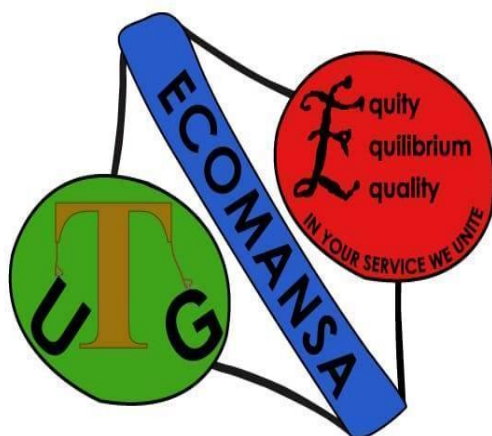


**THE IMPACT OF CLIMATE CHANGE ON AGRICULTURE IN THE GAMBIA AND
GUINEA BISSAU: CASE OF THE CASHEW SECTOR**



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ABSTRACT

This study aims to assess the efficiency and effectiveness of cashew production, identify climate change trends, analyze the vulnerability of cashew industries, and evaluate mitigation strategies employed by stakeholders in The Gambia and Guinea Bissau.

The sample size determination relied on Slovin's formula, leading to 400 respondents for each country. The study encompassed three cashew-producing regions in The Gambia and four in Guinea Bissau. A structured questionnaire, pretested for clarity and relevance, was used for data collection.

Preliminary findings suggest that Guinea Bissau exhibits greater efficiency in cashew production, while both countries face challenges from changing climatic conditions. The Gambia appears more strongly impacted by climate change, with respondents expressing discontent and citing negative effects on cashew production. Stakeholders in both countries recognize the importance of mitigating climate change, emphasizing the need for government support, public engagement, and resource allocation for effective climate change initiatives.

This research contributes valuable insights into the comparative dynamics of cashew production and climate change impacts in The Gambia and Guinea Bissau, offering a foundation for informed policy interventions and sustainable agricultural practices in the face of climate challenges.

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CHAPTER ONE

1.0 Introduction

1.1 Background of the Study

The Gambia is one of the smallest mainland countries in West Africa with an arable land size of about 440 thousand hectares in 2021(World Bank). The 2018 Labor Force Survey (LFS) conducted by The Gambia Bureau of Statistics (GBoS) shows that the population of The Gambia is about 2.4 million people; the country's economy is mainly dominated by three main sectors: Services, Tourism and Agriculture respectively. In 2020 agriculture contributed about 23% to the Gross Domestic Product (GDP) and provides about 70% to 80% employment to the population (GBoS, 2018). Most of those engaged in agriculture are rural Gambians with less skills and low educational attainment. Overall, unemployment is a major phenomenon in The Gambia; about 35% of the population is unemployed.

Despite the significant role agriculture plays in the economy of The Gambia, there have been production setbacks in the sector over the past years. The sector has been experiencing a decline in productivity. According to studies, this is as a result of many factors such as Covid-19, Climate Change etc. In addition, according to the World Bank report on The Gambia Poverty and Gender Assessment (2022), the poverty rate in 2020 in The Gambia increased by 4.3% from 48.6% in 2015 to 53.4% in 2020; this is associated with climate change and other factors which have led to a declined in the agricultural sector.

On the other hand, Guinea-Bissau has a total land area of 2 812 000 hectares of which approximately 58 percent is agricultural land (1 630 000 hectares). About 71 percent of the land area is under forest while 38.4 percent is for permanent crops, arable land and other land. Whether from clearing for cultivation, local harvesting of wood, or for external commercial markets, the forest resources have been heavily degraded by rapid exploitation. The rate of deforestation has increased from about 2 percent per year between 1975 and 2000 to 3.9 percent over the 2000 to 2013 period (FAO). The population of the country is approximately 2,081,360 people as of December 11, 2022, based on world meter elaboration of the latest United Nations data. Guinea-Bissau is one of the best Cashew production centers in West Africa. The country has about 36,000 square km in area; most of its generally flat terrain averages just 20 to 30 meters above sea level, with low-lying plateaus in the east rising to 150m. The agro-food sector plays a central role in the Guinea-Bissau's economy, comprising almost half of GDP and harbors most of the labor force., It is a critical sector addressing both poverty and food insecurity, especially for the 120,000 small-scale farmers in the country. Mainly, cashew production is done by smallholder farmers around villages and about 85% of the population depends on cashew farming.

The significance of The Gambia and Guinea Bissau in the global cashew sector cannot be overemphasized. These two West African nations play a pivotal role in cashew production, contributing substantially to the world's supply of this economically vital crop. The cashew industry is not only a crucial source of revenue for both countries but also a paramount lifeline for their rural populations. The cashew sector provides employment opportunities for a

significant portion of the workforce, particularly in rural areas where alternative livelihoods are limited. Furthermore, cashew exports from The Gambia and Guinea Bissau bolster their foreign exchange earnings, supporting national economies and trade balances.

Guinea-Bissau relies significantly on cashew nuts as its primary export commodity, with a notable surge in exports over the past decade. The cashew harvesting industry stands as the predominant economic activity among households in Guinea-Bissau, underlining its vital role in the country's economy (World Bank, 2016).

However, in light of the importance of cashew in these two economies, climate change threatens the viability of this cashew sector. For instance, according to Loum and Fofarassy (2015), it has led to decline in production leading to a reduction in employment creation, export etc. Therefore, in light of climate change and as global demand for cashew nuts continues to rise, understanding and addressing the impacts of climate change on cashew production in these nations is paramount, both for the well-being of their citizens and the stability of the international cashew market.

The effect of climate change if not addressed by stakeholders, will lead to food insecurity and declining and worsened productivity in the coming years as a result of storms, drought, erratic rainfall and flooding etc. (Farooq et al., 2022). For instance, about 97% of farmers in The Gambia and Guinea Bissau depend on rainfall for agricultural activities and about 90% of the sub-Sahara African food and feed are provided by rain fed agriculture. Due to the fall in the agricultural sector in The Gambia over the past years, about 55.1% of the population cannot meet the daily required minimum calories of 2400 per day per person (Loum & Fofarassy, 2015).

Furthermore, from 2015 to 2020 these adverse effects of climate change have increased the number of household victims in The Gambia from 6.3% to 11.8%; most of these victims are from the poor households in The Gambia.

Climate change is another reason for the low output of agriculture as many developing countries are depending on farming characterized by droughts, hot temperatures and poor farmers who do not have proper management systems. In The Gambia, windstorms in 2021 nearly affected 17,000 people in 100 communities, destroyed social infrastructure and left 100 individuals injured and 10 persons dead. The climate change actions are not only affecting farmlands and creating unemployment as well as affecting the lives of individuals in their respective residences, increase in heat as the ozone layer depletes causing floods, low rainfalls, windstorms and other natural disasters (AFrican Development Bank, 2022).

In the pursuit of bolstering cashew production, various organizations have taken significant steps to enhance the cashew value chain in the West African region. Notably, a report by the U.S. Embassy in The Gambia (2020) highlights a pivotal initiative: In January 2020, the U.S. launched the \$38 million, six-year USDA Food for Progress project, LIFFT-Cashew. This initiative aimed at strengthening the regional cashew value chain, in The Gambia, Senegal, and Guinea-Bissau, underlining the sector's growing importance and regional integration efforts. These strategic endeavors reflect the global recognition of the cashew sector's economic significance and its potential for further development.

It is crucial to understand climate change itself in the quest to mitigating its impacts. The Intergovernmental Panel on Climate Change (IPCC, 2007) defines climate change as a change in the state of the climate that can be identified by changes in the mean or variability of its properties and that persists for an extended period, typically decades or longer’.

To mitigate the adverse effect of climate change on agricultural output in The Gambia, the government and other stakeholders need to invest in the sector and the environment at large. Deforestation, bush burning, and the release of carbon monoxide need to be minimized. The sector has many dependents, and its contribution is just 1/3 to the GDP; this is as a result of low contribution by the government compared to other service sectors and other natural factors like low rainfall, high temperatures. In the 2020 national budget, less than 2% was allocated to agriculture. As the pronounced backbone of the Gambian economy, this meager allocation cannot foster any form of meaningful improvement in the agricultural section for a transformational national development.

In light of this background, therefore, it is necessary to conduct a comparative study on the impact of climate change on agricultural products between The Gambia and Guinea Bissau using the cashew industry as a case study.

1.2 Objective of the Study

The General objective of the study is to conduct a comparative study on the impact of climate change on agricultural products between The Gambia and Guinea Bissau using the cashew industry as a case study.

The specific objectives are as follows:

1. To assess the efficient and effectiveness of the cashew production in The Gambia and Guinea Bissau.
2. To determine which country among the two experienced more changes in the climatic condition in the past and present.
3. To assess the country’s cashew production that is mostly affected by climate change in The Gambia and Guinea Bissau.
4. To determine the available strategies stakeholders used to mitigate climate change.

1.3 Research Questions

This study will aim to answer the following research questions;

- 2.0 Which among the two (2) countries (The Gambia and Guinea Bissau) is more efficient and effective in the production of cashew?
- 3.0 Which among the two (2) countries (The Gambia and Guinea Bissau) has experienced more changes to climatic conditions in the past?
- 4.0 Which country’s cashew production industry is mostly affected by the changes to climatic conditions?

5.0 What are the available strategies stakeholders used to mitigate climate changes and the problems faced in the process of mitigating climate changes?

1.4 Significance of the Study

Climatic condition is a very crucial factor in the agriculture sector, especially in cashew production and it affects people's life. The performance of cashew production might depend greatly on the nature of the climate as varies from one climatic condition to another.

Information on how climate change affects the Cashew sector is needed to determine if there is a need for adjustment on the crop and/or livestock production system to a system that suits the current climatic condition. The paper can contribute on the following:

- Help farmers to mitigate the impact of climate change and boost cashew production by knowing the measures to take.
- Helps in determining whether there is a need for new measures to improve the climatic condition to a state that suits agricultural production in The Gambia and Guinea-Bissau.
- Help government make appropriate policies that is aimed at promoting good climatic conditions to boost the productivity of the cashew sector. This becomes more possible if the necessary information which this paper aims to offer is available.

1.5 Scope of the Research

The scope of this study is limited to the Effects of Climate Change on Agricultural Sector: Case of The Cashew Sector in The Gambia and Guinea Bissau by conducting survey in the two countries. In this research, agriculture is termed as land used activities involving cultivation, production, processing of food, and livestock keeping. This study seeks to assess the extent to which the effects of climate change on the agricultural products and some of the policy existing measure to address these challenges across the region. Thus survey interviews will be conducted, with the help of questionnaire for the farmers within The Gambia and Guinea Bissau.

CHAPTER TWO

2 Literature Review

This section review existing academic literature, reports, and studies related to climate change and agriculture.

Mendelsohn (2009), while assessing the impact of climate change on agriculture in developing countries concluded that tropical and subtropical agriculture in developing countries is more climate sensitive than temperate agriculture. His paper further reviews several studies that measure the size of the impact of warming on farms in developing countries He found out that global warming is expected to cause large damages to agriculture in developing countries over the next century even though adaptation will blunt some of the worst predicted outcomes.

Nugroho et al., (2023) compared the effects of climate change on the competitiveness of agriculture in developing and developed countries. They discovered that agricultural competitiveness raises temperatures in developing countries while decreasing temperatures in developed countries. The temperature change has the same effect of reducing the agricultural competitiveness in both developing and developed countries but agricultural competitiveness in developed countries is more sensitive to temperature changes. Ayinde et al., (2011) also revealed that change in temperature exerts negative impact while a rainfall change exerts positive impact on agricultural productivity.

Similarly, Ketema & Negeso, (2020) revealed that climate change has an important impact on agricultural output. Their error correction term coefficient was -0.738, suggesting about 73.8% annual adjustment towards long run equilibrium. Their estimated coefficients of short-run showed that mean annual rainfall have significant effect whereas average temperature has insignificant effect on output.

