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Full Length Research Article

CLIMATE CHANGE-RESILIENCE FARMING MODEL FOR ENHANCED FOOD SECURITY AND SUSTAINABLE DEVELOPMENT IN SUB-SAHARAN AFRICA

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ABSTRACT

The devastating impact of climate change on the agricultural sector threatens farmers' livelihood, food security, and environmental sustainability. This study identified trends in crop production reports, harvest reports, and climate change trends to provide critical information necessary to tackle chronic food insecurity and enhance environmental sustainability in West Africa. A systematic search of national and international organizations' databases, Google Scholar, Scopus, AgEcon Search, and Web of Science for peer-reviewed publications from 2010 to 2024 on Climate-smart agriculture practices in Sub-Sahara Africa was carried out. The results showed that Rwanda had the highest percentage of banana production (80.46 %) while Benin had the lowest (0.84 %). Nigeria had the highest Cassava production (67.65 %) while Burkina Faso recorded the lowest (0.02 %). On trends in yield harvested, Senegal had the highest banana yield (100 kg/ha), while Benin had the lowest (4.26 kg/ha). Overall, there was low yields and disruptive food production systems in West African countries. To curb with this challenge, there is a need for increased sensitization and awareness among farmers to adopt the climate-smart agriculture model, provide incentives and markets to help reduce chronic food insecurity and ensure environmental sustainability.

Keywords: Climate-resilience, Food insecurity, Environmental sustainability, West Africa

INTRODUCTION

The impact of climate change significantly influences global biophysical and socio-economic activities (Wiebe *et al.,* 2015). Food insecurity and climate change have gathered great attention among expert scientists, political leaders, and governmental, and non-governmental organizations universally. However, preventing the impact of climate change on agriculture requires different farming models such as climate-smart agriculture (CSA) or climate change resilience agriculture which remains the focal point for adaptation and mitigation of global and regional food insecurity (FAO, 2017; IPCC, 2019). Climate change resilience agriculture or climate-smart agriculture takes into consideration environment safety approaches such as enhancing farmers' adaptive capacity, improving agricultural intensification for meaningful living, and reducing and/or completing greenhouse gas elimination (Lipper and Thornton, 2014). In 2022, The Intergovernmental Panel on Climate Change (IPCC, 2022) observed that ecosystem degradation and weather disasters (flood, drought, storm surge, and hurricane), pose significant threats to climate change globally. In Sub-Saharan Africa, the impact of climate change is intensive due to dilapidated infrastructure, technology deficiency, and unpreparedness among member nations.

The recent climate predictions in sub-Sahara African countries revealed a drastic temperature increase than the global average above 2°C by 2050 which will significantly affect wildlife population, fisheries, and terrestrial and aquatic ecosystem sustainability (Niang *et al.,* 2014; Tesfaye *et al.,* 2018; Jacob *et al.,* 2023; Obot and Jacob, 2024). Although uncertainties existed in the expected rainfall pattern in the middle and end of the twenty-first century across SSA, severe storms, flooding, and droughts as extreme climatic events are also expected more frequently and with greater severity (AGRA, 2014; Jacob *et al.,* 2024). Hence, the impacts of such climate conditions may result in decreased agricultural productivity, reduced farmers' yields, and reduced economic output for farmers in the region.

In the West African Sub Region (WASR) unpredictable rainfall, recurring droughts, desertification, pest and disease infestation, poor soil quality, inadequate market access, and infrastructures remain a major challenge for farmers thereby putting immense pressure on food security in the region (Kpadonou *et al.,* 2017). About 3–6°C temperature rise and reduced/extreme rainfall pattern during the rainy season by 2100, indicating a future agricultural production risk in the region (USAID, 2017).

Food crops such as Cowpea, maize, millet, rice, sorghum, groundnut, and vegetables are mostly produced in the WASR. Unfortunately, the recorded average yield produced between 2010 and 2020 was below (<700 kg/ha) for cowpea, maize (<3000 kg/ha), millet (<1000 kg/ha), sorghum (<1500 kg/ha), and groundnut (<1500 kg/ha) in Mali, Niger, Nigeria, Ghana, South Africa and Kenya. This report revealed a remarkable decrease of about 5-25% in cereal crops, indicating significant food insecurity problems in WASR (FAOSTAT, 2022). Therefore, the need for urgent strategies and mitigation measures to cope with the impact of climate on poor rural farmers cannot be over-emphasized (Ou´edraogo *et al.,* 2019).

