International Journal of Environmental Sciences & Natural Resources
ISSN: 2572-1119

Juniper Publishers
key to the Researchers

Review Article
Volume 12 Issue 5 - July 2018
DOI: 10.19080/IJESNR.2018.12.555849

Int J Environ Sci Nat Res

Environmental Issues and Food Insecurity in Africa

Jonathan Ali Ogwuche* Owoicho Christopher and Dahiru K Muhammed

[1]*Department of Geography, Benue State University, Nigeria*

Submission: June 11, 2018; **Published:** July 05, 2018

***Corresponding author:** Jonathan Ali Ogwuche, Department of Geography, Benue State University, Makurdi, Nigeria, Email: ogwuche.jonathan@yahoo.com

Abstract

Environmental issues, notably climate change, impact heavily on food security, and have direct and indirect impacts on the human existence of the African continent. Such impacts include higher temperatures, changes in rainfall patterns, extreme weather, drought and flooding. Indirect impacts include increased infestations and diseases, water supply, rising sea level, mass migration, unsustainable agricultural practices and changes in atmospheric composition. While agriculture is regarded as a victim of climate change, its impact on global warming cannot be overlooked. Various types of adaptation can be distinguished, that vary as countries vary in their peculiarities. Measures, such as Climate Smart Agriculture to ensure food security in the face of climate change must be pursued by African leaders if they aim to achieve sustainable and robost agricultural development.

Introduction

The main environmental issue that revolves around agriculture is climate change. The climate has changed since mankind has been on this earth, and there is increasing evidence that the world is experiencing climate change on a scale never previously known in human history [1]. Climate change is a conspicuously marked deviation from the normal pattern or occurrence of climate. This deviation or change can be in terms of single or a combination of climatic elements - radiation, sunshine duration, temperature, pressure, wind velocity and direction, evaporation/evapo-transpiration, cloud cover, and precipitation. All these elements are very key to agriculture and food production, also, increased emission of greenhouse gases (CO_2, CO, CH_4, N_2O and CFCs) as well as the injection of solid particles (aerosols) into the atmosphere changes the chemistry and physics of the atmosphere which affect the functioning of the entire ecosystems of the earth. As a consequence, we are experiencing rapid rate of global carbon dioxide (CO_2) with increasing temperature, leading to global warming, snow melting, ocean swelling on African coastlines, and frequent occurrences of drought and flooding. For instance, Sahara desert is advancing coast wards at a fast rate and taking the savannah ecosystem as an arrow-head on the migration track. The Intergovernmental Panel on Climate Change (IPCC) refers to Africa as one of the most vulnerable continents to climate variability and change because of multiple stresses and low adaptive capacity [2]. This is also so because majority of the population on the continent are dependent on weather for activities such as agriculture, which are largely subsistence and contributes 80% of Africa's agricultural production Carlos [3]. Given that approximately 65% of Africans rely on agriculture as their primary source of livelihood, and despite the wide variety of crops, animals and farm practices across the continent ECA 2013 it is no surprise that Africa has the lowest levels of agricultural productivity in the world. In fact, compared to the rest of the world, while Africa hosts around 15% of the world's population, it is home to close to a third of those affected by hunger on our planet, hence food insecurity. Food security concerns the available amount of food for a certain purpose. This could be to feed a family or an individual, or to feed a nation, or even the amount of food needed to feed the whole world population. Aside from the simple quality of required food, food security also includes concerned issues like the transport of food to people and storage issues, as well as food safety (Wlokas, no date). The United Nations Organization for Food and Agriculture (FAO) define the four most crucial factors for a household's food security as food availability, access to food, stability of supply and accessibility and the degree to which food is nutritious and safe and can therefore be utilized FAO [4]. Caritas International [5] defines food security as reliable access to a sufficient quantity of affordable and nutritious food. Climate change impacts heavily on food security, and this has a direct and essential impact on human existence. Many countries in Africa are food insecure and a large portion of the population relies on subsistence farming where farmers both consume their product and sell it in local markets (Brown and Funk, 2008). The top three causes of food insecurity are lack of resources for small scale farmers, low agricultural productivity and the impact of climate change Caritas International [5]; and further identified the results of food and insecurity as hunger and malnutrition, increased migration, income disparity and crime. In Africa, estimates show

a dramatic increase of people experiencing chronic hunger over the period 1990-2007 and even more, following the 2008-2009 financial and economic crises (ECA 2013). Political instability, wars, harsh weather and lack of incentives for agricultural transformation have played a major role in compounding food security in Africa (ECA 2013). Even then, rapid population growth and climate change continue to negatively impact on food security and need to be factored into sustainable strategies and policies.