Bello et al., (2017) analyzed the opinions of cashew farmers of the climate change and its effect on cashew productivity as well as to identify the adaptation strategies developed to mitigate them. They discovered that producers have reported an increase in temperature and decrease in rainfall and an observable occurrence of violent winds. The new climate change indicators identified in their study were the high rates of dried flowers and yield losses.

Singh et al., (2013) discovered that the productivity of cashew is higher in regions where the minimum temperature ranges from 10°C to 22°C and is lower in regions where the minimum temperature drops below 10°C. Accordingly, their research showed that unseasonal rainfall and heavy dew during flowering and fruiting intensify the incidence of pests and diseases as well as deterioration of raw cashew nuts and finally affect the quality of kernels extracted from such blackened nuts While unseasonal rainfall of about 201 mm received at DCR farm during 15 to 25 March 2008 had affected the yield and quality of nut drastically. Studies conducted on “Impact of Climate Change on Cashew” by the Directorate of Cashew Research, Puttur, India, indicated that the rain-fed cashew crop is highly sensitive to changes in climate and weather vagaries, particularly during reproductive phase. Cashew requires relatively dry atmosphere and mild winter (15-20°C) coupled with moderate dew during night for profuse flowering. High temperature (>34.4 °C) and low relative humidity (<20%) during afternoon cause drying of flowers, resulting in yield reduction. Unseasonal rains and heavy dew during flowering and fruiting period aggravated the incidence of pests and diseases. All these situations resulted in reduction yield up to 50 to 65% (Datta, 2013).

According to Molua & Lambi (2007), decrease in precipitation and increase in temperature leads to a decrease in net revenue of farmers. The study revealed that the marginal effect of

temperature on net revenue is -15.4USD/ha and about 5.65USD/ha. The paper used a Ricardian cross-sectional approach on data from over 800 local farmlands. In his study, The Impact of Climate Change on Agriculture in Asia, Mendelsohn, (2014) discovered that both temperature and precipitation have significant impacts on net earnings and the impacts are not the same in each season. His overall results are predicted to be more harmful with a 3°C warming.

In another study, Mendelsohn (2017), while assessing the impact of climate change on Asian agriculture, used the coefficients of the Ricardian analysis of China to measure climate sensitivity and the magnitude of the impact of climate change on 29 countries in Asia – assuming farmers in these countries are as just climate sensitive as Chinese farmers. The paper revealed that 1.5°C warming will lead to a decline of 13% in crop net revenue and a 3°C warming leads to a fall in crop net revenue of 28%. However, the paper further revealed that, the magnitude of the impact varies from different climate conditions as warming in fact leads to a large percentage gain in places that have relatively cold springs.

In Benin, manifestations of climate change and its negative impact on cashew were perceived by producers in the zones. Rainfall trends are felt through signs such as irregularity of rains and decline in rainfall. There was also an increase in temperature and violent winds as indicators of climate change as well as a high rate of dried cashew flowers every year leading to a low yield of cashew. The study assessed the perception of cashew producers on the impact of climate change on cashew productivity using data on 217 surveyed cashew producers with ANOVA. The results further revealed that targeted respondents have been using techniques such as mulching, and fertilizer application as ways of mitigating the impacts of climate change on cashew productivity (Bello, et al., 2017).

CHAPTER THREE

3.0 Research Methodology

To conduct this comparative study, a scientific approach was followed which drew on scientific practice in this type of research work. The approach is grounded on literatures of similar papers.

3.1 Sampling Technique

The sampling technique for this research involved employing a random sampling approach to select participants from the cashew sector in The Gambia and Guinea Bissau. This method was chosen to ensure the representativeness of the sample, accounting for the variability of these two countries' cashew industries.

3.2 Sample Size Determination

Due to lack of data on Cashew farmers, the sampling frame used for the case of The Gambia was the Integrated Household Survey 2015 - 2016. The sample size was determined using Slovin's formula, considering a confidence level of 95% and a margin of error of 5%. After applying the formula; a sample size of 400 for each country using frame of each country was derived. In The Gambia, various regions, notably West Coast (WCR), North Bank Region (NBR), and Lower

River Region (LRR), were selected through probability sampling to ensure unbiased data collection. A similar sampling technique was applied for the case of Guinea Bissau. Again, with a targeted sample for each country of 400 respondents, it was fully met in the case of The Gambia but due to certain challenges, mainly of language barrier, 311 interviews were conducted in Guinea Bissau.

Below is Slovin's formula adopted for the sampling;

$$n = \frac{N}{1 + N(e)^2}$$

Where, n is the sample size, N the Population size and e is the Error margin. Since the areas of focus are three cashew producing regions in The Gambia namely, West Coast and the Greater Banjul Area, North Bank, and Central River while four cashew producing regions in Guinea Bissau (selected based on ease of access) namely; Bissau, Biombo, Oio and Cacheu; therefore, only the populations of these regions were considered during sampling.

3.3 Participant Selection Criteria

Participants in this study primarily consisted of cashew farmers and individuals within the realm of cashew value chain. The selection criterion for inclusion in the study was based on active involvement in cashew production or processing.

3.4 Questionnaire Design

To collect the necessary data, a structured questionnaire was developed. The questionnaire was designed using the Survey Solution tool, a versatile software that enables the creation of complex and detailed question in surveys. The questionnaire was meticulously developed to elicit detailed and relevant responses, addressing the specific objectives of the study.

3.5 Questionnaire Pretesting

Prior to the main data collection, the questionnaire was pre-tested on a small sample of participants within the cashew sector, but outside the final sample, to ensure clarity, relevance, and consistency of questions. After the pretesting phase, feedback from respondents was used to refine the questionnaire, ensuring that it addressed the research objectives effectively.

3.6 Enumerator Training

A team of enumerators, carefully selected for their familiarity with the local context and fluency in the languages spoken in the study areas, underwent rigorous training sessions. The training encompassed a comprehensive understanding of the research objectives, ethical considerations, and survey administration techniques. Given the diverse backgrounds and cultures of our participants, we prioritized ethical considerations. Enumerators were informed about the purpose of the study and trained on the tools used in assessing the impact of climate on cashew. Consent and cultural respect were paramount throughout the research process.

3.7 Data Collection and Analysis Process

Data collection was carried out by the trained enumerators using the Survey solutions tool, by visiting the selected participants, explaining the research's purpose and confidentiality, and administering the structured questionnaire through face-to-face interviews. The respondents' informed consent was obtained prior to data collection. Upon completion of data collection, the collected data were stored on the Survey solutions demo server and retrieved in dta format and

subsequent data analysis was conducted using STATA (Version 17th and others). The team conducted a descriptive analysis of the data, employed various statistical techniques to analyze and interpret the data, including graphs and charts to visually show the responses of respondents.

CHAPTER FOUR

4.0 Data Analysis

This chapter discusses the results of the study such as Demographic, Efficiency and effectiveness of the cashew sector, effects of climate change and other indicators.

4.1 Demographic Analysis

This section looks into the demographic characteristics of the respondents such as Age, Gender Nationality, Country of residence, and interview location

Table 1: Socio-Demographic Characteristics of Respondents

Characteristic	Count	Mean	SD	Min	Max
Female	710.00	0.44	0.50	0.00	1.00
Male	710.00	0.56	0.50	0.00	1.00
Engage in Cashew Sector	Count	Mean	SD	Min	Max
Farmer	710.00	0.75	0.43	0.00	1.00
Extension workers	710.00	0.01	0.10	0.00	1.00
Dealers middlemen	710.00	0.01	0.07	0.00	1.00
Regulator	710.00	0.14	0.35	0.00	1.00
Exporter	710.00	0.00	0.05	0.00	1.00
Ministry of Agriculture	710.00	0.01	0.07	0.00	1.00
Processor	710.00	0.00	0.04	0.00	1.00
Other	710.00	0.03	0.16	0.00	1.00
Nationality	Count	Mean	SD	Min	Max
The Gambia	710.00	0.55	0.50	0.00	1.00
Guinea Bissau	710.00	0.44	0.50	0.00	1.00
Senegal	710.00	0.00	0.06	0.00	1.00
Other	710.00	0.00	0.04	0.00	1.00
Country	Count	Mean	SD	Min	Max
The Gambia	710.00	0.56	0.50	0.00	1.00
Guinea Bissau	710.00	0.44	0.50	0.00	1.00
Region in Guinea Bissau	Count	Mean	SD	Min	Max
Biombo	311.00	0.50	0.50	0.00	1.00
Oio	311.00	0.22	0.41	0.00	1.00
Cacheu	311.00	0.28	0.45	0.00	1.00
Local Government Area	Count	Mean	SD	Min	Max
Brikama	399.00	0.67	0.47	0.00	1.00
Mansakonko	399.00	0.15	0.36	0.00	1.00

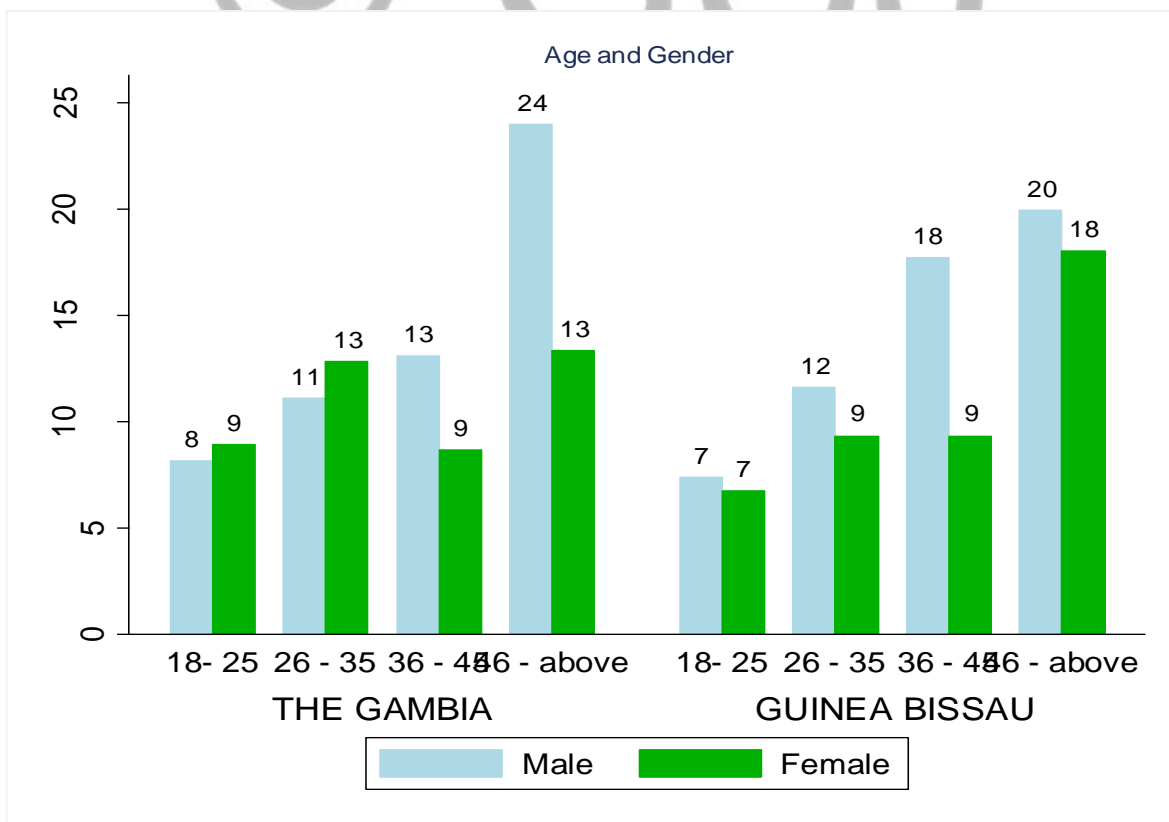
Kerewan	399.00	0.18	0.38	0.00	1.00
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Overall, a total of 710 respondents were interviewed during the data collections process which 399 (56%) were from The Gambia while 311(44%) were interviewed in Guinea Bissau. Of this, 44% were female while 56% were Male. Majority of the respondents interviewed were farmers which amounted to 75% of the total respondents. The remaining percentage is shared among other dealers in the sector.