The use of climate-smart agricultural technologies (CSAT) to cope with the devastating effects of adverse weather, and climate change in agriculture and reduce greenhouse gas emissions has been extensively promoted among experts recently (CCAFS, 2022). Hence, adapting and implementing appropriate CSAT can help to ameliorate the impact of climate change over a long period (Di Falco and Veronesi, 2013). Different agricultural practicing models are categorized into CSAT this includes sustainable land management (SLM) practices, soil and water conservation (SWC), minimum tillage, improved grazing, intercropping, non-toxic and environmentally friendly agrochemicals (fertilizers, herbicides, and pesticides), improved varieties of crops and breeds of animals. The CSAT and/or climate change resilience agricultural model adopts preexisting practices and technology to enhance agricultural practices and ensure environmental sustainability. However, the collaboration between governmental and non-governmental organizations to introduce and disseminate CSAT in the WASR has been reported recently (Bello, 2024). CAST is usually introduced to farmers independently not as a complementary of the previous package (Bello, 2024). With the increasing human population in the WASR, augmenting farmers' access to these CSAT remains critical to cope with food insecurity challenge in this region (Olayide *et al.,* 2020; Ou´edraogo *et al.,* 2019).

Thus, this study examined the trend in crop production reports, harvest reports, and climate variability in West African countries to provide critical information to tackle chronic food insecurity and enhance environmental sustainability in the region. This approach is critical for stakeholders to make informed decisions in the adoption, encouragement, and dissemination of the Climate Change resilience Agricultural model and/or CSAT to cope with increasing food insecurity and ensure environmental sustainability in WASR.

Table 1: Climate Change Resilience Agricultural Model (CCRM) and its benefit

Categories of CCRAM	Reason for fitting into climate-smart and/or resilience Agricultural model
1) **Improved seed variety (ISVs)**	
Early and rapid maturation	Ability to withstand adverse weather conditions and variability
Improve yield	Improve crop production and profitability.
Resistance to drought and disease	Reduces agro-economic losses
2) Aspect of Agrochemical (AGC)	
Inorganic Fertilizer	Increase Crop productivity through poor/unfertile soil conditions recovery.
Herbicide	Enhance resilience to climate-induced stress in crops (disease and pest) resulting from climate change.
Pesticide	
3) Technology advancement/practices for Sustainable land management	
Conservation of soil and water	Increase resilience to weather stress and soil fertility improvement.
.Mulch compost	Reduced greenhouse gas (GHG) emissions (methane CH_4, and CO_2)
Cover Cropping	Help to improve soil fertility.
Minimal Tillage	Help in carbon sequestration.
Intercropping	Crop productivity improvement
Integrated pest management technology	Help to ensure food security and environmental sustainability.
Pasture and grazing improvement	Income diversification and promote food security

Source: Bello *et al.,* 2024 (Modified)

Numerous studies have investigated the contribution of the climate change resilience agriculture model to food security, job creation, and environmental sustainability in different parts of the world including Sub-Sahara Africa and Nigeria (Little *et al.,* 2023; Baraj *et al.,* 2024). The climate change-resilient agriculture model utilizes sustainable land management practices, such as conservation agriculture, agroforestry, and soil, and water conservation to improve water availability and quality, decrease soil erosion, and raise soil fertility, increasing family farming's productivity and adaptability (Sgroi 2022; Barrios *et al.,* 2020; Duc, *et al.,* 2021; Issahaku, and Abdul-Rahaman, 2019)

Climate change-resilience and environmental sustainability agriculture models rely on financial services provision, improved technology, and access to markets (Barnes *et al.,* 2020). Financial services and markets can furnish resources and incentives for investment and innovation. However, harnessing the potential of family farming as a model of climate change resilience agriculture still witnesses some levels of setback in West Africa due to inadequate infrastructural and policy frameworks, scarce resources, and lack of awareness (Sarker, *et al.,* 2023). Therefore, a collaborative approach involving farmers, policymakers, researchers, and civil society organizations, is imperative to address the challenges in adopting the climate change-resilience and environmental sustainability agriculture model (Sarker, *et al.,* 2023; Lamine, 2015; Jacob *et al.,* 2024).