Agricultural Production and Climate Change

Climate change is perhaps the most serious environmental threat to agricultural production, especially in Africa. Climate change does not occur in the same way and with the same impact across the region of the world. According to Ethan [6], the patterns of the impact of climate change are dependent on latitude, altitude, type of crop grown and livestock reared. The direct impact of climate change on agricultural systems are changes in rainfall and temperature which could impact on agro-climate conditions, altering growing reasons, planting and harvesting calendars, water availability, pest, weed and disease populations. Again, climate change would also impact on alteration in evapo-transpiration, photosynthesis and biomass production and land suitability for agricultural production. The Intergovernmental Panel on Climate Change IPCC [2] emphasis that climate change exerts multiple stresses on the biophysical as well as the social and institutional environments that underpin agricultural production. Khanal [7] classifies the pattern of impact of climate change on agriculture into biophysical and socio-economic. The biophysical impacts include physiological effects on crop and livestock, change in land, soil and water resources, increased weed and pest challenges, shifts in spatial and temporal distribution of impacts, sea level rise and changes to ocean salinity and sea temperature rise causing fish to inhabit in different ranges. The socio-economic impacts result in decline in yield and production, reduced marginal Gross Domestic Product (GDP) from agriculture, fluctuation in world market price, changes in geographical distribution of trade regime, increased number of people at risk of hunger and food security, migration and civil unrest.

The United Nations Food and Agriculture Organization FAO [8] gives an elaborate and critical consideration of the impact of climate change on crop production and states that the pattern has both positive and negative impacts. For example, rises in temperature helps to grow crops in high altitude areas and towards the poles. In these areas, increases in temperature extend the length of the potential growing season, allowing earlier planting, early harvesting and opening the possibility of completing two crop cycles in the same season. The warmer conditions support the process of natural decomposition of organic matter and contribute to the nutrient uptake mechanisms. The process of nitrogen fixation, associated with greater root development is also predicted to increase in warmer conditions and with higher carbon dioxide, if soil moisture is not limiting. The increased carbon dioxide levels lead to a positive growth response for a number of staples under controlled conditions also known as the carbon fertilization effect.

But when temperatures exceed the optimal level for biological processes, crops often respond negatively with a sleep down in net growth and yield. FAO further states that heat stress might affect the whole physiological development, maturation and finally reduces the yield of cultivated crop. The negative effects on agricultural yields will be exacerbated by more frequent weather events. In the same way, rising atmospheric carbon dioxide concentration, higher temperatures, changes in animal and seasonal precipitation patterns and in the frequency of extreme events will affect the volume, quality, quantity, stability of food production and the natural environment in which agriculture takes place. Climatic variations will have consequences for the availability of water resources, frequency of pest and diseases and soil quality, leading to significant changes in the conditions for agriculture and livestock production. In extreme cases, the degradation of agricultural ecosystems could mean desertification, resulting in a total loss of the productive capacity of land.

Direct and Indirect Impact of Climate Change on Agriculture

Agriculture is perhaps the most sensitive of all food security activities to climate change, in the following ways.

Impact of Higher Temperature

Scientific studies have found that increasing temperatures will have different effects on farming in different parts of the world. Productivity may increase in medium and high latitudes due to larger growing season. According to Gornall et al. [9] at 20C temperature increase in wheat production, but could result in a corresponding loss in lower latitudes. However, in semi-arid and tropical regions, where farming conditions are extreme, a temperature increase could result in reduced harvests, increasing the stress of high temperature, with increased water loss during evaporation, further increasing water stress for plants. Soil fertility could also be affected by increased air temperatures. Losses from evaporation and longer growing seasons could result in increased water demand in the Middle East, North Africa and South East Asia Gornall et al. [9].

