
|-----|---------------|---------------------------|------------|------------|------------------------------|------------|-----------------------|--------------------|----------------------|--------------------|
| 1 | Angola | 25.0 | 20,184,710 | 12,681,562 | 1,246,700 | 16.4 | 3432 | 71 (2015) | 58.3/32.6 | 145/189 |
| 2 | Benin | 10.8 | 5,433,806 | 6,689,394 | 112,622 | 18.2 | 902 | 42 (2018) | 38.2/21.8 | 158/189 |
| 3 | Botswana | 2.2 | 1,565,400 | 786,227 | 582,000 | 24.4 | 8259 | 89(2015) | 33.2/23.1 | 102/189 |
| 4 | B. Faso | 18.5 | 5,798,656 | 13,104,617 | 272,967 | 17 | 731 | 41 (2018) | 48.4/31.8 | 183/189 |
| 5 | Burundi | 11.1 | 1,456,375 | 9,643,625 | 27,834 | 17.6 | 275 | 68 (2017) | na | 184/189 |
| 6 | Cameroon | 23.7 | 14,215,400 | 9,128,600 | 475,442 | 18.3 | 1527 | 77 (2018) | 40.4/24.2 | 153/189 |
| 8 | C.A.R | 4.9 | 1,930,200 | 2,969,800 | 622,984 | 17.8 | 510 | 37 (2018) | 51.4/46.9 | 188/189 |
| 9 | Chad | 14.0 | 3,569,015 | 10,430,985 | 1,284,000 | 16.1 | 730 | 22 (2016) | 52/46.4 | 187/189 |
| 10 | Congo Rep | 4.6 | 3,509,318 | 1,090,682 | 342,000 | 18.9 | 2148 | 80 (2018) | 38.1/26.6 | 149/189 |
| 11 | Cote d'Ivoire | 22.7 | 12,729,900 | 9,970,100 | 322,463 | 18.3 | 1716 | 47 (2018) | 31.4/26.3 | 161/189 |
| 12 | DR Congo | 77.2 | 37,376,670 | 39,823,330 | 2,344,858 | 16.8 | 562 | 77 (2017) | na | 174/189 |
| 13 | Djibouti | 0.88 | 745,819 | 134,181 | 23,200 | 23.7 | 3414 | na | 48.5/33.2 | 166/189 |
| 14 | Eritrea | 5.2 | 1,149,670 | 2,396,751 | 117,600 | 18.9 | 642 | 77 (2018) | na | 180/189 |
| 15 | Ethiopia | 99.3 | 22,678,300 | 76,621,700 | 1,104,300 | 18.6 | 772 | 52 (2017) | 58.6/33.9 | 174/189 |
| 16 | Eq. Guinea | 1.1 | 825,196 | 274,804 | 28,051 | 22.2 | 10,174 | 95 (2015) | na | 145/189 |
| 17 | Gabon | 1.9 | 1,716,262 | 183,738 | 267,668 | 22.6 | 8030 | 85(2018) | 18.5/12.5 | 119/189 |
| 18 | Gambia | 2.0 | 1,397,018 | 602,982 | 10,689 | 17 | 712 | 51 (2015) | 27.9/21.5 | 172/189 |
| 19 | Ghana | 27.7 | 16,687,440 | 11,012,560 | 238,533 | 20.4 | 2202 | 77 (2015) | 29.9/15.5 | 138/198 |
| 20 | Guinea | 12.6 | 4,486,535 | 8,113,465 | 245,857 | 18.4 | 885 | 30 (2015) | 44.4/28.8 | 177/189 |
| 21 | G-Bissau | 1.8 | 812,700 | 987,300 | 36,125 | 18.9 | 778 | 60 (2015) | 44.2/30.3 | 178/189 |
| 22 | Kenya | 46.0 | 13,891,530 | 32,108,470 | 580,367 | 19 | 1711 | 82 (2018) | 37.9/24 | 141/189 |
| 23 | Lesotho | 2.1 | 593,502 | 1,506,498 | 30,355 | 21.3 | 1324 | 79 (2015) | 32.7/23.5 | 165/189 |