Out of the total respondents interviewed in Guinea Bissau, about 50% were from Biombo, about 22% from Oio and 28% were from Cacheu. These were the three regions in the sample of regions in Guinea Bissau. In the case of The Gambia, the data collections were on three (3) Local Government Area (LGA) namely Brikama, Mansakonko, and Kerewan. Out of the 399 respondents in The Gambia, 67% were from Brikama, 15% from Mansakonko and 18% of the respondents were from Kerewan.

On the aspect of Nationality, 55% of the respondents were Gambian national, 44% were Guinea Bissau national and the reaming 1% were Senegalese and other nationals.

Figure 1: Age and Gender of Respondents

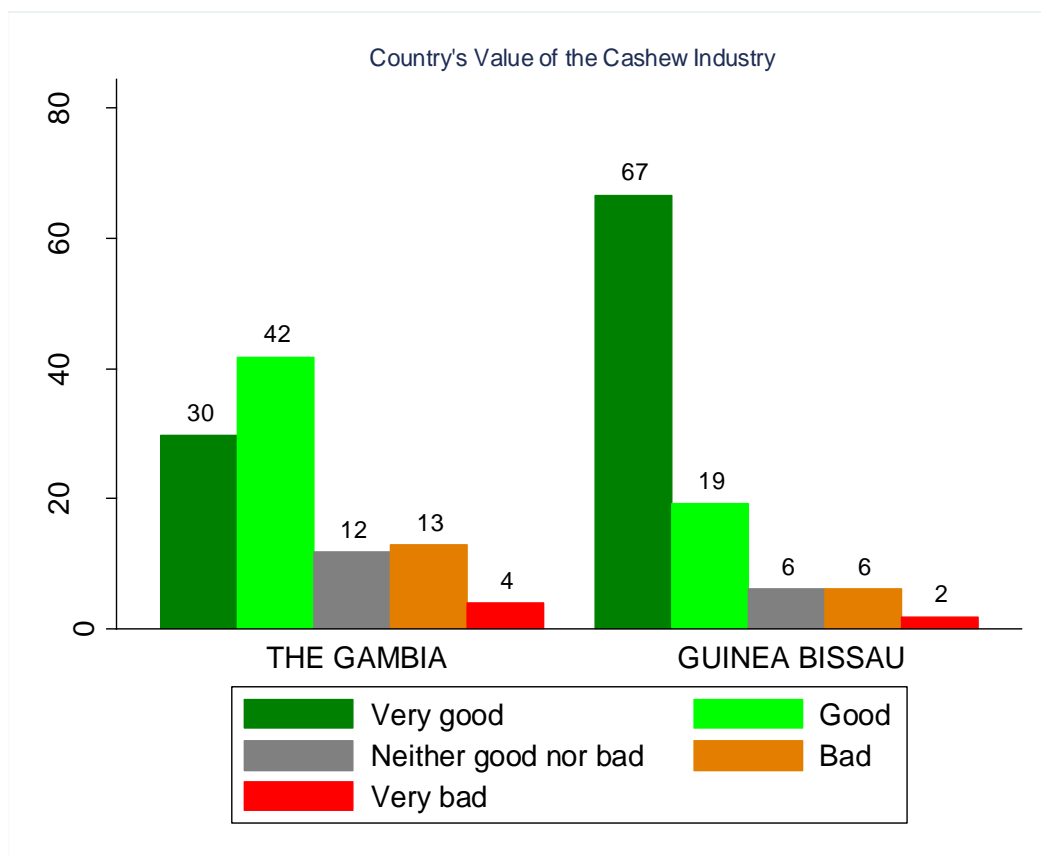


2.3 Efficiency and Effectiveness of Cashew Production

This section discusses the relative effectiveness and efficiency of cashew production in both countries.

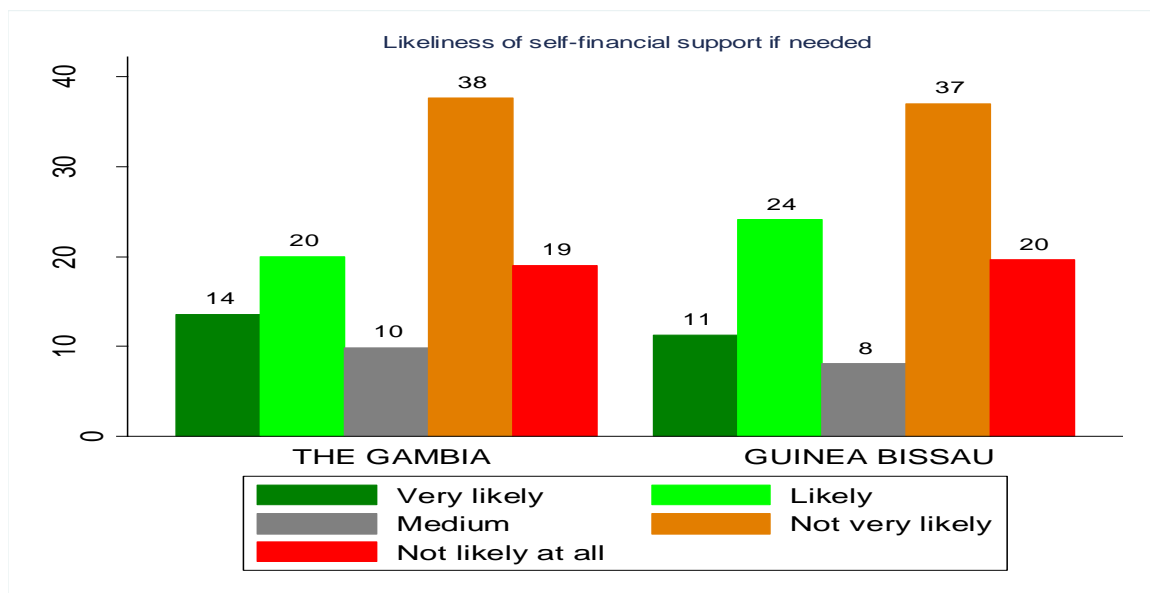
The figure below shows the level at which respondents valued cashew production. The results reveal that about 72% of the respondents in The Gambia said the level by which cashew is valued is at least good with 30% saying “very good”, whereas 86% of respondents in Guinea Bissau said cashew valuation is at least good with 67% saying “very good”. These results show that respondents in Guinea Bissau valued the cashew industry more than the respondents in The Gambia do. These results might be attributed to the fact that in terms of participation level in the sector exports and market share, Guinea Bissau has an upper hand than The Gambia. Furthermore, in The Gambia, about 17% said the level by which cashew is valued is bad relative to Bissau where only 8% said it is bad. The results further shows that about 12% and 6% of respondents in The Gambia and Guinea Bissau respectively are neutral with regards to the level by which people valued Cashew production. The fact that more respondents in The Gambia valued the cashew industry at most bad also supports our previous argument that the cashew industry is valued more in Guinea Bissau than in The Gambia.

Figure 2: Value of the Cashew Industry



The figure below shows the percentages of respondents about their likelihood to be able to support themselves when there is need for expansion. This can be used to measure the financial stability of those involved in the cashew value chain in both countries. There are very little differences as to the responses given by both countries, in essence, 34% and 35% of the respondents in The Gambia and Guinea Bissau respectively are at least likely to be able to support themselves financially when the need arises for business expansion. Although, majority of both countries are at most not very likely to be able to support themselves with 57% of both countries stating either not very likely or not likely at all. Although Guinea Bissau is slightly better, but the results revealed that the relative effectiveness of the financial stability in the context of potential expansion is almost the same in both countries.

Figure 3: Likeliness of Self-Financial Support

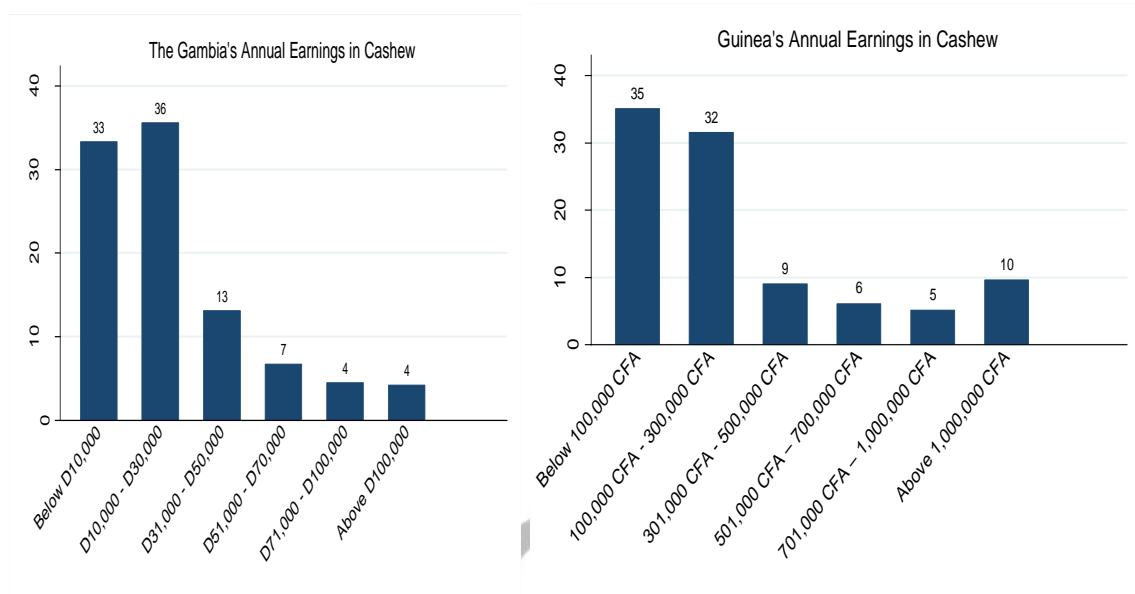


Like the relative effectiveness of their financial stabilities, the level of earnings of the two countries in the cashew sector is also similar. Majority of The Gambians and Guineans earn not more than D30, 000 (about CFA 300,000) per annum in cashew production, which is about 69% in The Gambia and 67% in Guinea Bissau. This signifies that majority of both countries who are involved are not very productive in cashew production. The most productive of them are those that earned more than D100, 000 (about CFA 1,000,000) per annum which constitute about 10% of Guinea Bissau and only 4% of The Gambia.

The above results might explain the why significant number of the respondents in both The Gambia and Guinea Bissau are not satisfied with their level production. The result reveals that about 32% respondents in The Gambia and 31% in Guinea Bissau are either not very satisfied or

not satisfied at all with their level of cashew production. Although 57% of respondents in The Gambia and 52% in Guinea Bissau said they are at least satisfied with their cashew production level, the number of respondents that are not satisfied and are prepared to produce more when given the required support is high in both countries.