MATERIAL AND METHODS

Description of the study area

The West Africa region is a tropical region from eastward from the Atlantic Ocean to Chad, separating the Sahara Desert to the north and the Sudanian Savana to the south (USAID, 2017). The region is highly vulnerable to climate change and environmental degradation. The temperature in this region was projected to increase about 1.5 times higher than in other parts of the world (Del Rio, 2014; USAID, 2017). The region was characterized by rapid population growth, chronic humanitarian drought, flooding, food insecurity, epidemics, violent conflict, and forced migration (USAID, 2017).

Data Collection

Secondary data sets were collected from national and international organizations' databases using a systematic search model. Relevant databases such as Google Scholar, Scopus, AgEcon Search, and Web of Science were searched for English-based relevant scientific peer-reviewed publications, including reviews, research articles, book chapters, books, and miscellaneous editorial material from 2010 - 2024 for published research papers on Climate-smart agriculture practices in Sub-Sahara Africa and other region of the world, food insecurity in west Africa, and Agricultural systems. The reference section of collected articles was also screened for relevant studies tailored toward the climate change resilience agriculture model and Climate-smart Agriculture. Also, Reports on organizations focusing on climate change resilience farming practices in Sub-Sahara Africa such as the World Bank, WHO, African Development Bank, FAO, and Consultative Group for International Agricultural Research were also gathered for this study. These data serve as key indicators that represent the capacity of individual countries to adapt to climate change. These indicators provide significant insight on the status of farmers' vulnerability in Sub-Saharan Africa to climate change-induced burden and food insecurity constrained. Considerations were given to datasets that were relevant to our

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research and the availability of variables related to the climate change-resilience farming model to ameliorate the food crisis and ensure environmental sustainability in Sub-Saharan Africa.

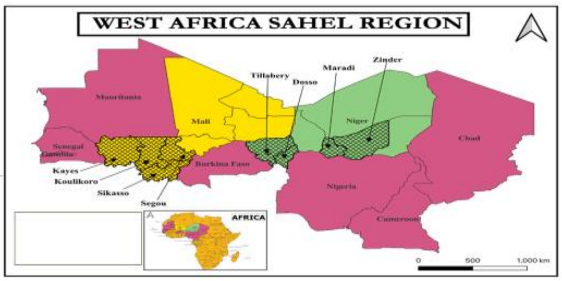

Fig. 1: The West African Sahel region.

RESULTS AND DISCUSSION

Production (Tonnes) of valuable food crops by some West African countries (%)

The percentage production of some important food crops by West African countries covering a period from 2015-2022 is presented in Table 2. Rwanda had the highest percentage of banana production (80.46%) while Benin had the lowest (0.84%). However, there was no data for Chad, Niger and Nigeria. The highest Cassava fresh production (67.65%) was recorded in Nigeria, while the lowest (0.02%) was recorded in Burkina Faso. Meanwhile, there was no record of cassava fresh production in Mauritania. This may be due to a lack of records by the farmers, lack of agricultural extension workers, and farmer literacy levels.

Climate change has chronic consequences on food security and environmental sustainability in Africa resulting in unpleasant environmental consequences (Adenle *et al.,* 2017; IPCC, 2007; Zougmoré *et al.,* 2021). The extremely low percentage production (tonnage) of cassava, groundnut, Banana, Millet, Rice, sorghum, vegetable primary, and maize produced by most West African countries explains the reason why food security is a major challenge in West Africa and other African countries. For example, maize is a major ingredient in human food and livestock feed. The percentage production recorded for the different countries in West Africa study revealed that most African countries depend on livestock feed importation for livestock production. With predicted high drought and unpredictable precipitation patterns in the mid to late 21st century, severe impacts of climate change are expected to worsen in West African countries (IPCC, 2007).