| 24 | Liberia | 4.5 | 2,464,955 | 2,035,045 | 111,369 | 18.6 | 674 | 48 (2017) | 46.8/30.8 | 173/189 |
| 25 | Madagascar | 24.2 | 9,767,237 | 14,432,763 | 587,041 | 18.7 | 461 | 75 (2018) | 44.1/36.3 | 163/189 |
| 26 | Malawi | 17.2 | 3,072,933 | 14,127,067 | 118,484 | 17.4 | 389 | 62 (2015) | 45.3/27.3 | 174/189 |
| 27 | Mali | 17.6 | 8,080,546 | 9,519,454 | 1,240,192 | 16 | 901 | 36 (2018) | 43.9/29.6 | 184/189 |
| 28 | Mauritania | 4.1 | 2,363,349 | 1,736,651 | 1,030,700 | 19.7 | 1219 | 54 (2017) | 33.5/22.6 | 157/189 |
| 29 | Mauritius | 1.3 | 516,155 | 755,613 | 2040 | 35.6 | 11,239 | 91 (2018) | 16.1/12.9 | na |
| 30 | Mozambique | 27.9 | 10,615,010 | 17,284,990 | 801,590 | 17.2 | 490 | 61 (2017) | 49.2/32.5 | 181/189 |
| 31 | Namibia | 2.4 | 1,224,911 | 1,175,089 | 825,615 | 21 | 5931 | 92 (2018) | 32.5/31.8 | 129/189 |
| 32 | Niger | 19.8 | 3,686,254 | 16,113,746 | 1,267,000 | 14.9 | 412 | 19 (2015) | 53/34.5 | 189/189 |
| 33 | Nigeria | 181.8 | 98,611,180 | 83,188,820 | 923,768 | 17.9 | 2028 | 62 (2018) | 41/32.8 | 161/189 |
| 34 | Rwanda | 11.6 | 2,117,287 | 9,482,713 | 26,338 | 19.4 | 773 | 73 (2018) | 58.5/30.3 | 159/189 |
| 35 | Senegal | 15.1 | 6,685,973 | 8,414,027 | 196,722 | 18.3 | 1522 | 52 (2017) | 37.9/23.2 | 167/189 |
| 36 | Sierra Leone | 6.5 | 2,928,221 | 3,571,779 | 71,740 | 18.3 | 523 | 43 (2018) | 53.5/38.9 | 182/189 |
| 37 | Somalia | 11.1 | 5,960,600 | 5,139,400 | 637,657 | 16.5 | 499 | na | na | na |
| 38 | Sudan | 40.2 | 13,185,766 | 27,014,234 | 1,886,068 | 18.9 | 977 | 61 (2018) | na | 171/189 |
| 39 | South Africa | 54.4 | 38,339,670 | 16,060,330 | 1,221,037 | 26.1 | 6340 | 87 (2017) | 18/12.4 | 115/189 |
| 40 | Swaziland | 1.2 | 307,330 | 892,670 | 17,364 | 20.4 | 4140 | 88(2015) | 30.4/26 | na |
| 41 | Tanzania | 51.4 | 16,277,264 | 35,122,736 | 945,087 | 17.3 | 1051 | 78 (2015) | 42.5/28.7 | 164/189 |
| 42 | Togo | 7.3 | 3,289,910 | 4,010,090 | 56,785 | 18.9 | 672 | 64 (2015) | 38.6/23.0 | 168/189 |
| 43 | Uganda | 39.0 | 10,157,000 | 28,843,000 | 241,550 | 15.8 | 643 | 77 (2018) | 39.3/27.6 | 160/189 |
| 44 | Zambia | 16.2 | 7,551,686 | 8,648,314 | 752,612 | 17.1 | 1540 | 87(2018) | 50.9/41.1 | 145/189 |
| 45 | Zimbabwe | 15.6 | 4,650,663 | 10,949,337 | 390,757 | 19 | 2147 | 87 (2015) | 40.8/30.8 | 150/189 |

References

1. Chauvin, N.D.; Mulangu, F.; Porto, G. *Food Production and Consumption Trends in Sub-Saharan Africa: Prospects for the Transformation of the Agricultural Sector*; WP 2012–011; UNDP Regional Bureau for Africa: New York, NY, USA, 2012; Volume 2, p. 74.