Changes in Rainfall Patterns

Water is essential for plant life. Any change to rainfall pattern would impact directly on agriculture, 80 percent of which is dependent on rain water Gornall et al. [9]. It is very difficult to predict the effect of global warming on rainfall in a particular region as a result of the changes this will cause to atmospheric circulation patterns. Nevertheless, most of the forecasts produced conclude that there will be an increase in rainfall at high latitudes, with lower rainfall in tropical and subtropical regions. It has been estimated that rainfall shortages in certain African countries dependent on cultivation of non-irrigated and semi-humid crops could reduce production by 50 percent by 2020 Altieri and

How to cite this article: Jonathan Ali Ogwuche, Owoicho Christopher, Dahiru K Muhammed. Environmental Issues and Food Insecurity in Africa. Int J Environ Sci Nat Res. 2018; 12(5): 555849. DOI: 10.19080/IJESNR.2018.12.555849

Nicholis [10]. Maize would be one of the crops most affected by increased temperatures and changing rainfall. Some studies have found that output might decrease by 10 percent by 2055, mainly in Africa and Latin America, affecting over 170 million small scale farmers in those regions Jones and Thornton [11].

Extreme Weather

According to a scientific study published in nature magazine, issue 432, heat waves have been more frequent since the end of the last century, and this trend is expected to continue over coming decades. Together with lack of rainfall, this directly impacts on the performance of some crops. The adaptation of crops to these occasional temperature increases varies depending on the geographic region. The impact will be more in hotter regions where agriculture is already at the limit of its ability to adapt, and where it might be faced by conditions that have never been experienced before. If there is a heat wave during a key period in the plants development, such as when it is flowering, this could have a serious impact on the harvest.

Drought

Drought is a regional phenomenon with different characteristics depending on the climatic region, frequency and duration. According to WMO [12], there is no general description of what constitutes a drought; it is a natural catastrophe that affects a large part of the population, with high economic, social and environmental costs. Lack of rainfall causes water stress in plants and as with heat waves, the areas most affected will be those already suffering extreme water shortages. Dryness of the soil stops root growth and decomposition of organic material, further decreasing soil fertility. One further impact of climate change is the increase in the severity of droughts, both in terms of their frequency and duration, which has been seriously devastating the morn of Africa since 2011, with famine affecting 13 million people. Forecasts suggest that by 2050, the proportion of the earth subject to constant drought will increase from 2 percent to droughts increasing from 1 to 10 percent by the end of the 21st century (IOM) [13].

Flooding

Excess water can damage crops, running harvests, just as flooding can devastate large expanses of cultivated land. According to IPCC [14], tropical cyclones may become more intense over the coming decades, with stronger winds and higher rainfall.

Indirect Impact of Climate Change on Agricultural Production

From available literature, the following indirect impacts exist.

Increase Infestations and Diseases

Higher temperature from climate change causes changes to the geographic distribution of diseases, changing the dispersion of bacteria and fungi as wind patterns change, leading to the appearance of emerging and re-emerging illness, and an increase in the severity of pathogens (Rosenzweigh and Hillel).

Water Supply

Global warming influences melting of glaciers which rivers depend on, resulting in seasonal flows, which decrease in the dry season and increase in the rainy season with greater risks of flooding. In some regions, water drew from rivers help to migrate farms. According to Doll and Siebert (no date), irrigated crops account for 20 percent of cultivated land globally, but for 40 percent of the food produced. However, this practice depends on weather in remote areas. In other situations, water shortages are not due to low rainfall, but to surface run-off, evaporation and deep percolation.

Rising Sea Levels

Rising sea levels are an inevitable consequence of climate change. Climate causes an increase in the mass of water one to ice melting from warming. The 4th IPCC [2] report estimates that sea levels could rise by between 0.1m and 0.5m. Sea level rise will impact on the world's harvest due to salination or total flooding of good low-lying agricultural land. Currently, 200 million km2 of land of could be flooded if sea levels rise by one metre, a possibility during this century Stern Review [15].