Table 2: Trend in percentage tonnage of food crops production (Tonnage) for some West African countries

Country	Bananas	Cassava, fresh	Groundnuts	Millet	Rice	Sorghum	Vegetable primary	Maize (corn)
Benin	0.84	4.60	1.93	0.25	2.48	1.15	2.86	6.83
Burkina Faso	1.99	0.02	5.27	9.50	2.49	12.35	5.04	7.70
Chad	n/a	0.34	9.77	6.99	1.66	6.79	0.42	1.80
Ghana	4.16	24.52	5.90	1.94	5.74	2.21	3.20	11.42
Niger	n/a	0.43	6.22	35.28	0.74	13.56	11.70	0.11
Nigeria	n/a	67.65	49.69	18.46	58.58	49.43	62.05	52.27
Rwanda	80.46	1.30	0.17	0.05	0.76	1.17	2.55	1.92
Mali	11.10	0.12	4.87	18.12	18.06	10.76	8.45	15.37
Mauritania	n/a	n/a	0.01	0.03	1.95	0.56	0.02	0.06
Senegal	1.45	1.02	16.16	9.37	7.53	2.02	3.71	2.51

Source: Authors' calculations based on FAOSTAT, 2022 food production data (2015 – 2022)

This adverse weather event led to a loss in agricultural production and caused a high poverty rate, asset loss, and insurance market underdevelopment (Adenle *et al.,* 2017). A traditional agricultural model such as subsistence farm households which depend on precipitation for sustenance is increasingly vulnerable to climate change (England *et al.,* 2018; Katengeza *et al.,* 2019). Increasing water scarcity by 2025 has been predicted in West Africa and SSA in response to population growth in the region (UNECA, 1999). This requires the need to improve agricultural productivity in West Africa and other African nations, Farmers need to adopt practices that increase food production and environmental sustainability.

Trends in yield (100 kg/ha) production of valuable food crops by some West African countries (%)

Table 4 shows trends in yield (100 kg/ha) harvested by some West African countries. Senegal and Burkina Faso, had about 22.95% and 22.31%, of total banana yield (100 kg/ha) harvested during this period, while Rwanda and Benin had the lowest trend about 8.26% and 4.26% respectively. Niger and Ghana had about 19.67% and 16.57% of total cassava fresh yield (100 kg/ha) harvested. The lowest was recorded in Chad and Nigeria about 6.73% and 5.58%. Ghana and Nigeria had about 15.92% and 12.68% groundnut yield (100 kg/ha) while the lowest was recorded in Niger and Rwanda 6.20% and 4.74% respectively. These results revealed low food crop productivity in West African countries. And the reason most West African countries cannot overcome food insecurity. Ahsan *et al.,* (2020) observed that in the tropical and subtropical regions of the world, crops are vulnerable to increased rises in temperature, thereby increasing the demand pressure on scarce water resources.

Table 3: Trends in yield (100 kg/ha) production of valuable food crops by some West African countries (%)

Country	Bananas	Cassava, fresh	Groundnuts	Millet	Rice	Sorghum	Vegetable primary	Maize (corn)
Benin	4.26	9.62	9.90	12.04	11.30	11.06	7.65	7.61
Burkina Faso	22.31	11.82	8.51	10.41	6.66	10.48	10.39	10.23
Chad	n/a	6.73	11.70	7.54	4.31	8.97	11.94	7.30
Ghana	10.02	16.57	15.92	16.99	10.06	12.23	10.83	13.91
Niger	n/a	19.67	6.20	6.55	13.43	5.53	14.50	6.74
Nigeria	11.91	5.58	12.68	13.08	6.84	13.05	4.50	11.43
Rwanda	8.26	9.62	4.74	6.79	11.44	11.11	6.83	9.09
Mali	20.30	11.24	9.62	11.04	10.00	10.32	13.15	16.55
Mauritania	n/a	n/a	8.33	3.09	15.06	4.91	6.19	4.02
Senegal	22.95	9.16	12.39	12.47	10.89	12.34	14.01	13.12