2. Maitima, J.M.; Mugatha, S.M.; Reid, R.S.; Gachimbi, L.N.; Majule, A.; Lyaruu, H.; Pomery, D.; Mathai, S.; Mugisha, S. The linkages between land use change, land degradation and biodiversity across East Africa. *Afr. J. Environ. Sci. Technol.* **2009**, *3*, 310–325.
3. Wirsenius, S.; Azar, C.; Berndes, G. How much land is needed for global food production under scenarios of dietary changes and livestock productivity increases in 2030? *Agric. Syst.* **2010**, *103*, 621–638. [[CrossRef](#)]
4. Bongers, F.; Tennigkeit, T. *Degraded Forests in Eastern Africa: Management and Restoration*; Earthscan: London, UK, 2010.
5. Jayne, T.S.; Chamberlin, J.; Headey, D.D. Land pressures, the evolution of farming systems, and development strategies in Africa: A synthesis. *Food Policy* **2014**, *48*, 1–17. [[CrossRef](#)]
6. Scherr, S.J. A downward spiral? Research evidence on the relationship between poverty and natural resource degradation. *Food Policy* **2000**, *25*, 479–498. [[CrossRef](#)]
7. Eckert, S.; Kiteme, B.; Njuguna, E.; Zaehringer, J.G. Agricultural expansion and intensification in the foothills of Mount Kenya: A landscape perspective. *Remote Sens.* **2017**, *9*, 784. [[CrossRef](#)]
8. Molla, M.B. Land use/land cover dynamics in the central rift valley region of Ethiopia: Case of Arsi Negele District. *Afr. J. Agric. Res.* **2015**, *10*, 434–449.
9. AC-Chukwuocha, N.B. Analysis of structural changes in land use and land cover of Otamiri watershed in Owerri, south east Nigeria. *J. Environ. Earth Sci.* **2015**, *5*, 51–59.
10. Hogan, C.M.; Draggan, S. (Eds.) *Overgrazing*. In *Encyclopedia of Earth*; National Council for Science and the Environment: Washington, DC, USA, 2012.
11. UN. *Millennium Development Goals Report*; UN: New York, NY, USA, 2020.
12. AU. *An Update on Food Security*; African Union Headquarters, 2020. Available online: <https://au.int/en/au/priorities/food-security> (accessed on 27 January 2021).
13. Foley, J.A.; Ramankutty, N.; Brauman, K.A.; Cassidy, E.S.; Gerber, J.S.; Johnston, M.; Mueller, N.D.; O’Connell, C.; Ray, D.K.; West, P.C.; et al. Solutions for a cultivated planet. *Nature* **2011**, *478*, 337–342. [[CrossRef](#)]
14. Alexandratos, N.; Bruinsma, J. *World Agriculture Towards 2030/2050: The 2012 Revision*; Agricultural Development Economics Division; Food and Agriculture Organization of the United Nations: Rome, Italy, 2012. [[CrossRef](#)]
15. Rukuni, M. Africa: Addressing growing threats to food security. *J. Nutr.* **2002**, *132*, 3443S–3448S. [[CrossRef](#)] [[PubMed](#)]
16. UNDP. *Ghana Millennium Development Goals Report*; United Nations Dev. Programme: New York, NY, USA, 2015.
17. Bellefontaine, R. *Management of Natural Forests of Dry Tropical Zones (FAO Conservation Guides)*; Food and Agriculture Organization of the United Nations: Rome, Italy, 2000; ISBN 9251039704.
18. UNEP. *Our Work in Africa*; United Nations Environment Programme: Nairobi, Kenya, 2020.
19. Muyanga, M.; Jayne, T.; Kodhek, G.; Ariga, J. Staple Food Consumption Patterns in Urban Kenya: Trends and Policy Implications. Tegemeo Institute of Agricultural Policy and Development, Working Paper 16. Egerton University Institutional Repository, 2005. Available online: https://www.researchgate.net/publication/46470942_Staple_Food_Consumption_Patterns_in_Urban_Kenya_Trends_and_Policy_Implications (accessed on 27 January 2021).
