

A Work Project, presented as part of the requirements for the Award of a Master's degree in International Development & Public Policy from Nova School of Business and Economics.

CLIMATE CHANGE AND FOOD SECURITY IN GUINEA-BISSAU:
Exploring Local Perceptions and Pathways to Resilience

JENNIFER KEHL

Work project carried out under the supervision of:

Nikita Melnikov,
Brais Álvarez Pereira

12-09-2023

Abstract

This paper investigates the impact of climate change in the unique context of Guinea-Bissau. Examining local perceptions, characteristics that determine the population's understanding of climate change are investigated. Results highlight that the poorest suffering food, income, and water insecurity realize the extent to which they are affected. Further analysis shows that changing climatic conditions contribute to a perceived deterioration in agricultural conditions and dissatisfaction with environmental efforts. This fosters a broader sense of mistrust in the president and government. Consequently, climate change is perceived as a pressing concern in Guinea-Bissau, calling for effective adaptation measures and heightened political attention.

Keywords

Adaptation, Agriculture, Climate Change, Food Security, Guinea-Bissau

Acknowledgements

I would like to express my gratitude to my advisor, Nikita Melnikov, for their guidance and support throughout this thesis. I am sincerely grateful to Brais Álvarez Pereira for providing me with the opportunity to conduct my research at Bissau Economics Lab (BELAB), and for all the support they provided, especially during my stay in Guinea-Bissau. I sincerely thank DEMOS – Center for Democracy, Creativity and Social Inclusion (DEMOS) for providing the data from their “Voices of the People” project. Additionally, I would like to thank all interviewed experts for their time and willingness to share their experiences. These include Yannis Arvanitis, Filippo Camerini, Nicolas Desramaut, Isis Da Costa Semedo, Elisabete Dumbia, Anne-Lucie Lefebvre, Nuria Perea Alonso, Miguel Roe, Cláudia Santos, Thiago Soares, and Tanya Lisa Yudelman.

Funding

This work used infrastructure and resources funded by Fundação para a Ciência e a Tecnologia (UID/ECO/00124/2013, UID/ECO/00124/2019 and Social Sciences DataLab, Project 22209), POR Lisboa (LISBOA-01-0145-FEDER-007722 and Social Sciences Data-Lab, Project 22209) and POR Norte (Social Sciences DataLab, Project 22209).

1 Introduction

Climate change is one of the greatest concerns worldwide requiring mitigation and adaptation efforts globally. The consequences of climate change and lack of effective adaptation practices disproportionately affect vulnerable populations in developing nations (IPCC, 2023). Guinea-Bissau exemplifies this challenge, as it ranks 177th out of 191 countries on the Human Development Index (HDI) (UNDP, 2022), with 69 percent of the population living below the poverty line of \$1.90 per day (WBG, 2023a). At the same time, Guinea-Bissau is the fourth most vulnerable country to climate change globally (Notre Dame, 2023) and its population faces severe consequences on livelihoods and economic development (GNB, 2021). Additionally, challenges such as food and water security are a prevailing issue in the country and further exacerbated by climate change (WFP, 2023a).

Moreover, the country's challenging political economy further compounds obstacles to development (GNB, 2015). Agriculture is the foundation of Guinea-Bissau's economy and in particular the poorest parts of the population are strongly dependent on it as income and food source (GNB, 2021). Research highlights that effective adaptation measures can mitigate the impact of climate change in the Global South (Barrucand et al., 2017; Martiarena & Temudo, 2023; Sousa et al., 2023; Sousa & Luz, 2018; Temudo, 2011). Furthermore, international studies emphasize that people's perception of climate change significantly influence the choice and success of agricultural adaptation practices (Adesina, 2005; Ceci et al., 2021; Deressa et al., 2011; Maddison, 2007; Niles & Mueller, 2016). Moreover, despite the growing threat of climate change (IPCC, 2023), the most impoverished individuals may not prioritize learning about climate adaptation, as their immediate needs often take precedence (Camerini, 2023).

This study complements the existing literature by investigating the population's perception of climate change in Guinea-Bissau. Firstly, it is examined whether those most affected by climate change, especially the poorest and most vulnerable suffering bad living conditions as well as

water, food, and income insecurity, recognize the extent to which they are affected. Secondly, it is explored how this perception influences satisfaction with environmental policies and trust in the government. Given Guinea-Bissau's challenging political landscape (GNB, 2015), understanding the intersection of climate perception and governance is particularly interesting.