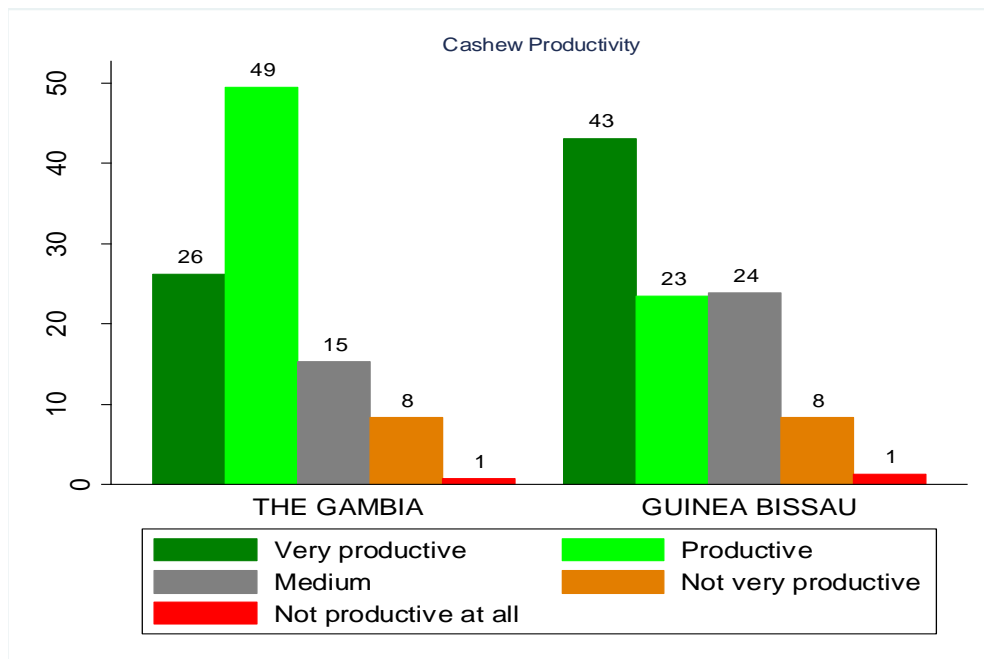
Figure 4: Estimated Country Earnings on Cashew



The figure below shows the percentage of respondents in The Gambia and Guinea Bissau with regards to their level of productivity in the cashew sector. The result reveals that about 75% of respondents in The Gambia said cashew production is “at least productive”, with 26% of respondents in The Gambia saying “very productive” while in Guinea Bissau, 63% saying “at least productive” and 43% saying “very productive”. Furthermore, 8% of “not very productive” and 1% of “not productive at all” is the response in both Guinea and The Gambia. Furthermore, 15% of the respondents in The Gambia and 24% in Guinea Bissau said that their cashew sector is neither productive nor unproductive, i.e. medium.

Based on the presented data, it can be concluded that Guinea Bissau appears to be more efficient and effective in the production of cashew compared to The Gambia. Majority of respondents in Guinea Bissau valued the cashew industry more positively, expressed greater satisfaction with their production levels, and reported higher productivity levels in the cashew sector. Additionally, Guinea Bissau had slightly better financial stability for potential expansion in the industry. These findings collectively suggest a higher level of efficiency and effectiveness in cashew production in Guinea Bissau relative to The Gambia.

Figure 5: Cashew Productivity



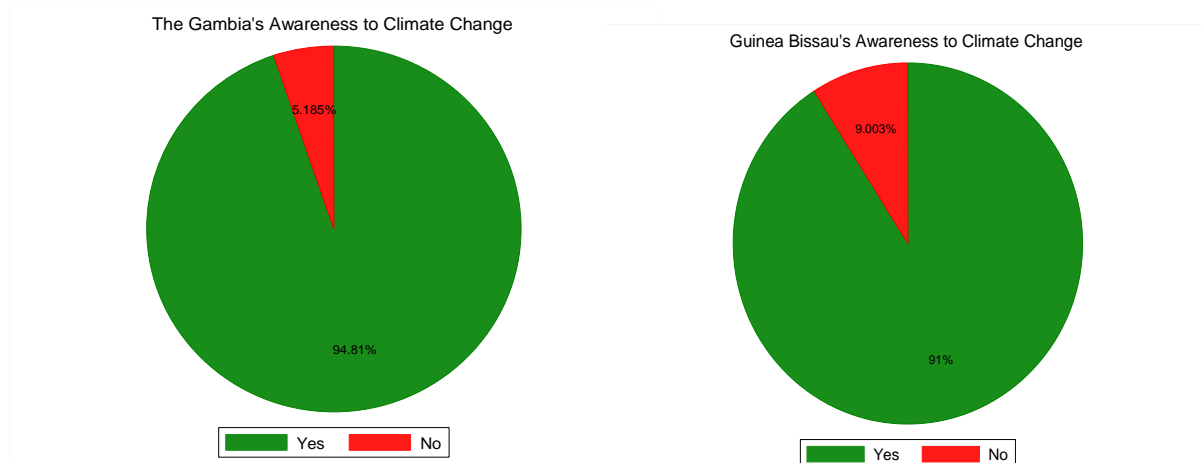
2.4 Changes to the Climatic Conditions

This section presents the results of respondents' experiences of changes in their climatic conditions.

A significant number of respondents in both The Gambia and Guinea Bissau agreed that climate is an essential factor that has strong bearing on cashew production. In The Gambia, 98% of the respondents agreed that Climate is an essential factor in cashew production while only 2% disagreed or stayed neutral. On the other hand, in Guinea Bissau, 81% agreed, 7% were neutral and 11% disagreed to the statement that Climate is an essential factor in cashew production. This significant agreement could be associated to the respondents' awareness of climate change. Furthermore, the number of respondents that realized changes to climatic conditions from the past to date is higher in The Gambia than in Guinea Bissau. The pie charts below illustrate the awareness of respondents to changes in the climatic conditions in the two countries.

The figure below shows climate change awareness in The Gambia and Guinea Bissau. 95% of respondents in The Gambia acknowledged that they have are aware of climate changes, while 91% in Guinea Bissau. Conversely, 5% of respondents in The Gambia and 9% in Guinea Bissau said they are not aware of changes in climatic conditions.

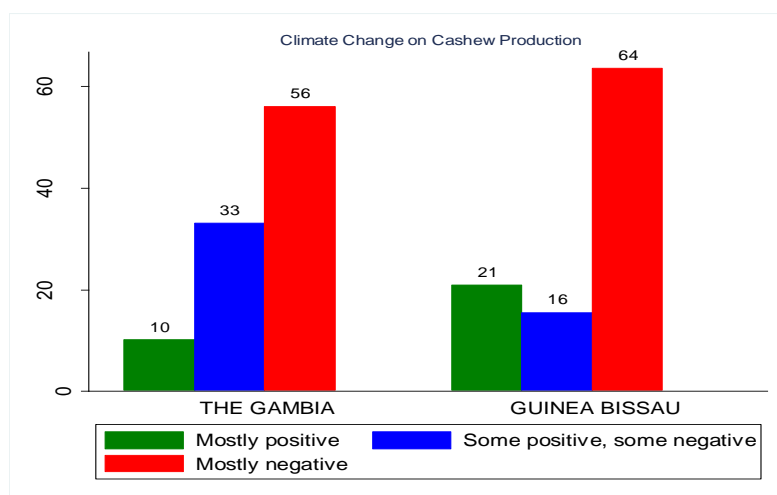
Figure 6: Awareness of Climate Change on Agriculture



Moreover, of the people who have realized changes in their climatic conditions, majority in both countries said these changes are most negative towards cashew production. The figure below depicts the responses given by these people about the nature of the climate changes they realized on cashew production.

The figure below reports the impact of climate change on cashew production in both countries. In The Gambia, 10% of respondents said the impact of climate change on cashew production is mostly positive, 32% of respondents were neutral, and 57% stated it is mostly negative. In Guinea Bissau on the other hand, 21% of respondents said it is mostly positive, 16% neutral, and 64% stated it is mostly negative.

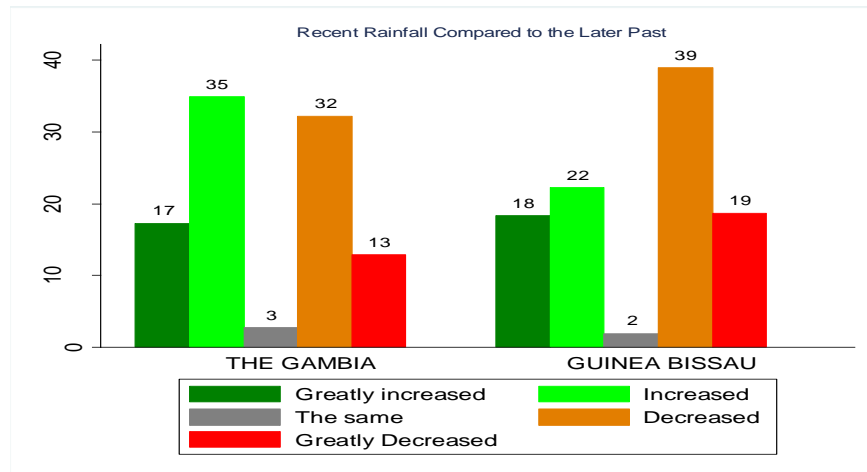
Figure 7: Effects of Climate Change on Cashew Production



Additionally, the results revealed a significant number of respondents agreed that the availability of rainfall in recent years has at least decreased compared to the previous years. The results are shown in the figure below.

Majority of the respondents in The Gambia said that the recent rainfall compared to the past has increased while the reverse was reported in Guinea Bissau. In The Gambia, 62% of respondents said rainfall has increased and 40% of respondents in Guinea Bissau said the same while 3% in The Gambia and 2% in Guinea Bissau said the level of rainfall remains the same. However, 45% in The Gambia and 58% in Guinea Bissau said it has decreased.

Figure 8: Recent Rainfall Compared to the Past



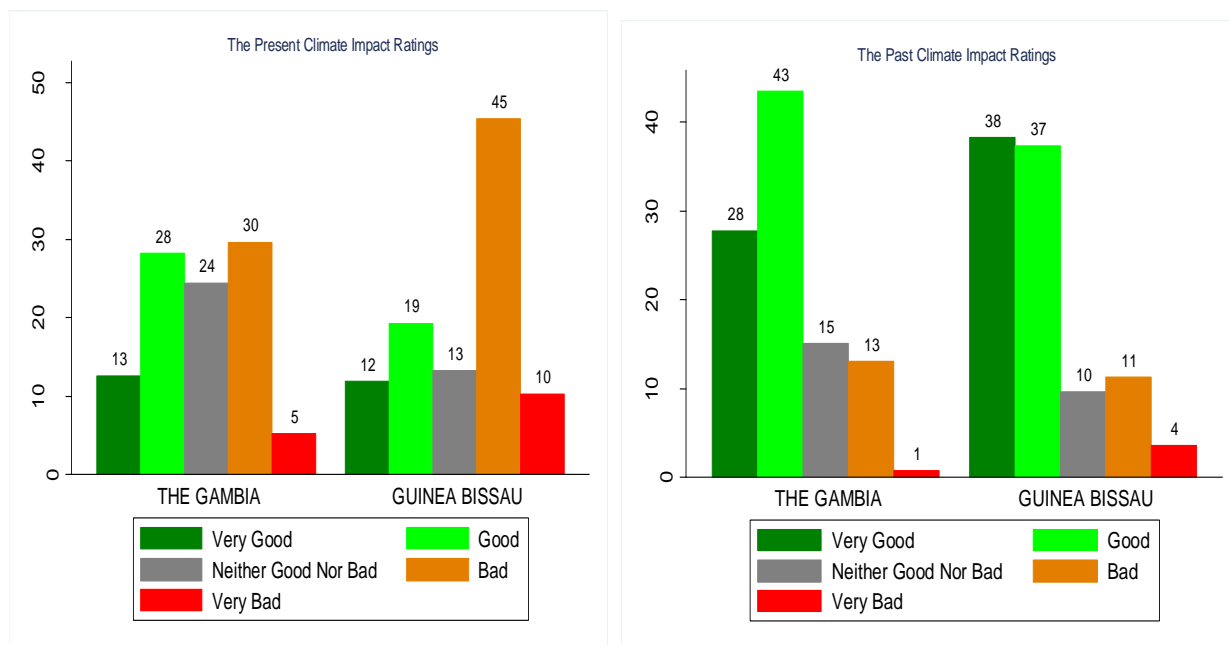
According to the reported information so far, it appears that both The Gambia and Guinea Bissau have gone through climatic shifts in the past; however, the type and scope of these changes may have varied between the two nations. Majority of respondents in both countries agreed that climate plays a significant role in cashew production and that climatic circumstances are changing. The Gambia had a somewhat higher proportion of respondents who said they were aware of climate change, which is noteworthy. Furthermore, although there are some differences in the proportions of positive and negative replies, it appears that both countries generally view the impact of these changes on cashew output as negative. These results imply that both countries have experienced difficulties as a result of changing climatic circumstances, although further research may be needed to determine the precise nature and severity of these changes in each country.