Mass Migration

Mass migration is increasing with climate change and has led to the terms 'environmental migrations or environmental refugees'. The IPCC was estimated that by 2050, about 150 million people will have been forced to migrate from their homes as a result of the effects of climate change. Majority of the migrants are the able-bodied men and women who are engaged in agricultural production. Relatively unknown, among the problem and consequences of climate change is its tendency to precipitate violent conflict, especially the worsening incidence of conflict between Fulani herdsmen and farmers. The immediate cause of the conflict is natural resource scarcity (Odo and Chilaka). The demand for land for feed grain is increasing the pressure on already scarce grazing land. Grazing is moving into marginal lands, where it leads to desertification and into forests or other ecologically valuable areas Stenifeld [16]. According to them, this crisis has led to loss of several fertile lands, livestock, lives, agricultural farmlands, crops, injuries and incapacitation of farmers who would not go back to farming again. According to Reuveny, most of these problems and consequences resulting from climate change are in developing countries and this mass migration may result in further tension and conflict in the areas they move.

Unsustainable Agricultural Practices

Soil degradation and the over-use of agrichemicals are sharply slowing down the rate of growth in crop yields (FAO 2009). Over exploitation of arable land and soil damage is causing the loss of

How to cite this article: Jonathan Ali Ogwuche, Owoicho Christopher, Dahiru K Muhammed. Environmental Issues and Food Insecurity in Africa. Int J Environ Sci Nat Res. 2018; 12(5): 555849. DOI: 10.19080/IJESNR.2018.12.555849

millions of hectares of once-productive crop land Pimentel et al. [17]. Also, 13 million hectares of land are lost each year through deforestation FAO [4]. As a result of these, much land is converted for agricultural use, with the stress on land in Africa much greater than that in other regions.

Changes in Atmospheric Composition

A higher concentration of carbon dioxide in the atmosphere has a direct effect on the physical processes in plants, such as photosynthesis and transpiration. In general, studies show that increased carbon dioxide in the atmosphere increases photosynthesis by between 10 to 50 percent and this is beneficial Gornall et al. [9]. However, comparing the overall effect of carbon dioxide on fertility with the results of climate change, the experts consider whether harvests increase or decrease. If carbon dioxide fertilization remains high, climate change will benefit agriculture in Europe and the United States of America. However, in Africa and India, despite the increased fertilization levels resulting from higher carbon dioxide, climate change will result in harvests falling by 5 percent in 2050 Gornall et al. [9].

Impact of Climate Change on Food Security in Africa

The latest IPCC Report says that about 90 percent of the sub-Saharan African population depends on rainfed agriculture for food production, and this could result in decreased crop yields to 22 percent across sub-Saharan Africa. The report also says that at the same time, Africa's population continues to grow - animal growth is estimated at 2.4 percent and the population is predicted to double to 1.8 million by 2050.According to the Food and Agriculture Organization, and reported by Chatel [18], to feed the projected population, crop production will need to increase by 260 percent by 2050, yet crop models used by the international food policy research institute indicate that by 2050, if current how input crop management practices were maintained, average rice, wheat, and maize yields in sub-Saharan Africa will decline by up to 14, 22 and 5 percents respectively as a result of climate change. Based on 2012-2014 information for the FAO Africa Region, 214 million people are undernourished FAO [19]. And IPCC [14] defines how the most crucial factors of a household's food security can be affected by climate change in the following ways;

a) Food availability is expected to be heavily impacted as climate change may transform the area suitable for agriculture, the length of growing seasons and yield potential.

b) The access to food and stability of supply are closely linked to the conditions of the infrastructure, which includes roads, railways, cargo transfer and the possibility to transport food over long distances by plane. Roads and railways might suffer under increasing weather stress and air transport might be regulated due to greenhouse gas reduction efforts.

c) The safety of food comes back to the quality of the available food. The production of yields from rain fed agriculture could be reduced by up to 50 percent by 2020.

Many countries in Africa are food insecure and a large portion of the population relies on subsistence farming where farmers both consume their product and sell it in local markets (Brown and Funk, 2008). The relative importance of climate change for food security differs between regions Gregory et al. [19]. Food security has a direct impact on human health, and the physical conditions of humans have a strong influence on their ability to work and earn money.