20. Kearney, J. Food consumption trends and drivers. *Phil. Trans. R. Soc.* **2010**, *365*, 2793–2807. [[CrossRef](#)]
21. Ene-Obong, H.N.; Sanusi, R.A.; Udentia, E.A.; Williams, I.O.; Anigo, K.M.; Chibuzo, E.C.; Aliyu, H.M.; Ekpe, O.O.; Davidson, G.I. Data collection and assessment of commonly consumed foods and recipes in six geo-political zones in Nigeria: Important for the development of a National Food Composition Database and Dietary Assessment. *Food Chem.* **2013**, *140*, 539–546. [[CrossRef](#)] [[PubMed](#)]
22. Savige, G.S.; Crawford, D.; Worsley, A.; Ball, K. Food intake patterns among Australian adolescents. *Asia Pac. J. Clin. Nutr.* **2007**, *16*, 738–746. [[PubMed](#)]
23. Rivera, J.Á.; de Cossío, T.G.; Pedraza, L.S.; Aburto, T.C.; Sánchez, T.G.; Martorell, R. Childhood and adolescent overweight and obesity in Latin America: A systematic review. *Lancet Diabetes Endocrinol.* **2014**, *2*, 321–332. [[CrossRef](#)]
24. Partearroyo, T.; Samaniego-Vaesken, M.L.; Ruiz, E.; Aranceta-Bartrina, J.; Gil, Á.; González-Gross, M.; Ortega, R.M.; Serra-Majem, L.; Varela-Moreiras, G. Current food consumption amongst the Spanish anibes study population. *Nutrients* **2019**, *11*, 2663. [[CrossRef](#)]
25. Devèze, J.-C. *Challenges for African Agriculture*; Agence Française de Développement and the World Bank: Washington, DC, USA, 2011.
26. Cao, L.J.; Tian, W.M.; Wang, J.M.; Malcolm, B.; Liu, H.B.; Zhou, Z.-Y. Recent Food Consumption Trends in China and Trade. *Australas. Agribus. Rev.* **2013**, *21*, 15–44.
27. Akram, W.; Henneberry, S. *Consumption Patterns of Urban Punjab of Pakistan: Evidence from HIES 2013–14*; Government of Pakistan, Pakistan Bureau of Statistics, Ministry of Planning Development and Special Initiatives, June 2020. Available online: https://www.researchgate.net/publication/308508892_Consumption_patterns_of_Urban_Punjab_of_Pakistan_Evidence_from_HIES_2013-14 (accessed on 27 January 2021).
28. Galbete, C.; Nicolaou, M.; Meeks, K.A.; de-Graft Aikins, A.; Addo, J.; Amoah, S.K.; Smeeth, L.; Owusu-Dabo, E.; Klipstein-Grobusch, K.; Bahendeka, S.; et al. Food consumption, nutrient intake, and dietary patterns in Ghanaian migrants in Europe and their compatriots in Ghana. *Food Nutr. Res.* **2017**, *61*, 1341809. [[CrossRef](#)]

29. Streeter, J.L. Socioeconomic Factors Affecting Food Consumption and Nutrition in China: Empirical Evidence During the 1989–2009 Period. *Chin. Econ.* **2017**, *50*, 168–192. [CrossRef]
30. Song, F.; Cho, M.S. Geography of Food Consumption Patterns between South and North China. *Foods* **2017**, *6*, 34. [CrossRef]
31. Mottaleb, K.A.; Rahut, D.B.; Kruseman, G.; Erenstein, O. Changing food consumption of households in developing countries: A Bangladesh case. *J. Int. Food Agribus. Mark.* **2018**, *30*, 156–174. [CrossRef]
32. Sharma, R.; Nguyen, T.T.; Grote, U. Changing consumption patterns—Drivers and the environmental impact. *Sustainability* **2018**, *10*, 4190. [CrossRef]
33. Saleem, S.B.; Ali, Y. Effect of lifestyle changes and consumption patterns on environmental impact: A comparison study of Pakistan and China. *Chin. J. Popul. Resour. Environ.* **2019**, *17*, 113–122. [CrossRef]
34. Paré, S.; Söderberg, U.; Sandewall, M.; Ouadba, J. Land use analysis from spatial and field data capture in southern Burkina Faso, West Africa. *Agric. Ecosyst. Environ.* **2008**, *127*, 277–285. [CrossRef]
35. Grinblat, Y.; Kidron, G.J.; Karnieli, A.; Benenson, I. Simulating land-use degradation in West Africa with the ALADYN model. *J. Arid. Environ.* **2015**, *112*, 52–63. [CrossRef]