Source: Authors' calculations based on FAOSTAT, 2022 food production data (2015 – 2022)

From 2000-2019, it was reported that climate change will negatively impact the average crop yield in SSA by about 0.1 t/ha. This value represents more than a 10% average decrease in crop yield (FAO, 2023). However, similar studies in East African countries namely Kenya, southern Somalia, and southern Ethiopia revealed a decreased rainfall of about 50% to 75% below normal levels profoundly affected their food security because farmers in these regions heavily rely on rain for agricultural production. In comparison, this report was in line with the findings of this study and the reports of other studies in sub-Saharan Africa (Blanc, 2012, Abdi *et al.,* 2023). In these studies, the authors concluded that climate change significantly impacted agricultural production in the different regions of Africa with a severe effect on fisheries and other water resources, food security, environmental sustainability, and human health implications (Attiaoui, and Boufateh, 2019; Blanc, 2012, Abdi *et al.,* 2023; Jacob *et al.,* 2023). Also, it is imperative to note that environmental pollution and water sources used to irrigate agricultural land can impede the sustainability of the environment with severe human health consequences (Jacob *et al.,* 2024b; Isangedighi *et al.,* 2024).

CROP DIVERSIFICATION INDEX BY WEST AFRICAN COUNTRIES

The average levels of crop production in some West African countries are presented in Table 3. Ghana had the highest diversification in cereals (0.768), > Nigeria (0.658), > Rwanda (0.645), > Chad (0.614). The less diversified countries were Niger (0.421) and Mauritania (0.391). In Ghana, the diversification index was higher (0.812) in the 1960s and lower in 2000-2014 (0.714). In Nigeria, the diversification index was higher (0.751) from 2000-2014 and lower (0.563) in the 1960s. In Niger, the highest (0.273) crop diversification index was recorded in the 1980s and the lowest (0.255) was in the 2000s.

Table 4: Crop Diversification index by country

Countries	1960s	1970s	1980s	1990s	2000s	2000-2014	Average
Ghana	0.812	0.818	0.782	0.742	0.736	0.714	0.768
Nigeria	0.563	0.571	0.635	0.682	0.744	0.751	0.658
Rwanda	0.713	0.676	0.628	0.626	0.649	0.574	0.645
Chad	0.562	0.622	0.659	0.626	0.591	0.582	0.614
Benin	0.549	0.565	0.525	0.548	0.548	0.504	0.542
Mali	0.548	0.53	0.483	0.488	0.499	0.529	0.508
Burkina Faso	0.416	0.428	0.415	0.416	0.448	0.497	0.437
Senegal	0.409	0.381	0.37	0.396	0.479	0.463	0.412
Mauritania	0.314	0.282	0.335	0.453	0.471	0.507	0.391
Niger	0.262	0.259	0.273	0.257	0.255	0.259	0.261

Source: Kevin, 2021

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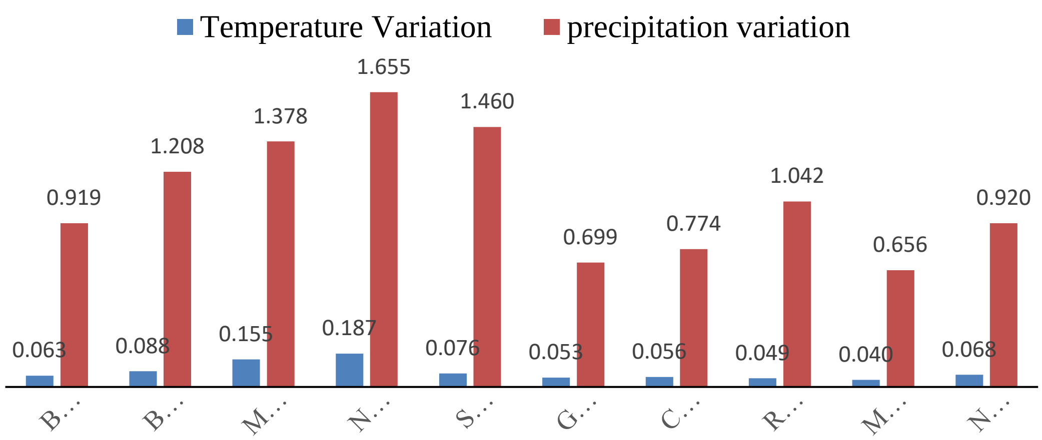
From the econometric calculation model, the Crop diversification index had a significant positive relationship for Burkina Faso, Nigeria, Senegal, and Chad. A similar, positive relationship though not significant was reported in Benin, Ghana, and Rwanda. On the other hand, an observed negative effect was seen in Mauritania, Mali, Niger and Senegal. A significant level of this effect was only reported in Mauritania. These results revealed the dynamics of crop diversification which indicate the increase and/or decrease in response to the past diversification process. The crop diversification agriculture approach is critical for improving food production and environmental sustainability (Bello *et al.,* 2024; Jacob *et al.,* 2024a). These results call for adopting a climate-smart agriculture or climate change resilience agriculture model as a panacea to tackle food insecurity and climate change in West Africa. Interestingly, opined that the dynamics of crop shift effect occur concurrently with yield output and change in climate pattern goes in line with (Banerjee *et al.,* 2015)