In general, climate change impacts on food security in Africa in the following ways;

a) The top 10 countries with the highest percent of their populations affected by drought are in Africa Kellett et al. [20].

b) 429,000 to 772,000 deaths from malaria in Africa in 2010, a trend that is climate drive Niang et al. [21].

c) Over 711 natural disasters killed over 40,000 people and affected over 137 million from 2005 to 2014 EM-DAT [22].

d) Climate change causes 22 percent of decrease in agricultural yields in sub-Saharan Africa.

e) Annual temperature increases and reductions in precipitation will reduce water availability, exacerbate the vulnerability of agricultural systems and increase climate relevant health impacts Niang et al. [21].

f) Adaptation to climate change estimated at $60 billion a year by 2030 Niang et al. [21].

Impact of Agriculture on Climate Change

While agriculture is regarded as a victim of climate change, its impact on global warming cannot be overlooked. A critical examination of this will impact significantly on the design and funding of policies to combat climate change. This, no doubt is a sure way in which measures can be implemented to make agricultural systems more resilient to the climate and attain food security. About 14 percent of human-generated greenhouse gases are estimated to come directly from agriculture SPORE [1]. For instance, almost half of all methane and nearly 60 percent of nitrous oxide emission are generated by agricultural activities, including livestock production, and fertilizer and pesticide applications. A further 18 percent of greenhouse gases come from land use changes such as clearance of forest for crops and pasture, soil erosion or machine intensive farming methods, which also contribute to increased carbon dioxide concentrations in the atmosphere. Global greenhouse gases emissions in 2050 need to be 85 percent below those of 2000 if we are to have a reasonable chance of limiting temperature rise to around 2 ^{0}C. To achieve this, global emission must peak no later than 2015 and get down to the level of 2000 emission by 2030 Pachauri [23]. The livestock sector is responsible for a large proportion (18 percent) of total global greenhouse gas emissions and therefore needs to make substantial reductions within a short timeframe. Livestock production is responsible for 37 percent of global methane (CH_4)

How to cite this article: Jonathan Ali Ogwuche, Owoicho Christopher, Dahiru K Muhammed. Environmental Issues and Food Insecurity in Africa. Int J Environ Sci Nat Res. 2018; 12(5): 555849. DOI: 10.19080/IJESNR.2018.12.555849

emissions, 65 percent of global nitrous oxide (N_2O) emissions, and 9 percent of global carbon dioxide (CO_2) emission Pachauri [23]. In addition, 64 percent of ammonia emissions originate in livestock production and contribute to air, soil and water pollution, arid rain and damage to the ozone layer Stenifeld et al. [16]. According to them, globally, the most important sources of livestock-related greenhouse gases are enteric fermentation (methane produced by digestion), animal manure and fertilizers used for food production.

Nitrious oxide emission are projected to increase by up to 35-60 percent by 2030 due to increased manure production by animals and increases in nitrogen fertilizer, much of which will be used to grow feed IPCC [14]. The expansion of large scale commercial production of pigs and poultry is predicted to raise global emissions of methane from pig slurry and nitrous oxide from poultry manure (United States Environmental Protection Agency USEPA [24]. Climate change directly and indirectly impacts many aspects of food security, particularly in the agricultural and livestock sectors. The livestock sector makes a significant contribution to climate change, while also being a prime cause of soil and water pollution.

Adaptation to Climate Change

The fourth (4^{th}) IPCC [2] report states that the maximum increase in global temperatures must be limited to 2 ^{0}C. This means that greenhouse gas emissions will have to be reduced. It therefore implies that international progress towards a global agreement to reduce greenhouse gas emissions should be geared up, as this will greatly contribute to offsetting the effects of climate change. Many farmers, especially in Africa, are starting to feel the effects of climate change and are seeing their subsistence threatened. The sooner the effects are accepted, the sooner appropriate measures can be taken to adapt agricultural systems to climate change. The IPCC define adaptation in 2001 as adjustment in natural or human systems in response to actual or expected climate stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation. This implies that as every continent or country varies with its own peculiarities, adaptation measures required vary from place to place. The challenge of adapting is much more difficult for developing countries because, in addition to being more exposed to the effects of climate change and being more vulnerable, they have weaker institutions and limited access to technology and markets (IPCC, 2001). According to IPCC, the extent to which systems are susceptible to climate change is a function of the magnitude of climate change, the sensitivity of the system to changes in climate, and the ability to adapt the system to changes in climate. However, the experts argue that the agricultural sector should be focused on the following areas:

a. Analysis of hot spots

b. Improvement and integration of weather forecasting systems

c. Early warning systems for serious weather conditions

d. Appropriate handling of risks resulting from natural disasters and the preparation of contingency and social and plans.

e. Rural investment, harvest insurance, incentives and the adoption of best farming and land use practices.

f. Improvement of water storage and conservation systems

g. Water reuse

h. Desalination

i. Increased efficiency of water use and irrigation

j. Changes to planting cycles for different crops

k. Improvements to land management to avoid soil erosion and

l. Implementation of disease monitoring systems to warm off possible outbreaks.