36. Badjana, H.M.; Helmschrot, J.; Selsam, P.; Wala, K.; Flügel, W.-A.; Afouda, A.; Akpagana, K. Land cover changes assessment using object-based image analysis in the Binah River watershed (Togo and Benin). *Earth Space Sci.* **2015**, *2*, 403–416. [CrossRef]
37. Olorunfemi, I.E.; Fasinmirin, J.T.; Akinola, F.F. Soil physico-chemical properties and fertility status of long-term land use and cover changes: A case study in Forest vegetative zone of Nigeria. *Eurasian J. Soil Sci.* **2018**, *7*, 133–150. [CrossRef]
38. Olorunfemi, I.E.; Fasinmirin, J.T.; Olufayo, A.A.; Komolafe, A.A. GIS and remote sensing-based analysis of the impacts of land use/land cover change (LULCC) on the environmental sustainability of Ekiti State, southwestern Nigeria. *Environ. Dev. Sustain.* **2020**, *22*, 661–692. [CrossRef]
39. Olorunfemi, I.E.; Fasinmirin, J.T. Land use management effects on soil hydrophobicity and hydraulic properties in Ekiti State, forest vegetative zone of Nigeria. *Catena* **2017**, *155*, 170–182. [CrossRef]
40. John, K.M.K.; Demi, S.M.; Amegashie, D.P.M. Analysis of Food Security Stats of Farming Households in The Forest Belt of The Central Region of Ghana. *Russ. J. Agric. Socio-Econ. Sci.* **2013**, *13*, 26–42. Available online: https://www.researchgate.net/publication/285273477_ANALYSIS_OF_FOOD_SECURITY_STATUS_OF_FARMING_HOUSEHOLDS_IN_THE_FOREST_BELT_OF_THE_CENTRAL_REGION_OF_GHANA (accessed on 27 January 2021).
41. Chamberlin, J.; Jayne, T.S.; Headey, D. Scarcity amidst abundance? Reassessing the potential for cropland expansion in Africa. *Food Policy* **2014**, *48*, 51–65. [CrossRef]
42. Molinario, G.; Hansen, M.; Potapov, P.; Tyukavina, A.; Stehman, S. Contextualizing landscape-scale forest cover loss in the Democratic Republic of Congo (DRC) between 2000 and 2015. *Land* **2020**, *9*, 23. [CrossRef]
43. Geenen, S. Relations and regulations in local gold trade networks in South Kivu, Democratic Republic of Congo. *J. East. Afr. Stud.* **2011**, *5*, 427–446. [CrossRef]
44. I.T.T.O. *Annual Review and Assessment of the World Timber Situation*; International Tropical Timber Organization: Yokohama, Japan, 2004.
45. Brink, A.B.; Bodart, C.; Brodsky, L.; Defourney, P.; Ernst, C.; Donney, F.; Lupi, A.; Tuckova, K. Anthropogenic pressure in East Africa—Monitoring 20 years of land cover changes by means of medium resolution satellite data. *Int. J. Appl. Earth Obs. Geoinf.* **2014**, *28*, 60–69. [CrossRef]
46. Van de Giessen, E. *Horn of Africa: Environmental Security Assessment*; Institute for Environmental Security: The Hague, The Netherlands, 2011; Volume 2518, p. 152. Available online: https://static.s123-cdn.com/uploads/2385729/normal_5d3c85739e5ed.pdf (accessed on 27 January 2021).
47. Masayi, N.N.; Omondi, P.; Tsingalia, M. Assessment of land use and land cover changes in Kenya’s Mt. Elgon forest ecosystem. *Afr. J. Ecol.* **2021**, 1–16. Available online: <https://onlinelibrary.wiley.com/doi/abs/10.1111/aje.12886> (accessed on 27 January 2021). [CrossRef]
48. Mubaya, C.P.; Njuki, J.; Mutsvangwa, E.P.; Mugabe, F.T.; Nanja, D. Climate variability and change or multiple stressors? Farmer perceptions regarding threats to livelihoods in Zimbabwe and Zambia. *J. Environ. Manag.* **2012**, *102*, 9–17. [CrossRef] [PubMed]
49. de Graaff, J.; Kessler, A.; Nibbering, J.W. Agriculture and food security in selected countries in Sub-Saharan Africa: Diversity in trends and opportunities. *Food Secur.* **2011**, *3*, 195–213. [CrossRef]
50. Kotikot, M.S. *Telling the Story of Changing Land Cover in Namibia*; SERVIR, 2015. Available online: <https://servirglobal.net/Global/Articles/Article/1445/telling-the-story-of-changing-land-cover-in-namibia> (accessed on 27 January 2021).