2.5 Effects of Climate Change on Cashew

This section discusses the results of the perception of the respondents on the effects of climate change using indicators such as rainfall and temperature.

The graphs below show the impact of current and past climatic conditions on cashew production. About 71% of respondents in The Gambia and 75% of the respondents in Guinea Bissau said that the climate condition in the past was good towards cashew production, while 14% in both The Gambia and Guinea Bissau said it was bad. In the present climate ratings, the dominant response from both countries is that climate towards cashew production in bad (35% and 45% in The Gambia and Guinea Bissau respectively). The number of respondents who maintained that the current climate condition is good towards cashew production is 29% in Guinea Bissau and 33% in The Gambia.

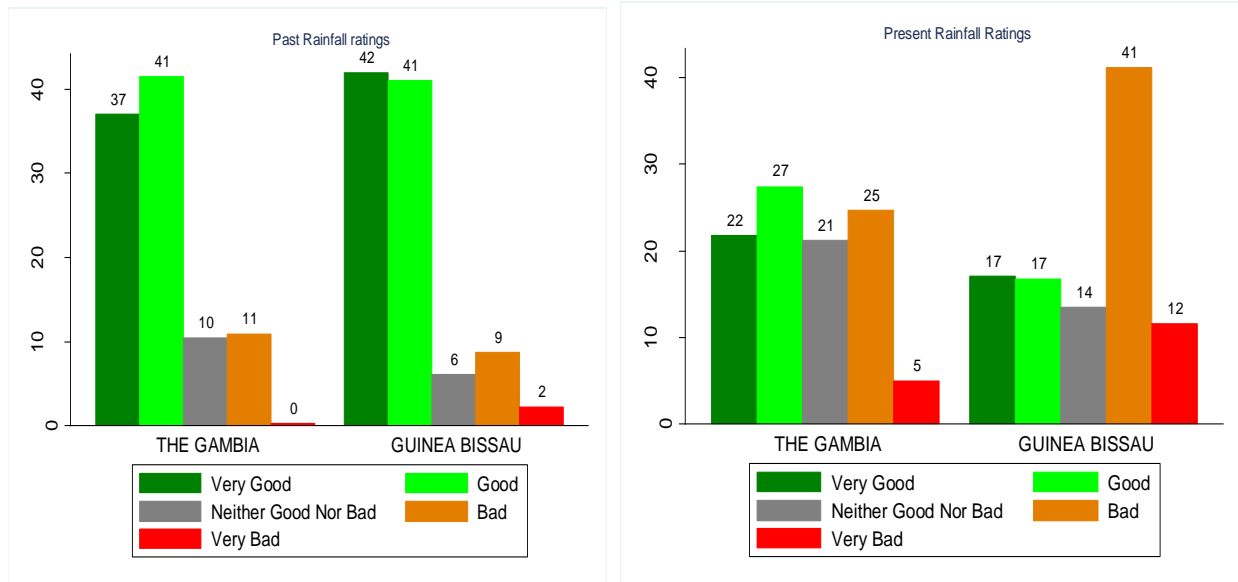
Figure 9: Past and Present Climate Ratings



This result implied that, there has been a significant change in the climatic condition with regards to agricultural production in both countries, cashew production in particular. The fact that Guinea Bissau records majority in both statements that it was at least good in the past and at least bad now may lead one to conclude that Guinea Bissau has experience a greater change to climate than The Gambia.

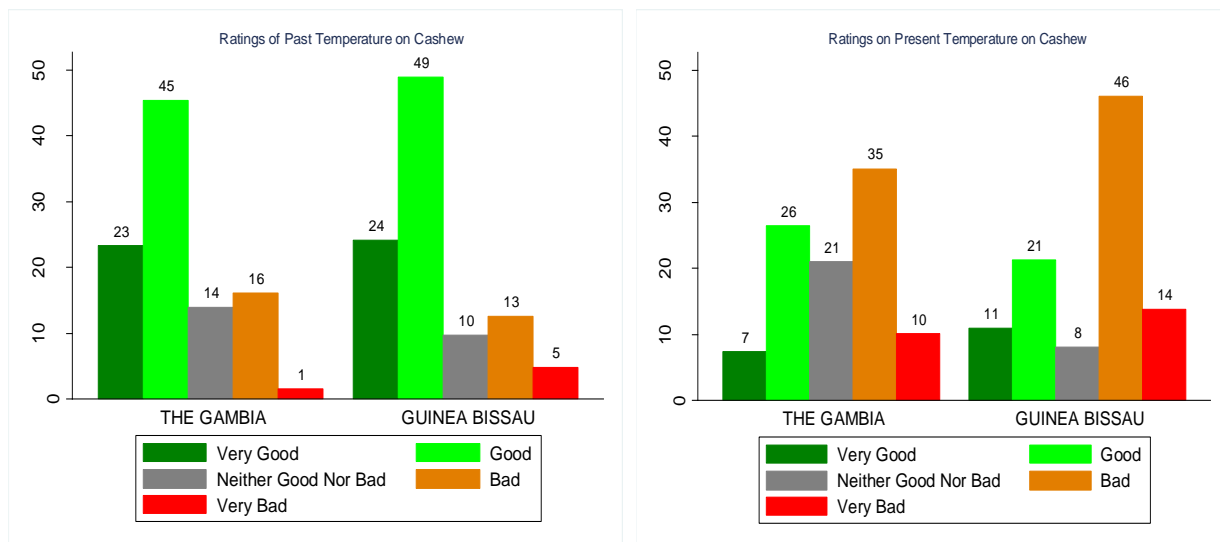
The below figure exhibits rainfall availability in The Gambia and Bissau in the past. Majority of the respondents from both countries said rainfall availability in the past was good (78% of respondents in The Gambia and 83% in Guinea Bissau). In the present rainfall ratings, 53% of the respondents in Guinea Bissau said that it is bad while in The Gambia, at least 30%. This infers that rainfall availability has greatly changed overtime more in Guinea Bissau than in The Gambia, conforming to the previous conclusion that there are more changes in climatic conditions in Guinea Bissau than in The Gambia.

Figure 10: Past and Present Rainfall Ratings



The temperature ratings also confirms the conclusion made above, with very good and good dominating in the past and bad and very bad dominating in the present climatic conditions. The percentage of respondents in Guinea Bissau dominates in both of these two cases, with 73% reporting “at least good” temperature in the past and 60% reporting “bad” temperature recently. In The Gambia, at least 68% said that temperature was good in the past, while 45% said that the current temperature is bad.

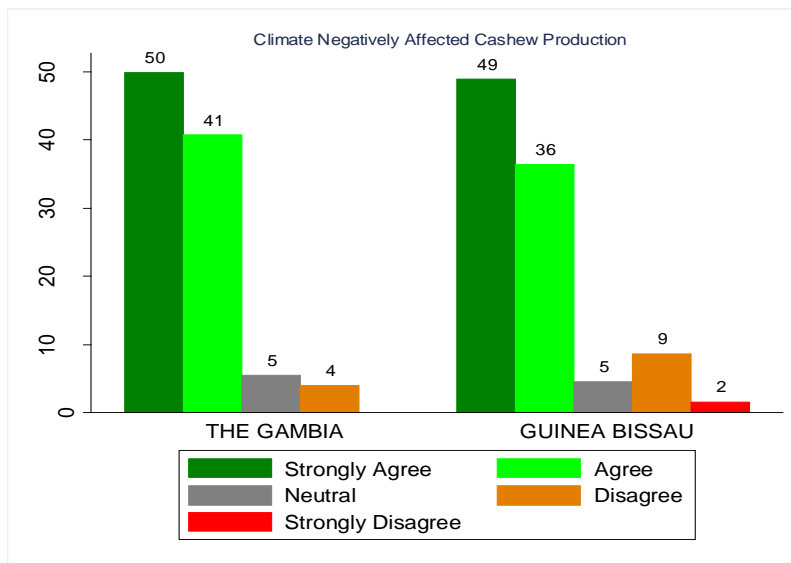
Figure 11: Past and Present Temperature Ratings



The graph below shows the negative effects of climate change on cashew yield. Majority of the respondents from both countries agreed that climate change has negatively affected the yield of

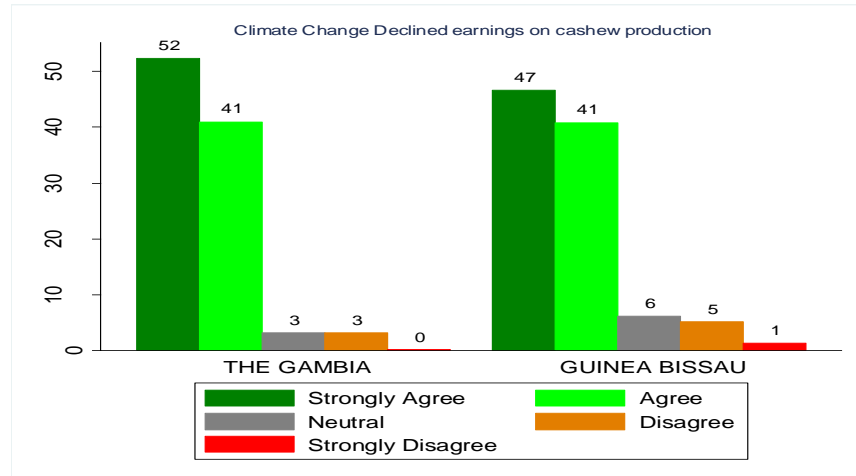
their cashew. The Gambia has the highest percentage of respondents who at least agree with 91% agreeing, while 85% in Guinea Bissau. In addition, 11% of respondents in Guinea Bissau at least disagreed while only 4% in the case of The Gambia. Guinea Bissau has more respondents that disagreed and this could be attributed how climate change has negatively affected cashew production; interesting to report is there were no respondents in The Gambia who strongly disagreed to it. With these results, it can be concluded that climate change has more negative impact on cashew production in The Gambia than in Guinea Bissau.

Figure 12: The Negative Effect of Climate on Cashew Production



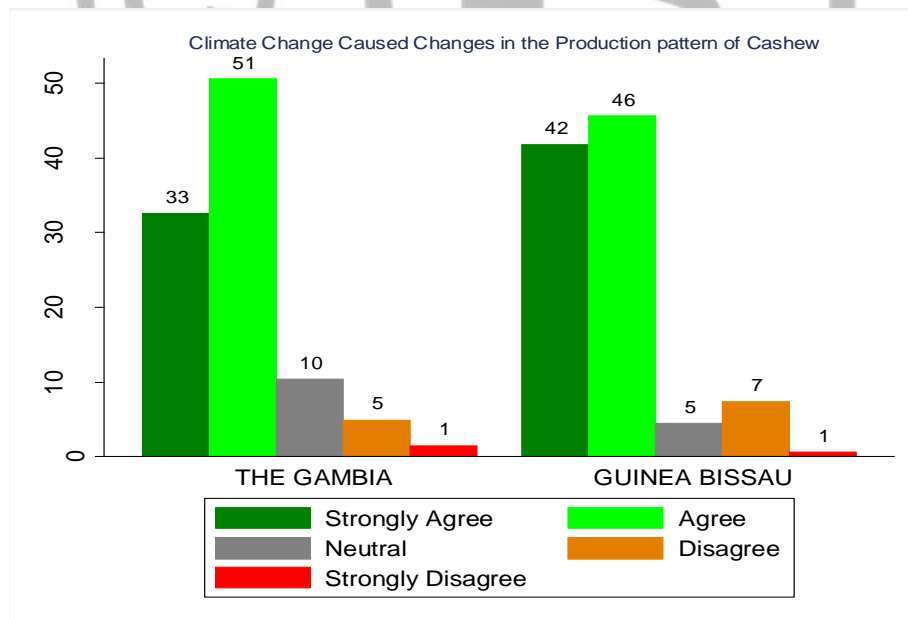
The figure below portrays the impact of climate change on the earnings from cashew. The result shows that 93% of the respondents in The Gambia and 88% in Guinea Bissau at least agree that climate change has caused a decline in earnings realized from cashew production. This significant response evinces that climate change has negatively affected agriculture in general and the cashew sector in particular in both The Gambia and Guinea Bissau. The fact that The Gambia has more respondents that agreed supports our previous conclusion that climate change has more negative impact on cashew production in The Gambia relative to Guinea Bissau.