Measures to ensure food security in the face of climate change must aim to achieve sustainable and robost agricultural development, taking into consideration the needs of the most vulnerable such as women and children, while improving nutritional quality, as appropriate nutrition helps make the population more resistant to the consequences of climate changes such as disease outbreaks and poor hygiene.

UNDP has outlined a number of adaptation strategies that most African countries have adopted to aimed mitigating the impact of climate change. These include:

i. Agricultural decision-making, in Burkina Faso and Mozambique, is informed through improved automatic weather stations coverage and trained agronomists, agricultural extension workers, community radio staff and meteorologists.

ii. Regional climate information and early warning systems (EWS) have been enhanced through a partnership with the international research institute for climate and society, providing informed and timely decision-making.

iii. Indices for livestock and crops developed in Burkina Faso and Niger for implementation of weather index insurance schemes aimed at protecting small folder farmers against agricultural loss caused by extreme weather events.

iv. Adaptation planning has been improved in Burkina Faso, Malawi and Tanzania through the development of national and local adaptation plans that are aligned with planning and bud-setting frameworks through participatory processes involving rural communities.

How to cite this article: Jonathan Ali Ogwuche, Owoicho Christopher, Dahiru K Muhammed. Environmental Issues and Food Insecurity in Africa. Int J Environ Sci Nat Res. 2018; 12(5): 555849. DOI: 10.19080/IJESNR.2018.12.555849

v. Food security risk has been reduced in Malawi via the implementation of agro forestry as an adaptation measure with communities planting multipurpose trees alongside food crops.

vi. Regional climate products and services have been improved by training experts and equipping the two (2) regional climate centres in Africa - AGHRYMET and ACMAD - based in Niamey, Niger.

vii. Community resilience and livelihoods have been enhanced in vulnerable parts of Africa via supporting drought and flood risk management practices for small holder farms, as well as promoting innovative climate finance solutions, including micro-credit for small/medium enterprises and weather-indexed insurance for farmers, and

viii. Water security has been improved via water harvesting technologies and solar-based irrigation initiatives that have benefitted poor rural farmers across hundreds of communities.

Task for Agriculture and the Way Forward

To meet the needs of the world's expanding population, which is projected to be a million by 2050, farmers will have to produce more, baring climate change, which will lead to dramatic change in agricultural productivity and water availability. The added challenge is to produce more but in ways that will protect the environment, especially soil and water, while minimizing agricultural contribution to climate change. Agriculture is rapidly evolving to address the drivers of climate change, for instance through irrigation fertilizers and the provision of better germplasm for higher productivity and improved products WEF [25]. In many less developed parts of the world, increased production has occurred through the extension of agricultural lands rather than through intensification Henao and Baanante [26]. At a global scale, both intensification and extensification are currently having a significant negative effect in the environment, depleting the natural resource base upon which we rely (MEA 2005, IAASTD 2009). The need to reduce the environmental impacts while increasing productivity requires a significant change in the way agriculture currently operates WEF [25]. Beyond the threats, there are opportunities related to climate change for small holder farmers. The opportunity lies in Climate Smart Agriculture (CSA), defined as agriculture that sustainably increases productivity, resilience (adaptation), reduces/removes greenhouse gases (mitigation) and enhances achievement of national food security and development SPORE [1]. According food and agriculture organization, CSA has the potential to increase sustainable productivity increase the resilience of farming systems to climate impacts and mitigate climate change through greenhouse gas emission reductions and carbon sequestration (FAO). This no doubt represents a significant approach to achieving short and long term agricultural development priorities in the face of climate change and serves as a bridge to meeting other development priorities. Launched in 2015, the global alliance for CSA will help support countries and other actors in securing the necessary policy, technical, and financial conditions to enable the triple win (food security, adaptation and mitigation) that can be achieved through CSA approaches. All these practices in Table 1 address food security and lead to higher productivity, but their ability to address adaptation and mitigation varies. In most cases, food security improvements will also raise the adaptation capacity of farmers. Many CSA practices can be integrated into a single farming system and will provide multiple benefits that can improve livelihoods and incomes.