Climate Variability in West Africa

Variation in average annual temperature and precipitation patterns, for West African countries is presented in Figure 1. The wet climate was described from 1930-1960. However, 1970-1980 was marked by incensed droughts. The 1990s and 2000s were the return of rainfall in the region. The Sahel's population was significantly impacted by these climate variability (FAO, 2008). Significant changes in average annual temperature in West African countries have been observed from (1960-2015), indicating a 50-year observation period with increased temperature and decreased rainfall patterns in most West African countries.

Figure 1: Average annual temperature and rainfall for 10 West African countries, 1960-2015



Fig, 2: Temperature and precipitation variations. **Source:** Author's graphical illustration from Kevin (2021).

The average annual temperature and precipitation were 27.3°C and 89.2 mm, respectively for the entire region. The Sahelian nations had the highest mean temperature of 28.2°C compared to tropical nations' 26.9°C. The Tropical countries recorded the highest average precipitation of 118.1 mm, compared to the Sahelian countries' 38.6 mm. A coefficient of variation (CV) of about 0.082 temperature and 1.063 precipitation was reported for the entire sample. These values were higher in the Sahelian region than in the tropical region. For Sahelian and tropical countries, the temperature varies between 0.126 and 0.056.

The results for temperature variability and crop diversification revealed a negative relationship for most countries except Benin, Ghana, and Mali. A significantly positive effect was observed in Mali, indicating a lack of no adverse effect relationship between temperature and crop diversification. Another noticeable implication of this result is that precipitation variability has a negative and non-significant effect on crop diversification. Precipitation variability was significantly favorable for crop diversification in Burkina Faso and significantly unfavorable in Ghana. The results confirm the findings that the negative impact of climate variability on agriculture in West Africa is driven mainly by an increase in temperature, while rainfall has the potential to exacerbate or mitigate this impact depending on whether rainfall decreases or increases (Sultan and Gaetani, 2016; Roudier *et al.,* 2011). No adverse effect of climate variability and crop diversification in most Sahelian countries was recorded for high temperature and rainfall variability. Only Senegal recorded negative non-significant effects. In China, Huang *et al.,* (2014) reported similar results in their study. They reported that in an area with extreme climate events, agricultural diversification is the favorable agricultural model to cope with such adverse weather conditions. Similarly, from previous experience, agricultural diversification was influenced by the weather event

Definition and descriptive statistics of the variables used in the econometric model

About 0.841 to 0.243 crop diversification index has been recorded across countries in sub-Saharan Africa. However, the average value for the entire sample analyzed was 0.540. Meanwhile, 0.617 and 0.405 average values were recorded for tropical and Sahalian countries respectively Table 6. This result revealed less crop diversification in the region. Crop diversification was higher in tropical countries than in Sahalian countries.