51. Zhen, L.; Cao, S.; Cheng, S.; Xie, G.; Wei, Y.; Liu, X.; Li, F. Arable land requirements based on food consumption patterns: Case study in rural Guyuan District, Western China. *Ecol. Econ.* **2010**, *69*, 1443–1453. [CrossRef]
52. Kinda, S.R.; Badolo, F. Does rainfall variability matter for food security in developing countries? *Cogent Econ. Financ.* **2019**, *7*, 1640098. [CrossRef]
53. Zinyengere, N.; Crespo, O.; Hachigonta, S. Crop response to climate change in southern Africa: A comprehensive review. *Glob. Planet. Chang.* **2013**, *111*, 118–126. [CrossRef]
54. Shukla, P.; Skea, J.; Calvo Buendia, E.; Masson-Delmotte, V.; Pörtner, H.; Roberts, D.; Zhai, P.; Slade, R.; Connors, S.; Van Diemen, R. *2019: Climate Change and Land: An IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems*; IPCC: Geneva, Switzerland, 2019.

55. Tarchiani, V.; Rossi, F.; Camacho, J.; Stefanski, R.; Mian, K.A.; Pokperlaar, D.S.; Coulibaly, H. Smallholder farmers facing climate change in West Africa: Decision-making between Innovation and Tradition. *J. Innov. Econ. Manag.* **2017**, 151–176. Available online: https://www.researchgate.net/publication/320168933_Smallholder_Farmers_Facing_Climate_Change_in_West_Africa_Decision-Making_between_Innovation_and_Tradition (accessed on 27 January 2021). [CrossRef]
56. Barbier, B.; Yacouba, H.; Karambiri, H.; Zoromé, M.; Somé, B. Human vulnerability to climate variability in the Sahel: Farmers' adaptation strategies in northern Burkina Faso. *Environ. Manag.* **2009**, 43, 790–803. Available online: <https://link.springer.com/article/10.1007/s00267-008-9237-9> (accessed on 27 January 2021). [CrossRef]
57. Wallenfang, J.; Finckh, M.; Oldeland, J.; Revermann, R. Impact of shifting cultivation on dense tropical woodlands in southeast Angola. *Trop. Conserv. Sci.* **2015**, 8, 863–892. Available online: https://www.researchgate.net/publication/287198021_Impact_of_Shifting_Cultivation_on_Dense_Tropical_Woodlands_in_Southeast_Angola (accessed on 27 January 2021). [CrossRef]
58. Aklile, Y.; Beyene, F. Examining drivers of land use change among pastoralists in Eastern Ethiopia. *J. Land Use Sci.* **2014**, 9, 402–413. [CrossRef]
59. Kemeze, L.S.; Mensah-Bonsu, A.; Egyir, I.S.; Amegashie, D.P.K.; Nlom, H.J. Impact of bioenergy crop adoption on total crop incomes of farmers in Northern Ghana: The case of *Jatropha Curcas*. In *Building a Resilient and Sustainable Agriculture in Sub-Saharan Africa*; Palgrave Macmillan: Cham, Switzerland, 2018; pp. 97–119.
60. Burney, J.A.; Naylor, R.L.; Postel, S.L. The case for distributed irrigation as a development priority in sub-Saharan Africa. *Proc. Natl. Acad. Sci. USA* **2013**, 110, 12513–12517. [CrossRef] [PubMed]
61. Marsabit. *Environmental Impact Assessment For Bakuli 4 Dam Project and Introduction of Sewage System in Marsabit Town, Marsabit Central Sub-County*; Marsabit County Government: Marsabit, Kenya, 2016.