To gather insights into climate change dynamics, political economy, regional disparities and ongoing development initiatives, the author conducted a research trip to Guinea-Bissau in June and July 2023 and carried out a series of expert and in-depth interviews.¹

The quantitative analysis in this study, based on data from DEMOS' "Voices of the People" survey (Carter & Cardoso, 2021) and climate data (WBG, 2023d), shows the population's acute awareness of climate change as a pressing issue. Further examination reveals the significant influence of poverty on individuals' perceptions of climate change, as the most vulnerable groups recognize its profound impact. Additionally, reduced rainfall and rising temperatures are perceived to notably harm agriculture. These observations ultimately translate into dissatisfaction with environmental efforts and a decrease in trust in both the president and the government. Overall, the findings underscore the importance of robust climate policies, which may serve not only to effectively combat climate change but also to build greater public trust.

1.2 Literature review

To lay a theoretical foundation of the research topic and question, a literature review was conducted with the aim is to gain an overview of the current stage of academic knowledge about

¹ The interviewed experts include Nuria Perea Alonso (Bosque y Comunidad, ByC), Filippo Camerini (Ianda Guiné! Arrus), Cláudia Santos (Ph.D., Consultant), Elisabete Dumbia (United Nations Development Program, UNDP), Anne-Lucie Lefebvre (World Bank Group, WBG), Nicolas Desramaut (WBG), Isis da Costa Semedo (World Food Program, WFP), Miguel Roe (WFP), Thiago Soares (WFP).

Additionally, the author had the opportunity to join ByC and their local partner organization KAFO on a field trip to Oio to visit four communities in Binar, Canico Tumana, Djalicunda and Embunhe. The author conducted in-depth interviews with the local women's associations overseeing agricultural practices to explore their perceptions of climate change and its implications for agriculture and food security.

The interviews were transcribed with the detailed notes methodology and analysed based on qualitative or summary content analysis (Mayring, 2021). These interviews provided the foundational insights upon which the subsequent statistical analyses in the final chapters of this study are built.

the country and identify research gaps.

The scientific literature addressing climate change, agriculture and food security in Guinea-Bissau encompasses several key topics, including consequences of climate change, the influence of cashew monocultures, impact on rice production and adaptation strategies.

Some literature focusses on the effects of climate change on several different aspects of the country. Mendes et al. (2023) investigate an extreme weather event with the heavy rainy season 2020 which led to flooding in cities and farmlands and strongly impacted people's lives. Temudo et al. (2022) highlight the vulnerability of Guinea-Bissau to coastal erosion due to its flat lands and large coastal area. The authors present a case study of the island-village Djobel which is strongly affected by rising tides and highlight the population's vulnerability to protect their agricultural land, water, and safety. Others discuss the disturbances of fisheries by climate change, highlighting the negative impacts on food and nutrition security in this context (Ding et al., 2017). Research also analyses migration decisions due to climate change of coastal and island people in Guinea-Bissau, highlighting the importance of government support for local communities to overcome the increasing challenges related to climate change (Santos & Mourato, 2022). In other regions of Guinea-Bissau, climate-related migration decisions have worked as trigger in an existing conflict across villages (Temudo & Cabral, 2023).

An often-discussed topic is the cashew monoculture in Guinea-Bissau and the country's agro-economic development towards cashew production. This topic is mainly focussed on the structural characteristics of cashews as single cash crop and related risks (Catarino et al., 2015; Havik et al., 2018; Monteiro et al., 2017; Pacheco de Carvalho, 2015; Temudo & Abrantes, 2014). Researchers analyse Guinea-Bissau as long-standing single cash crop economy and highlight how cashew production today is highly dependent on smallholder farmers and affecting food security, biodiversity, and sustainability (Havik et al., 2018; Catarino et al.,

2015). It is shown that cashew production covers on average 4.8 months of income needs for food annually and ways to improve productivity are suggested (Pacheco de Carvalho, 2015).