Table 5: Definition and descriptive statistics of the variables for econometric model

Variables	Description	Obs	Min	Max	All sample	Tropical countries	Sahalian countries
TCEI	Crop diversification index	550	0.243	0.841	0.540 (0.153)	0.617 (0.124)	0.405 (0.095)
Temperature	Average annual temperature in °C	550	25.2	29.7	27.3 (0.932)	26.9 (0.718)	28.2 (0.640)
Precipitation	Average annual precipitation in mm	550	5.55	277.9	89.2 (41.98)	118.1 (39.76)	38.6 (22.06)
Temperature CV	Coefficient of variation of annual temperature	550	0.028	0.217	0.082 (0.045)	0.056 (0.010)	0.126 (0.047)
Precipitation CV	Coefficient of variation of annual precipitation	550	0.533	1.962	1.063 (0.322)	0.856 (0.152)	1.425 (0.196)
Cereal Yield	Output in tonnes per hectare	550	0.257	2.721	1.000 (0.381)	1.154 (0.377)	0.729 (0.295)
Root and Tuber Yield	Output in tonnes per hectare	550	2.627	22.21	7.885 (3.476)	7.706 (2.583)	8.198 (4.634)
Agricultural Land	Total arable land and land under permanent crops in hectare	550	7.37E+07	1522000	1.87E+07 (1.80E+0)	1.68E+07 (1.99E+0)	2.22E+07 (1.34E+07)
Agricultural Labour	Number of persons	385	7.14E+05	1.26E+07	3.53E+06 (3.12E+0)	3.73E+06 (3.77E+0)	3.16E+06 (1.30E+06)

Source: Compiled from Kevin (2022)

Unequal distribution of crops among the lands revealed low level of crop diversification index. However, a zero index of specialization indicated less crops dominants. On the other hand, a value greater than zero indicate crop diversification. A value close to one signifies good crop diversification. Traditional agricultural model such as subsistence farm households which depends on precipitation for sustenance are increasingly vulnerable to climate change (England *et al.,* 2018; Katengeza *et al.,* 2019). Increasing water scarcity by 2025 has been predicted in SSA in response to population growth in the region (UNECA, 1999). Solving food insecurity due to increasing population of West Africa and other African nations, Farmers needed to adopt agricultural practices which enhances increase food production and environmental sustainability.

THE IMPLICATION OF CLIMATE CHANGE ON AGRICULTURE

Increasing adverse weather events resulting in economic losses have been reported globally. The agricultural sector is highly vulnerable to climate change (Deori. *et al.,* 2024). From 1998-2017, about US$2908 billion economic losses was reported for countries impacted by the devastating impact of climate. However, 77% resulted from climate change-induced impact in the agriculture sector (UNISDR, 2018). In West Africa, and other tropical regions of the world, from 2010-2039, an estimated 9% and a drastic decline in key crop yields was predicted for this region (Kritee *et al.,* 2019). According to World Bank (2021) climate change-induced agricultural losses might be as high as 35% for rice, 20% for wheat, 50% for sorghum, 13% for barley, and 60% for maize in the future depending on the area. Considerable crop losses, lower yields, and disruptions to food production systems have been reported globally due to severe heat waves, droughts, floods, and landslides with significant interference in food production process and impending food insecurity (Deori. *et al.,* 2024; Aryal *et al.,* 2020).

Conclusion

Climate change significantly affects various aspects of human endeavor. The agricultural sector is highly impacted by climate change leading to chronic food insecurity, reduced rural livelihood and environmental sustainability. Adoption of climate change-resilient agriculture model and/or smart agriculture technology to improve sustainable agriculture, ensure food security, and mitigate the impact of climate on agriculture in the West African region becomes critical. Application of science-based approach and technological advancement is essential for farmers to increase productivity, enhance resilience, increase revenue and ensure environmental sustainability. Inter-sectorial collaboration between farmers, academics, extension agencies, and policymakers to facilitate climate resilient agriculture and help farmers cope with the devastating impact of climate change in West African countries and other developing countries is imperative. Continuous research, technology innovation and capacity building to improve resilient and sustainable agricultural systems is important to cope with the present and future food insecurity challenges, enhance farmer livelihood, ensure environmental sustainability, and help in achieving the United Nations 2030 sustainable development goals.

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