Figure 13: Decline in Production Earnings Caused by Climate Change



Majority of respondents of both countries at least agreed that climate change has changed the production pattern of cashew. The figure below shows that 84% of the respondents in The Gambia and 88% in Guinea Bissau responded as such which is indeed very significant. This could be a point to draw strong conclusions regarding the effect of climate change on the pattern of agriculture.

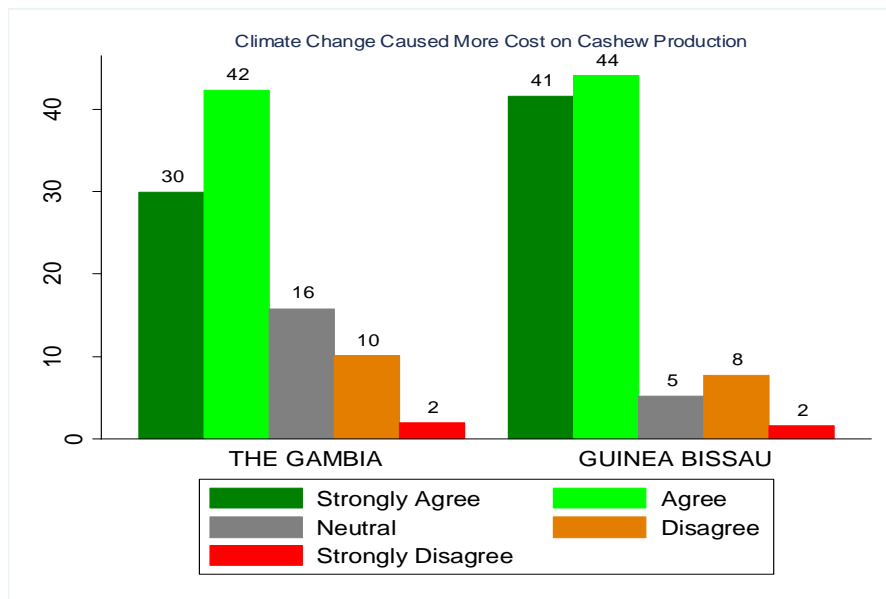
Figure 14: Climate Change Changed the Production Pattern of Cashew



In addition to the previous effects, the cost-effect of climate change was also used to gather more evidence on the effect of climate on cashew production. It was also discovered that majority of the respondents in both countries at least agreed that climate change has brought about more cost on the production of cashew; about 72% of the respondents in The Gambia and 85% in Guinea

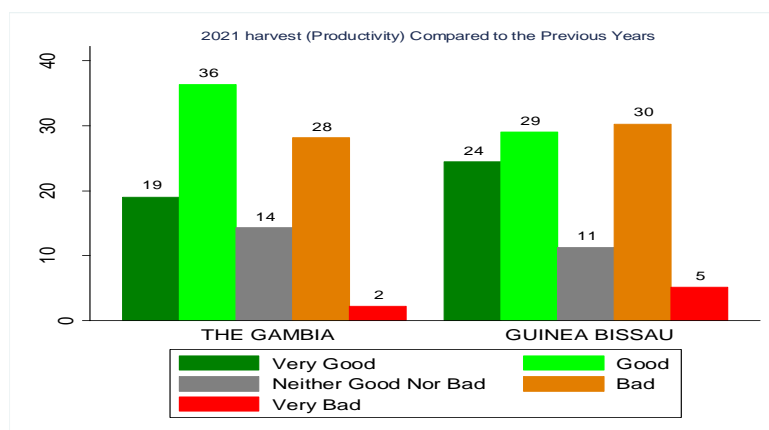
Bissau. Therefore, it can be concluded that climate change has a very huge impact on the cost of cashew production and hence on agriculture.

Figure 15: Climate Change Increased Cashew's Production Cost



The graph below shows the cashew productivity based on output in both countries. About 55% of the respondents in The Gambia and 53% respondents in Guinea Bissau agreed that the 2021 harvest of cashew was better than their previous years.

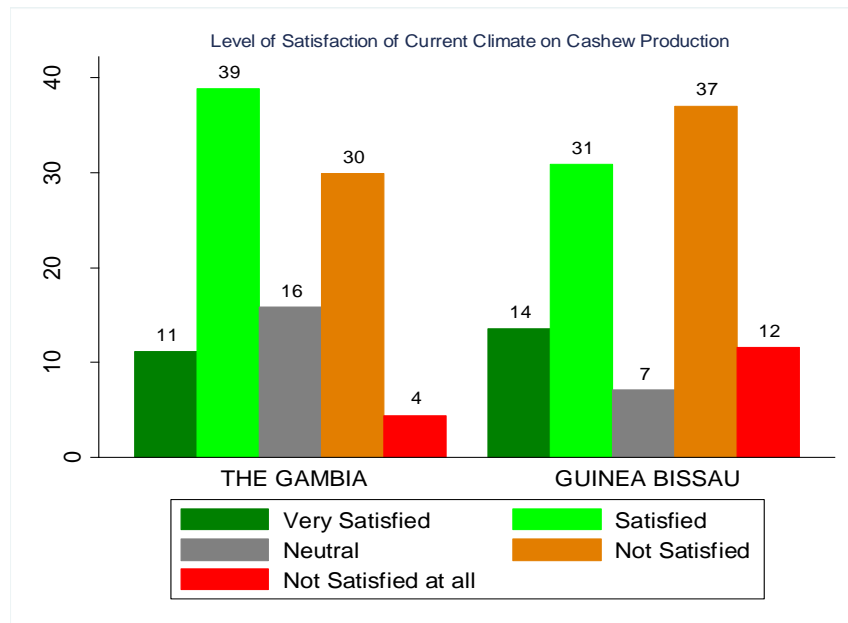
Figure 16: 2021 Harvest Compared to the Previous Years



The graph below shows the level of satisfaction about current climatic condition on the productivity of cashew in both countries. The result revealed that about 50% of the respondents in The Gambia and 45% of respondents in Guinea Bissau are satisfied with the current climatic conditions on cashew production. However, more respondents reported dissatisfaction in Guinea Bissau (49%) compare to in The Gambia (34%)

In addition, 16% of respondents in The Gambia steady neutral while in Guinea Bissau only 7% of the respondents stay the same. Therefore, it is safe to say that while the climatic conditions are not very favorable to some cashew producers both countries, a significant number in The Gambia are indifferent.

Figure 17: Level of Cashew Production Satisfaction



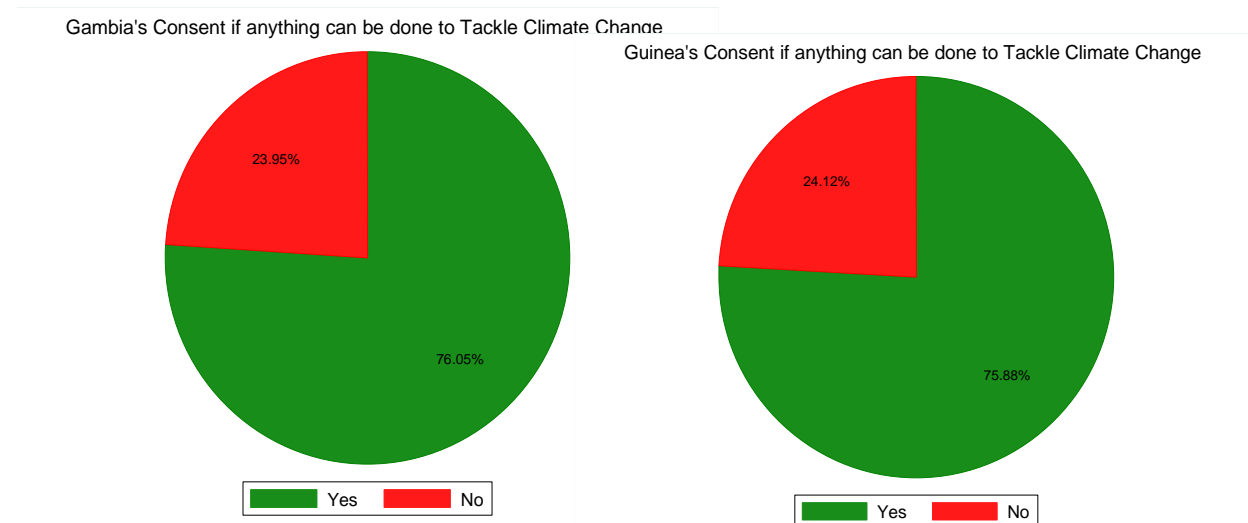
Compared to Guinea Bissau, it is likely that The Gambia's cashew producing business is more strongly impacted by changes in climatic circumstances based on the thorough study of the data that was presented. About half the respondents in The Gambia expressed discontent with the existing climatic conditions for cashew cultivation and cited negative effects of climate change on cashew production and revenue. The scope and severity of the negative effects of climate change appear to be somewhat less severe in Guinea Bissau than in The Gambia, despite the fact that Guinea Bissau recognized these effects as well. It is crucial to remember that both nations face climate change-related concerns, and that effective solutions will require more research and mitigation efforts.

2.6 Mitigation Techniques and Challenges Faced in Tackling Climate Change

This section presents and discusses the mitigation techniques that are practiced by the respondents and the challenges they faced while tackling climate change.

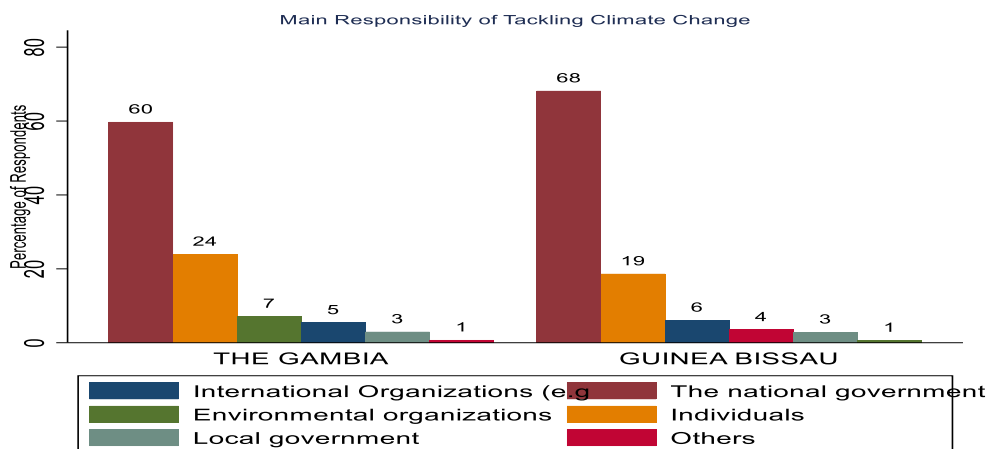
In The Gambia, about 76% of respondents agreed that something can be done to mitigate climate change, while about 24% did not. Almost the same amount agreed that something can be done to mitigate climate change in Guinea Bissau.

Figure 18: Possibility of Tackling Climate Change



In The Gambia, 60% believe the government is mainly responsible, 24% believe individuals are mainly responsible, 5% believe it's the responsibility of international organizations, 7% believe environmental organizations are mainly responsible, and 3% believe it's the responsibility of local government authorities. Only 1% believe it's the responsibility of others while In Guinea Bissau, 68% believe the government is mainly responsible, 19% believe individuals are mainly responsible, 6% believe it's the responsibility of international organizations, 1% believe environmental organizations are mainly responsible, and 3% believe it's the responsibility of local government authorities.