Literature related to food security in the country also focusses on the concept of rice production and adaptation to climate change. Adaptation strategies can help smallholder farmers and rural households to reduce effects from climate change on agriculture and their livelihood (Barrucand et al., 2017). Sousa et al. (2023) conducted a literature review to analyse how mangrove rice and mangrove forests have been studied in the literature in Guinea-Bissau to better understand the effects of climate change on coastal erosion and agriculture. In the context of mangrove rice, there exists also research on preservation of mangrove forests. Authors highlight the potential of mangroves as carbon-sink and investigate if the income from carbon stored in mangrove forests can offset the expenses of preservation to prevent deforestation (Vasconcelos et al., 2015). Other literature focusses on genetic engineering and climate-adaptation of rice to overcome cereal crises and environmental concerns (Temudo, 2011). Moreover, it is discussed how knowledge-sharing regarding rice adaptation practices works across villages in Guinea-Bissau. Researchers analyse how local knowledge about growing mangrove rice and climate change adaptation is passed down and exchanged across generations and communities (Martirena & Temudo, 2023; Sousa & Luz, 2018).

In the context of adaptation to climate change, research highlights the importance of smallholder farmer's perception to understand their decisions regarding adaptation methods (Adesina, 2005). The literature in the context of the perception of climate change mostly focusses on other countries and regions and information on Guinea-Bissau is very limited. Maddison (2007) published a book about the perception of climate change in several African countries (not including Guinea-Bissau) analysing the state of climate change perceptions and the influence on application of adaptation practices. The work highlights two steps of effective adaptation which consists of the farmer's realization of climate change and the adaptation of

agricultural practices. Hence, perceptions influence decisions about how to adapt to climate change (Maddison, 2007). Deressa et al. (2011) investigate the perception of and adaptation to climate change by farmers in the Nile basin of Ethiopia based on this two-step process. The authors find that perception of climate change is for example connected to age, income, education, while adaptation is related to education, family size, gender, help from experts and other factors. Research also suggests that people's perceptions of climate change are shaped by personal beliefs such as the question if it is human induced as well as environmental factors such as infrastructure (Niles & Mueller, 2016). A case study conducted in Guinea highlights the importance of climate-awareness for smallholder farmers in successfully applying adaptation strategies that positively impact their livelihood (Ceci et al., 2021).

Overall, scientific research on Guinea-Bissau is relatively limited, with existing studies on climate change and food security focusing on the effects of climate change, cashew monocultures, and adaptive strategies for rice agriculture. However, a notable research gap exists concerning the perception of climate change, particularly among the country's most vulnerable populations. This aspect holds significant potential for influencing decisions related to adaptation strategies and livelihoods. Moreover, given the complex political landscape in Guinea-Bissau, the prioritization of effective climate policies emerges as an interesting area of study. To date, there has been no investigation into how the perception of climate change impacts governance within the country. This study highlights how the perception of climate change by the poorest, changing climatic conditions, impact on agriculture, environmental policies and government trust are connected.

2 Background information on Guinea-Bissau

To lay a strong foundation for the understanding of the overall topic of the population's perception of climate change and impacts on governance, this chapter presents a short overview of vital data, demographics, socio-cultural factors, and the country's political economy.

2.1 Country overview and context

Guinea-Bissau is located in West Africa along the Atlantic Ocean and shares its borders with Senegal and Guinea. In 1973, the country gained independence from Portugal (BTI, 2023). The Small Island Developing State spans across 36,125 square kilometres and is the smallest country in the region. It is comprised of the mainland, eight islands as well as the substantial Bijagós archipelago, made up of 88 islands of which 21 are inhabited (GNB, 2021). Urbanization in Guinea-Bissau is relatively low, with only 45% of the two million people living in urban areas. The capital city, Bissau, is located on the west coast at the Atlantic Ocean and has around 643,000 inhabitants (WBG, 2023b).

Guinea-Bissau's large coastal region is covered with forests, accompanied by mangrove swamps that extend inland and cover more than 20 percent of the country (GNB, 2021). Inland, the country consists of plains and hills, with savannah areas in the east. In the southeast, the foothills of the Fouta Djallon massif form the highlands including the highest point of the country at 298 meters above sea level. The rest of the country is comprised of lowlands with altitudes up to only 10 metres above sea level (GNB, 2021).