62. Porkka, M.; Kummu, M.; Siebert, S.; Varis, O. From food insufficiency towards trade dependency: A historical analysis of global food availability. *PLoS ONE* **2013**, 8, e82714. [CrossRef]
63. Honfoga, B.; Van Den Boom, G. Food-consumption patterns in central West Africa, 1961 to 2000, and challenges to combating malnutrition. *Food Nutr. Bull.* **2003**, 24, 167–182. [CrossRef]
64. Martins, V.; Shackleton, C.M. Bushmeat use is widespread but under-researched in rural communities of South Africa. *Glob. Ecol. Conserv.* **2019**, 17, e00583. [CrossRef]
65. Ronquest-Ross, L.C. Food Consumption Changes in South Africa Since 1994. *S. Afr. Food Sci. Technol.* **2015**, 111, 1–12.
66. Smale, M.; Theriault, V.; Vroegindewey, R. Dietary Patterns in Mali: Implications for Nutrition. *Feed. Future Innov. Lab Food Secur. Policy Res. Pap.* **2019**, 148. [CrossRef]
67. Saumik, P. *Conflicts Food Security and Crop Diversification Strategies Evidence from Cote d'Ivoire*; Institute of Developing Economies, Japan External Trade Organization V.R.F Series, No. 492. 2015. Available online: <https://www.ide.go.jp/library/English/Publish/Reports/Vrf/pdf/492.pdf> (accessed on 27 January 2021).
68. Sahoré, D.A.; Ako, O.Y.A.; Abouattier, J.L. Composition of the Daily Food Ration in Ivory Coast. *J. Pharm.* **2017**, 7, 12–14. Available online: https://www.researchgate.net/publication/312377584_Composition_of_the_Daily_Food_Ration_in_Ivory_Coast (accessed on 27 January 2021). [CrossRef]
69. Ofwona, A.C. An analysis of the patterns of food consumption among households in Kenya. *J. Emerg. Trends Econ. Manag. Sci.* **2013**, 4, 111–113.
70. Aberman, N.L.; Meerman, J.; Benson, T. (Eds.) *Mapping the Linkages between Agriculture, Food Security and Nutrition in Malawi*; International Food Policy Research Institute (IFPRI): Washington, DC, USA, 2015.
71. Pauw, K.; Beck, U.; Mussa, R. Did rapid smallholder-led agricultural growth fail to reduce rural poverty? *Mak. Sense Malawi's Poverty Puzzle* **2016**, 499. Available online: <https://oxford.universitypressscholarship.com/view/10.1093/acprof:oso/9780198744795.001.0001/acprof-9780198744795-chapter-5> (accessed on 27 January 2021).
72. Tawodzera, G.; Crush, J. *The Return of Food: Poverty and Urban Food Security in Zimbabwe after the Crisis*; African Food Security Urban Network (AFSUN), 2016. Available online: <http://www.afsun.org/wp-content/uploads/2016/01/AFSUN22.pdf> (accessed on 27 January 2021).
73. Nsabuwera, V.; Hedt-Gauthier, B.; Khogali, M.; Edginton, M.; Hinderaker, S.G.; Nisingizwe, M.P.; de Dieu Tihabyona, J.; Sikubwabo, B.; Sembagare, S.; Habinshuti, A.; et al. Making progress towards food security: Evidence from an intervention in three rural districts of Rwanda. *Public Health Nutr.* **2016**, 19, 1296–1304. [CrossRef] [PubMed]
74. Rwanda. *Comprehensive Food Security & Vulnerability Analysis (CFSVA)*; United Nations World Food Programme, 2018. Available online: <https://www.wfp.org/publications/rwanda-comprehensive-food-security-vulnerability-analysis-december-2018> (accessed on 27 January 2021).
75. AU. *The 2017 Progress Report to the Assembly*; African Union: Durban, South Africa, 2017.
76. Crush, J. *The State of Poverty and Food Insecurity in Maseru, Lesotho*; African Food Security Urban Network (AFSUN), 2015. Available online: <http://www.afsun.org/wp-content/uploads/2016/06/AFSUN21.pdf> (accessed on 27 January 2021).
77. Hathie, I.; Seydie, B.; Samaké, L.; Sakho-Jimbira, S. *Ending Rural Hunger: The Case of Senegal*; Africa Growth Initiative at Brookings, 2017. Available online: <https://www.brookings.edu/wp-content/uploads/2017/10/senegal-erh-policy-brief.pdf> (accessed on 27 January 2021).