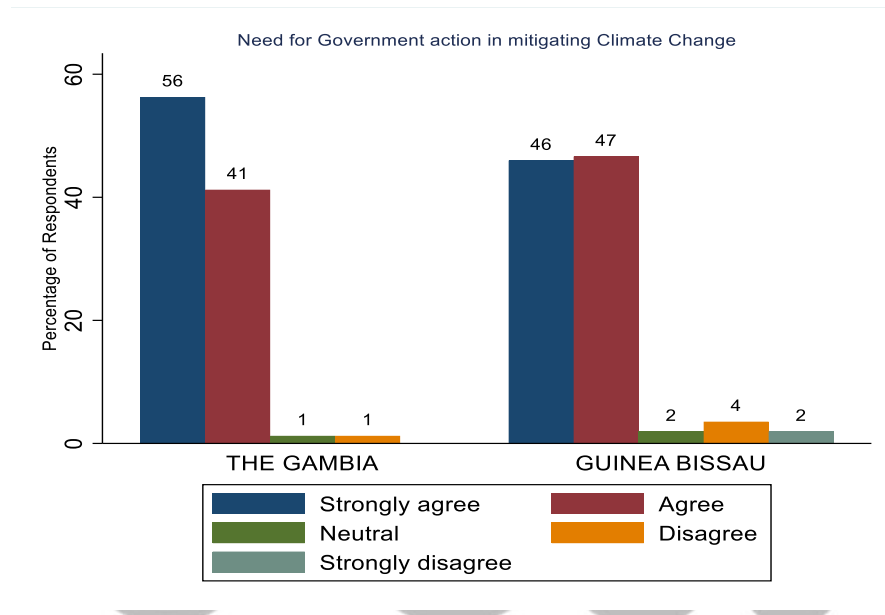
Figure 19: Main Responsibility of Tackling Climate Change



The fact that majority of the respondents believed that it is the government’s main responsibility to mitigate climate change justifies respondent’s dominant view that there’s need for government intervention.

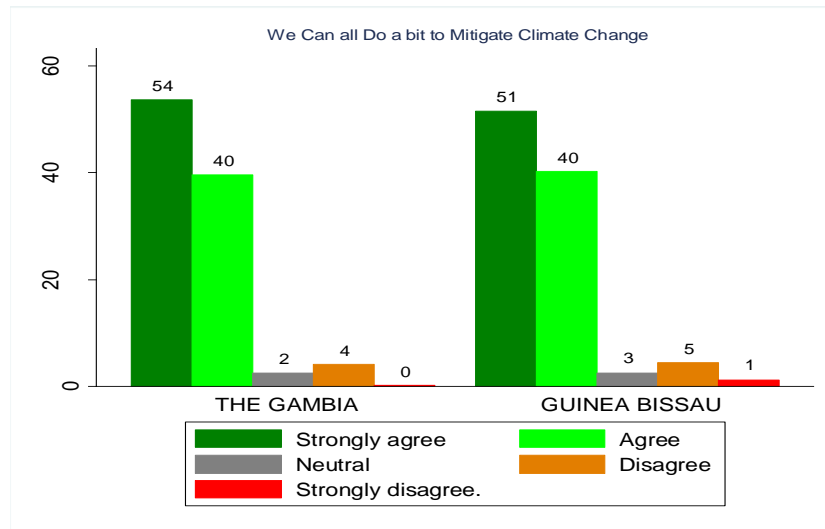
In The Gambia, 42% of respondents believe there is a need for action on climate change, while 58% do not see the need for action while In Guinea Bissau, 38% of respondents believe there is a need for action on climate change, while 62% do not see the need for action.

Figure 20: Need for Government Action?



In both The Gambia and Guinea Bissau, the majority of respondents express a positive sentiment toward the belief that individuals can contribute to mitigating climate change effects, with 94% and 91% combining strongly agree and agree responses, respectively. The Gambia demonstrates a slightly higher percentage of strong agreement, while Guinea Bissau shows a slightly higher combined percentage of disagreement. However, overall, both countries exhibit a strong consensus that individuals can play a role in addressing climate change, with minimal neutral or negative responses. The figure below represents the given analysis.

Figure 21: We Can All Do a Bit?



The figure below shows responses to the statement "Climate change is inevitable because of the way modern society works" in The Gambia and Guinea Bissau. In both countries, a significant majority, 76% each, either strongly agree or agree with the statement. The Gambia has a higher neutral response rate (14%) compared to Guinea Bissau (7%), while Guinea Bissau has a greater combined percentage (17%) expressing disagreement or strong disagreement, compared to 9% in The Gambia. These differences suggest varying levels of skepticism or disagreement within the two populations regarding the inevitability of climate change in the context of modern societal structures.

Figure 22: Climate Change Inevitable?

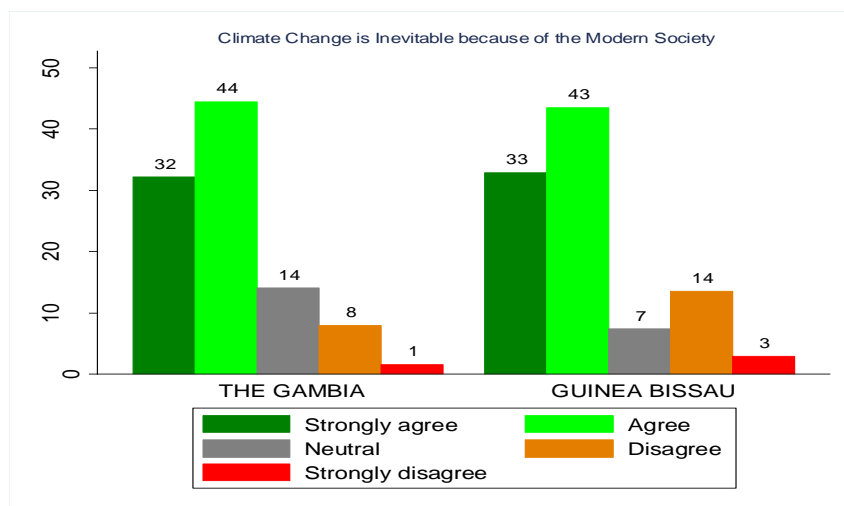
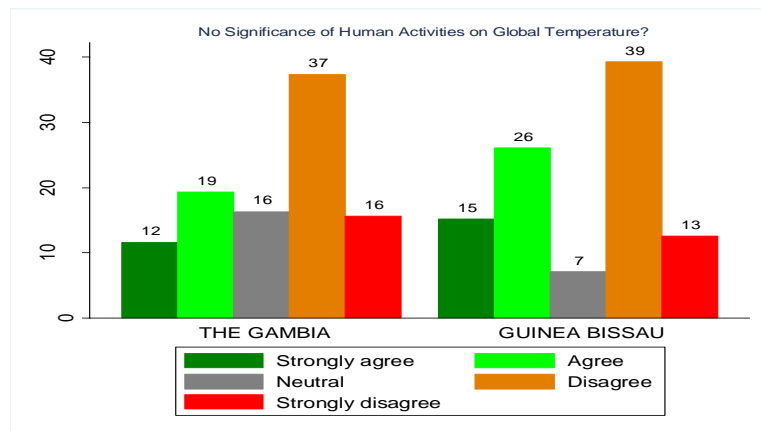


Figure 23 below illustrates responses to the statement "Human activities have no significant impact on global temperature" in The Gambia and Guinea Bissau. In The Gambia, a combined 31% (12% + 19%) agree with the statement, while 53% (37% + 16%) disagree, including 16% strongly disagreeing. In Guinea Bissau, a combined 41% (15% + 26%) agree with the statement,

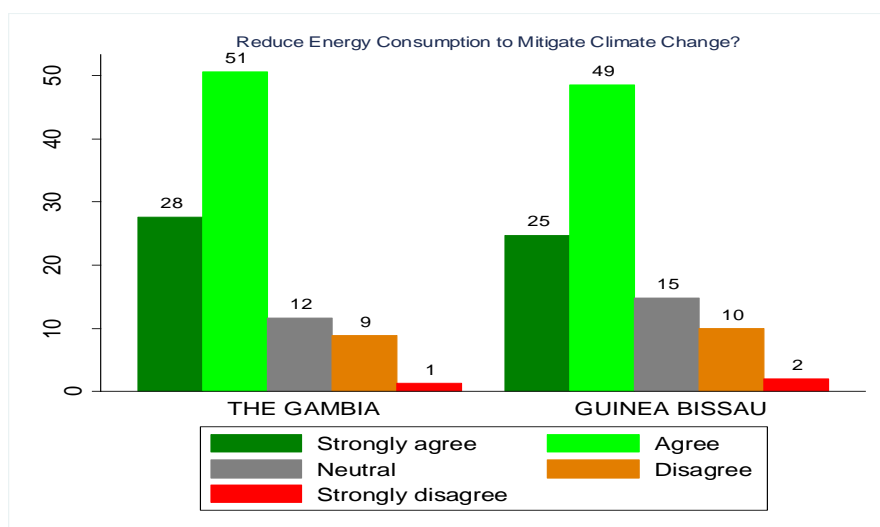
and 52% (39% + 13%) disagree, with 13% strongly disagreeing. Both countries demonstrate a substantial portion disagreeing with the notion that human activities have no significant impact on global temperature, with Guinea Bissau showing slightly higher percentages in both agreement and disagreement compared to The Gambia.

Figure 23: Human Activities Have no Significance on Global Temperature?



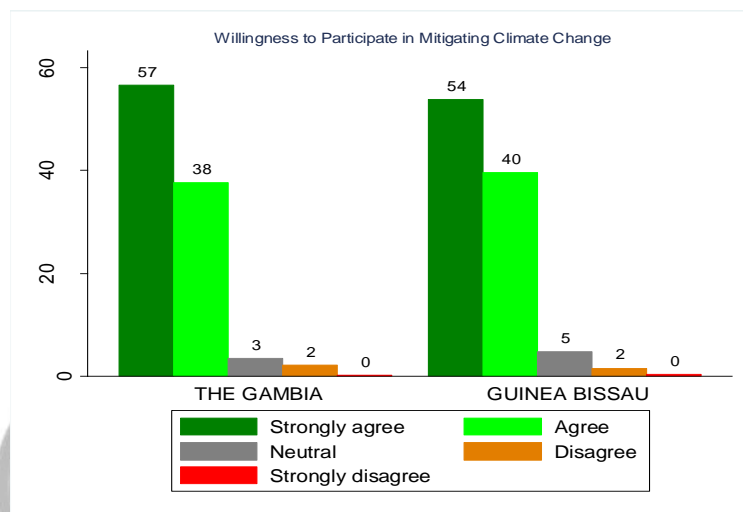
The figure below depicts responses to the statement "People should be made to reduce their energy consumption if it reduces climate change" in The Gambia and Guinea Bissau. In The Gambia, a combined 79% (28% + 51%) strongly agree or agree with the idea, while 10% (9% + 1%) disagree, with a minimal 1% strongly disagreeing. In Guinea Bissau, a combined 74% (25% + 49%) strongly agree or agree, and 12% (10% + 2%) disagree, with 15% expressing a neutral stance. Both countries express strong support for the notion that people should be compelled to reduce energy consumption for climate change mitigation, with slightly higher agreement percentages in The Gambia.

Figure 24: Reduce Energy Consumption to Mitigate Climate Change



The data reveals that in The Gambia, 95% (57% strongly agree + 38% agree) express a positive inclination towards personally contributing to climate change mitigation if others do the same, with only 2% in disagreement. Similarly, in Guinea Bissau, 94% (54% strongly agree + 40% agree) share this positive sentiment, with only 1% in disagreement. The figure below visualizes the responses.

Figure 25: Willingness to Participate in Mitigating Climate Change



The figure below shows respondents' ideas pertaining to government looking after environment's protectors in societies. It shows reports that 97% of The Gambia and 93% of Guinea Bissau at least agreed that government should be taking care of people who are looking after the environment.