The world agroforestry centre (2011) enumerates all that should be done to overcome the challenges of introducing CSA, to include:

i. Provide an enabling legal and political environment.

ii. Improve market accessibility

iii. Involve farmers in the project-planting process.

iv. Improve access to knowledge and training

v. Introduce more secure tenure

vi. Overcome the barriers of high opportunity costs to land and

vii. Improve access to farm implements and capital.

Conclusion

Environmental issues, notably climate change impact heavily on food security, and have direct and essential impact on the human existence of the African continent. To meet the food needs of Africa's expanding population, she needs to innovate in terms of ideas, transformation models, new innovation platforms. Smallholders dependent on nature and weather can no longer feature as the main source of African agricultural output in the era of knowledge based world economy. Another added challenge is to produce more food but in ways that will protect the environment while minimizing agriculture's contribution to climate change. This means adapting to climate change and reducing climate footprint by curbing greenhouse gas emissions. The surest way out is through Climate Smart Agriculture CSA which advocates for changes in agricultural practices as well as the adoption of radically innovative technologies through soil conservation techniques and land management strategies to enhance productivity, resilience and the carbon balance of agricultural systems. At the third global science conference on CSA held in France in [27], 700 researchers and development experts from 75 countries highlighted the need to set up early warning systems, develop agro-ecology research, promote family farming and local agricultural research and to bridge gaps disciplines. For small holder farmers in developing countries, the opportunities for greater food security and increased income together with greater resilience will be more important to adopting CSA than mitigation opportunities. For

How to cite this article: Jonathan Ali Ogwuche, Owoicho Christopher, Dahiru K Muhammed. Environmental Issues and Food Insecurity in Africa. Int J Environ Sci Nat Res. 2018; 12(5): 555849. DOI: 10.19080/IJESNR.2018.12.555849

intensive mechanized agricultural operations, the opportunities to reduce emissions will be of greater interest.

Opportunities exist for CSA to mitigate climate change, improve resilience to climate impacts and increase food security. Table 1 below shows some of a range of practices that are consistent with CSA in smallholder systems as well as in line with the AU-NEPAD agriculture climate change adaptation - mitigation framework AU-NEPAD [28] while most of these are applicable to all regions and climates of the tropics and subtropics, some practices are more appropriate to humid conditions (e.g. rice management) [29] to dry lands (e.g. grassland restoration, drip irrigation or to slopes (e.g. terraces, contour planting).

Table 1: Climate smart practices useful in small holder agricultural production.

Crop Management	Livestock Management	Soil and Water Management	Agro Forestry	Integrated Food System
a) Intercropping with legumes, b) Crop rotation c) New crops varieties d) Improved storage and processing techniques e) Greater crop diversity	a) Improved feeding strategies b) Rotational grazing c) Fodder crops d) Grassland restoration and conservation e) Manure treatment improved livestock health f) Animal husbandry improvements	a) Conservation agriculture b) Contour planting c) Terraces and bunds d) Planting pits e) Water storage f) Alternate wetting and drying g) Dams, pits, ridges, h) Improved irrigation	a) Boundary trees and hedgerows b) Nitrogen-fixing trees on farms c) Multipurpose trees d) Improved fallow with fertilizer shrubs e) Woodlots f) Fruit orchards	a) Biogas b) Production of every plant. c) Improved stores