The country has a young and growing population with a median age of 19 years and a life expectancy of around 58 years (WBG, 2023b). It is facing development challenges and is one of the poorest countries globally with approximately 69% of the population living below the poverty line of \$1.90 per day and 19% of the population living in extreme poverty (WBG, 2023a). Guinea-Bissau was ranked 177 out of 191 countries in the HDI Country Report 2021/22, placing the country in the “low human development” category (UNDP, 2022).

The culture is characterized by diverse ethnic communities, including Fula (29%), Balanta (23%), Mandinka (15%), and several others. Additionally, religion plays a major social role in the country and approximately 46 percent are Muslim, 31 percent follow indigenous religious practices (animista), and 19 percent are Christian (U.S. Department of State, 2022).

2.2 Political economy

Since gaining independence from Portugal in 1973, Guinea-Bissau has a young democracy and constitutional framework. The country has faced a complex and challenging political economy characterized by institutional instability and weak governance structures (BTI, 2023). The country ranks in the bottom tenth percentile for all indicators measuring public sector capacity in the WBG's Worldwide Governance Indicators databank (WBG, 2023c). Following a brief period of stability after the second democratic election in 2019, the country experienced a setback with an attempted coup d'état in early 2022. The United Nations Integrated Peacekeeping Office concluded its mission in 2020, transferring the responsibility for ensuring peace and stability in the country to the national security forces. This transition poses significant challenges in maintaining stability in Guinea-Bissau (WFP, 2022).

The prevailing political conflicts and instability contribute to a further delay of the country's development and hinder the creation of important infrastructures (BTI, 2023). The country confronts various obstacles in tackling issues such as high inequality, climate vulnerability, social cohesion, resource allocation, and enhancing public services (EU, 2023). Additionally, ongoing political challenges and persistent corruption hinder the effectiveness of both domestic and foreign investments in promoting sustainable socio-economic growth and inclusive human development (EU, 2023).

The country's gross domestic product (GDP) amounts to USD 1.6 billion, or USD 776 per capita (WBG, 2023b). Guinea-Bissau's economy relies heavily on "non-mechanized

agriculture, fishing, cashew nut exports, informal trade and foreign aid” (GNB, 2021). Raw cashew nuts account for 90 - 98 percent of export earnings and provides income for about 80 percent of the population, especially smallholder farmers in rural areas (WBG, 2023a). Cashews are often traded for rice as primary food source, making smallholders and the population extremely vulnerable to fluctuations in international cashew prices (WFP, 2023b). This lack of economic diversification makes the country highly vulnerable to external shocks and adverse climate conditions (WBG, 2023a). In 2020, the COVID-19 pandemic led to a decline of the average economic growth rate of 4.2 percent, observed since 2012 (WFP, 2022). In 2022, real GDP growth experienced a further decline, dropping to 3.7 percent. This slowdown was primarily driven by inflationary pressures, restraining private consumption. Inflation surged to 7.9 percent in 2022, due to increased prices for imported food and oil influenced by the war in Ukraine (AFDB, 2023).

Economic development in Guinea-Bissau is also constrained by limited access to ineffective basic services including administration, education, healthcare, security, and justice. These are notably weaker and insufficient in rural areas compared to the capital city Bissau (BTI, 2023). Access to quality education remains a pressing concern in the country and the weak educational sector poses significant challenges to economic development, exacerbating existing disparities (WBG, 2023a). Primary school enrolment in Guinea-Bissau stands at 69 percent for school-age children, with completion rates of 25 percent for girls and 29 percent for boys. About 54 percent of adults and 40 percent of the youth population are illiterate (WFP, 2023b).

Gender inequality is a persistent issue in Guinea-Bissau, impacting various aspects of society. It has profound implications for girls' education, ultimately hindering women's participation in the labour market and limiting their well-being (WBG, 2023a).

In addition to socio-economic challenges, Guinea-Bissau grapples with significant structural obstacles and a weak infrastructure that hinder its growth potential. A deficient national road

network, a low-capacity seaport, and costly internet access hamper economic growth (WBG, 2023a). The challenging infrastructure, coupled with policy uncertainty and weak institutions, hinder private sector investments and progress in economic diversification (WBG, 2023a).