78. Anderson, C.A.; Bellamy, S.; Figures, M.; Zeigler-Johnson, C.; Jalloh, M.; Spangler, E.; Coomes, M.; Gueye, S.; Rebeck, T.R. Dietary intake of Senegalese adults. *Nutr. J.* **2010**, 9, 1–5. [CrossRef]

79. NBS. *Socio-Economic Survey of Nigeria*; Nigeria National Bureau of Statistics; Federal Government of Nigeria, 2006. Available online: <https://www.nigerianstat.gov.ng/> (accessed on 27 January 2021).
80. WB. *Poverty Headcount Ratio at \$1.90 a Day*; World Bank: Washington, DC, USA, 2011.
81. Ecker, O.; Hatzenbuehler, P. Agricultural Transformation and Food and Nutrition Security of Farm Households in Nigeria. *Proceedings of the Sixth International Conference, African Association of Agricultural Economists (AAAE)*. 2019. Available online: <https://econpapers.repec.org/paper/agsaaae19/295761.htm> (accessed on 27 January 2021). [[CrossRef](#)]
82. Keeley, J.; Seide, W.M.; Eid, A.; Kidewa, A.L. *Large-Scale Land Deals in Ethiopia*; International Institute for Environment and Development: London, UK, 2014.
83. Ethiopia. *Comprehensive Food Security and Vulnerability Analysis (CFSVA)*; United Nations World Food Programme, 2019. Available online: <https://reliefweb.int/report/ethiopia/ethiopia-comprehensive-food-security-and-vulnerability-analysis-cfsva-2019> (accessed on 27 January 2021).
84. RGoZ. *The Zanzibar Strategy for Growth and Reduction of Poverty*; The Revolutionary Government of Zanzibar: Unguja, Zanzibar, 2007.
85. Nyangasa, M.A.; Buck, C.; Kelm, S.; Sheikh, M.; Hebestreit, A. Exploring food access and sociodemographic correlates of food consumption and food insecurity in Zanzibari households. *Int. J. Environ. Res. Public Health* **2019**, *16*, 1557. [[CrossRef](#)] [[PubMed](#)]
86. Westhoek, H.; Lesschen, J.P.; Rood, T.; Wagner, S.; De Marco, A.; Murphy-Bokern, D.; Leip, A.; van Grinsven, H.; Sutton, M.A.; Oenema, O. Food choices, health and environment: Effects of cutting Europe's meat and dairy intake. *Glob. Environ. Chang.* **2014**, *26*, 196–205. [[CrossRef](#)]
87. Henchion, M.; Hayes, M.; Mullen, A.M.; Fenelon, M.; Tiwari, B. Future protein supply and demand: Strategies and factors influencing a sustainable equilibrium. *Foods* **2017**, *6*, 53. [[CrossRef](#)]
88. Mekonnen, M.M.; Hoekstra, A.Y. A global assessment of the water footprint of farm animal products. *Ecosystems* **2012**, *15*, 401–415. [[CrossRef](#)]
89. Asseng, S.; Kheir, A.M.; Kassie, B.T.; Hoogenboom, G.; Abdelaal, A.I.; Haman, D.Z.; Ruane, A.C. Can Egypt become self-sufficient in wheat? *Environ. Res. Lett.* **2018**, *13*, 094012. [[CrossRef](#)]
90. Christofolletti, C.A.; Escher, J.P.; Correia, J.E.; Marinho, J.F.; Fontanetti, C.S. Sugarcane vinasse: Environmental implications of its use. *Waste Manag.* **2013**, *33*, 2752–2761. [[CrossRef](#)]
91. Wolfe, N.D.; Daszak, P.; Kilpatrick, A.M.; Burke, D.S. Bushmeat hunting, deforestation, and prediction of zoonotic disease. *Emerg. Infect. Dis.* **2005**, *11*, 1822. Available online: https://www.researchgate.net/publication/274836506_Bushmeat_Hunting_Deforestation_and_Prediction_of_Zoonotic_Disease (accessed on 27 January 2021). [[CrossRef](#)] [[PubMed](#)]