References

1. SPORE (2015) Technical Centre for Agricultural and Rural Cooperation: Global Warming: Doing Business in a Time of Climate Change. SPORE -The Magazine for Agricultural and Rural Development in ACP Countries.
2. IPCC (2007) Climate Change 2007: Mitigation of Climate Change. IPCC 4th Assessment Report, Working Group III. Chapter 8 Agriculture. Final Draft Pre-copy Edit Version.
3. Carlos L (2015) Agriculture as Part of Africa's Structural Transformation. Journal of African Transformation 1(1): 43-61.
4. FAO (2005) Global Forest Resources Assessment. First Area Statistics.
5. Caritas International (2015) Food Security Study: Summary Report Catholic Relief Services.
6. Ethan S (2015) Impact of Climate Change on Agriculture and Food Security in Nigeria: Challenges and Adaptation. Global Advanced Research Journal of Medicinal Plant 3(1): 001-009.
7. Khanal RC (2009) Climate Change and Organic Agriculture. The Journal of Agriculture and Environment 10: 100-110.
8. FAO (2007) Adaptation to Climate Change in Agriculture, Forestry and Fisheries: Perspective, Framework and Priorities. Inter-departmental Working Group on Climate Change of the Food and Agriculture Organization of the United Nations, Rome.
9. Gornall (2010) Implication of Climate Change for Agricultural Productivity in the Early Twenty-first Century. Phil Trans R Soc 365: 2973-2989.
10. Altieri MA, Nicholis C (no date) Cambio climatic y agricultura campesina: impacts respuestas adaptatives. University of California, Berkeley, USA.
11. Jones PC, Thornton PK (no date) The Potential Impacts of Climate Change on Maize Production in Africa and Latin America in 2055. Global Environmental Change 13: 51-59.
12. WMO (2006) Drought Monitoring and Early Warning: Concepts, Progress and Future Challenges.
13. IOM (2008) Report: Migration and Climate Change. IOM Research Migration and Series No. 31.
14. IPCC (2007) Climate Change 2007: Synthesis Report. International Panel on Climate Change.
15. Stern Review (2006) The Economics of Climate Change. HM Treasury and Cabinet Office.
16. Steinfeld H (2006) Livestock's Long Shadow: Environmental Issues and Options. FAO, Rome.
17. Pimental D (2008) Reducing energy inputs in the US food system. Human ecology 36: 459-471.
18. Chattel B (2015) Cocoa Trees Have the Shade, in SPORE.
19. FAO (2014) The State of Food Insecurity in the World.
20. Kellet J, Cavavan A, Pichon F (2014) Financing Disaster Risk Reduction: Towards a Coherent and Comprehensive Approach.
21. Niang IO, Ruppel MA, Abdrabo A, Essel C, Lennard J, et al. (2014) Africa in Climate Change 2014: Impacts, Adaptation and Vulnerability. Cambridge University Press, Cambridge, UK.
22. EM-DAT The International Disaster Database.
23. Pachaur RK (2007) IPCC 4th Assessment. Key findings. Presentation to UN, New York City, USA.
24. US-EPA (2006) Global Anthropogenic NON-CO_2 Greenhouse Gas Emissions pp. 1990-2020.
25. WEF (2010) Realizing a New Vision for Agriculture: A Road for Stakeholders. World Economic Forum, Geneva.
26. Henao J, Baanante C (2006) Agricultural Production and Soil Nutrient Mining in Africa: Implication for Resource Conservation and Policy Development. IFDC Tech, Bull, International Fertilizer Development Centre, Muscle Shoals, AI, USA.

How to cite this article: Jonathan Ali Ogwuche, Owoicho Christopher, Dahiru K Muhammed. Environmental Issues and Food Insecurity in Africa. Int J Environ Sci Nat Res. 2018; 12(5): 555849. DOI: 10.19080/IJESNR.2018.12.555849

27. PACJA (2015) Climate Smart Agriculture: Building Resilience and Safeguards for Smallholder Farmers. Policy Brief Paper, Nairobi, Kenya.

28. AU-NEPAD (2010) The AU-NEPAD Agricultural Climate Change Adaptation -Mitigation Framework. CAADP, Pretoria, South Africa.

29. Wlokes HL The Impacts of Climate Change on Food Security and Health in South Africa. Energy Research Centre, University of Cape Town, and the Free University Berlin.

DOI: 10.19080/IJESNR.2018.12.555849

How to cite this article: Jonathan Ali Ogwuche, Owoicho Christopher, Dahiru K Muhammed. Environmental Issues and Food Insecurity in Africa. Int J Environ Sci Nat Res. 2018; 12(5): 555849. DOI: 10.19080/IJESNR.2018.12.555849