Figure 26: Government Looking After the Environment's Protectors

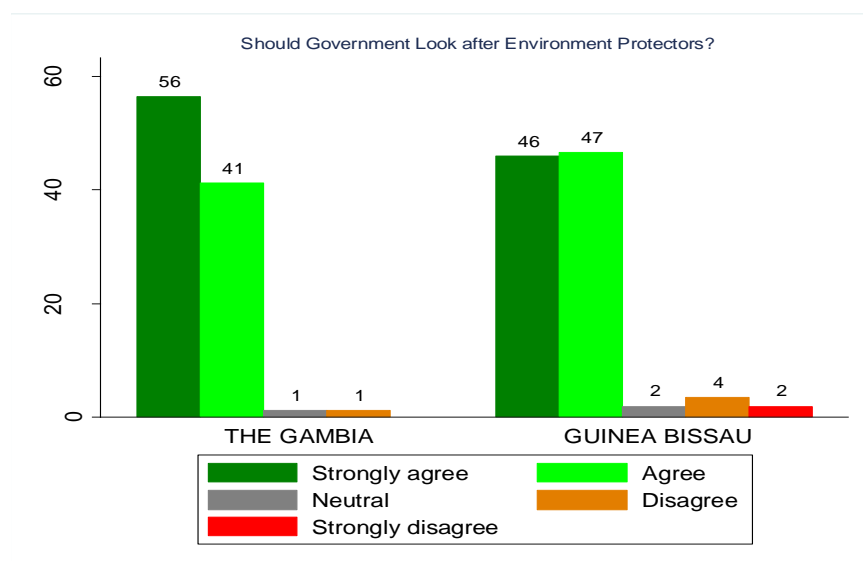
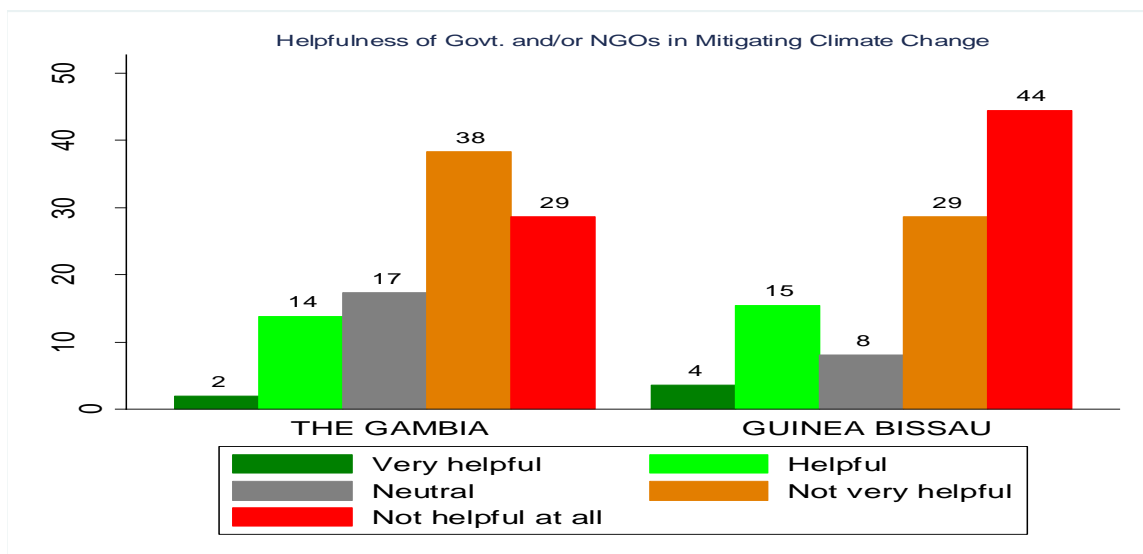


Figure 27 below demonstrates the perception of respondents in terms of Government and NGO's helpfulness in mitigating climate change. Reports from both countries have shown overwhelming negative perception regarding the helpfulness of these stakeholders in mitigating climate change. In The Gambia, a staggering 38% believe that Government and NGO have not been very helping, compared to just an aggregate of only 16% believing that they have been helpful. On the other hand, In Guinea Bissau, 29% believe that Government and NGO have not been very helping, compared to just an aggregate only 19% believing that they have been helpful in mitigating climate change.

In The Gambia, 2% believe the government and NGO have been very helpful, 14% believe they have been helpful, 17% believe they have been neutral, 38% believe they have not been very helpful, and 29% believe they have not been helpful at all in mitigating climate change while In Guinea Bissau, 4% believe the government and NGO have been very helpful, 15% believe they have been helpful, 8% believe they have been neutral, 29% believe they have not been very helpful, and 44% believe they have not been helpful at all in mitigating climate change.

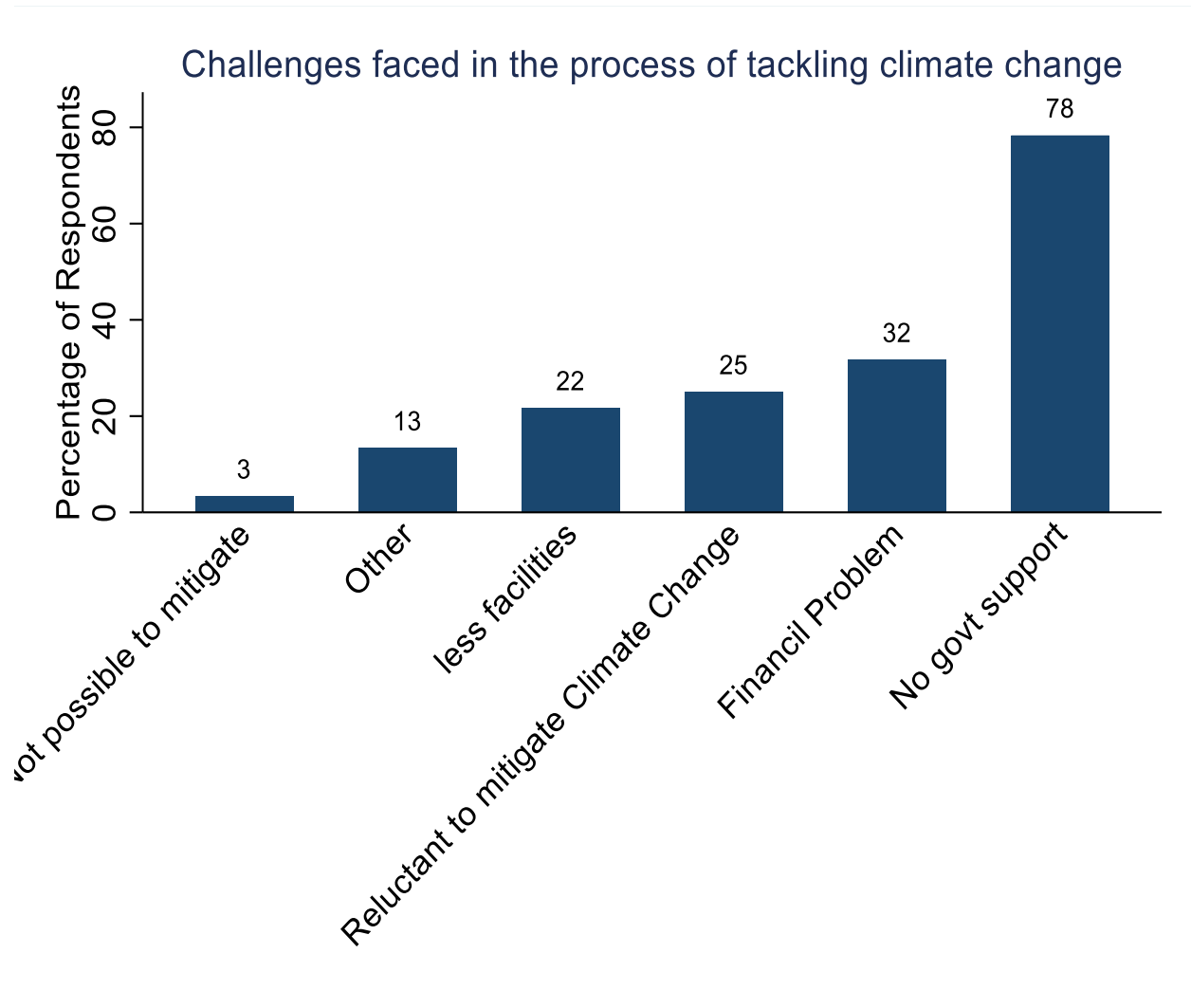
Figure 27: Helpfulness of Govt and NGOs in Mitigating Climate Change



Challenges face in tackling climate change

The graph below displays the challenges faced in the process of tackling climate change in The Gambia and Bissau. On aggregate, the results evince that about 78% of the respondents believe there is no government support while 32% believe that financial support is a challenge. In addition, 25% of the respondents believe that people are reluctant to mitigate climate change while 3% of respondents were with the view that it is not possible to mitigate climate change. These results suggest that there should be more support from government in the process of tackling climate change as well as public engagement to raise awareness on the existential nature of climate change.

Figure 28: Challenges Faced in Mitigating Climate Change



The data indicates that stakeholders in both The Gambia and Guinea Bissau recognize the importance of mitigating climate change, with the majority agreeing that action can be taken. However, there is a prevailing belief that governments should play a central role in addressing climate change, and a significant proportion of the respondents perceive a lack of government support as a major challenge. Financial constraints and reluctance from the public are also seen as obstacles. To effectively mitigate climate change in these regions, it is crucial for stakeholders to focus on enhancing government support, increasing public engagement, and allocating resources for climate change initiatives.

CHAPTER FIVE

5.0 Conclusion and Recommendations

This research has shed light on the intricate dynamics of the cashew sector in The Gambia and Guinea Bissau within the context of climate change. A total of 710 respondents were interviewed, with Guinea Bissau demonstrating a more efficient and effective approach to cashew production, as evidenced by greater satisfaction, higher productivity, and stronger financial stability. This disparity highlights the potential for cross-border learning and collaboration in the cashew industry. Both nations have experienced shifts in climatic conditions, with The Gambia displaying a more pronounced vulnerability to the effects of climate change on cashew production.

Evident from the research outcomes is that stakeholders in the cashew sector of The Gambia and Guinea Bissau recognize the importance of climate change mitigation; consequently, their shared awareness of climate change's detrimental effects on cashew production calls for concerted efforts to develop, implement, and strengthen mitigation efforts and strategies. However, the prevailing sentiment is that governments have played a central role to play in this endeavor, hence the need for increased government support, public engagement, and resource allocation. .

While both countries share concerns regarding the negative impacts of changing climatic conditions on overall cashew production, further investigations are essential to gain a deeper understanding of the specific nature and severity of these challenges. The findings underscore the need for proactive measures to address these challenges and enhance the resilience of the cashew sector in both countries.

Policy Recommendations

The study recommends the following to boost the productivity of the cashew sector and mitigate the impacts of climate:

- The Governments should foster initiatives for climate resilience, community involvement and engagements in climate change mitigation strategies, and the establishment of financial mechanisms to support these efforts.
- There is need for the establishment of a formal Cashew Farmers/Dealers association for easy monitoring and sensitization on best practices of cashew production and climate mitigations strategies.
- The Ministries of Agriculture should promote collaboration between the governments, industry stakeholders, and international organizations to create a more sustainable and climate-resilient cashew industry.

- In light of the apparent disparity in the efficiency and effectiveness of cashew production between The Gambia and Guinea Bissau, it is recommended that both countries engage in joint-initiatives as leading cashew producing countries in the sub-region. These initiatives should include knowledge sharing, technological transfer, and best practice exchanges to optimize cashew production in both countries.
- Given the shared challenges posed by changing climatic conditions, it is also imperative for both nations to develop and implement comprehensive climate resilience strategies. These strategies should include the introduction of climate-resilient cashew varieties, improved irrigation techniques, and enhanced monitoring of weather patterns.
- The Governments of both countries should take a proactive role in climate change mitigation within the cashew sector and beyond. This includes providing financial support, facilitating research on climate adaptation, and creating policy frameworks that incentivize sustainable practices.
- Sensitization on the rich value that cashew can bring and educate farmers as well as furnish them with the necessary tools and skills for more efficient methods of cashew production to boost this noble business to reclaimed the glory days of cashew sector.
- Establish cashew markets in all regions to boost sales and have a good market value for cashew and promote its processing for exports.

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