In summary, Guinea-Bissau's political economy is characterized by political instability, weak governance, an agriculture-dependent economy, strong socio-economic challenges, and a lacking infrastructure. These factors hinder economic development and contribute to persistent poverty and social challenges. Efforts to improve the political economy of Guinea-Bissau have been ongoing, with initiatives aimed at strengthening governance, promoting economic diversification, and enhancing social development. The government is poised to make significant investments in healthcare, education, and infrastructure, with the aim of overcoming poverty (UN, 2022). The current national long-term strategy, "*Terra Ranka*", envisions a prosperous and inclusive society by 2025. This strategy seeks to foster rising living standards for all through the sustainable development of the country (GNB, 2015). Achieving progress requires fundamental transformation across multiple levels, including the collective mindset, governance, rule of law, economic structures, and citizen engagement. It demands a unified and determined commitment from all stakeholders involved in development policy. Effective partnerships among the government, private sector, non-governmental organizations (NGOs), international organizations and partners are crucial in driving positive change and realizing sustainable development goals (UN, 2022).

3 Climate change and food security in Guinea Bissau

This chapter outlines the climatic conditions of the country and the effects of climate change with a focus on agriculture and food security. The information is enriched with insights from interviews the author conducted in Guinea-Bissau.

3.1 Climate change

The country's climate can be divided into the coastal zone and the interior. Annual temperatures average 26°C and vary by zone with extremes ranging from 16°C - 39°C. The country has one rainy season lasting from May to November. Along the coast, a tropical humid climate prevails with hot temperatures and substantial precipitation of 1400-2000mm/year. The interior has a drier climate with higher temperature variations between the rainy and dry season and precipitation of 1000-1500mm/year. (GNB, 2021).

Climate change projections indicate a gradual increase in average temperatures throughout the year in the coming decades. For the short-term scenario (2016-2045) a rise in temperatures is predicted at 1.2°C - 1.3°C along the coast and 1.4°C - 1.5°C in the countryside. For the medium-term (2046-2075), an overall temperature increase of 1.5°C - 2.9°C is projected across the country (GNB, 2021).

By 2030 and 2050, the onset and end of the rainy season in June and October are projected to become drier. However, a notable increase in precipitation is expected during August and September by 2030, followed by a decline towards 2050 (WFP, 2021).

The coastal zone and islands face challenges such as sea level rise, tropical storms, and coastal erosion. Saline intrusion worsens in agricultural fields, and water scarcity occurs. The oceans' increased acidity may also affect marine productivity and the availability of fish. The drier climate in the interior makes it susceptible to temperature and precipitation anomalies,

affecting agriculture. Floods are more likely to occur, impacting the availability of drinking water (GNB, 2021).

During the interviews, experts stressed the significance of these climatic changes (Camerini, 2023; Da Costa Semedo et al., 2023; Dumbia, 2023; Lefebvre & Desramaut, 2023; Perea Alonso, 2023; Santos, 2023). There are significant differences between regions of the small country including a wide range of changes and underlying needs (Da Costa Semedo et al., 2023).

3.2 Climate change and effects on food security

Food insecurity and malnutrition in Guinea-Bissau are chronic issues affecting a sizable portion of the population, with rates fluctuating between 11- 51 percent based on the year and region (GNB, 2021). More than two-thirds of the population cannot afford a nutritious diet and food insecurity still is a pressing issue, with women, girls, and children under 5 years old being the most vulnerable and disproportionately affected (WFP, 2023a). These strong challenges in ensuring a stable and sustainable food supply and water security are further exacerbated by climate change which is impacting agriculture mainly through rising temperatures, an irregular and unpredictable rainy season, and coastal erosion (GNB, 2021).

Major food crops are sowed and grown during the rainy season and harvested after the rainy season is over. Every year, there is a lean period just before the new harvest is available, with high levels of food insecurity. In the lean season of 2023, approximately 79,000 individuals were anticipated to experience severe food insecurity (FAO, 2023). Climate change leads to changing rainfall patterns and increasing unpredictability of the rainy season and timing of the lean season. During the expert interviews, UNDP highlighted the importance of projects that are working to decrease the length of this period and improve food security (Dumbia, 2023).

Irregular and unpredictable rainfall, including prolonged droughts and intense rainfall events, can lead to crop failures and reduced yields. There is a particularly strong effect on rice which is the center of alimentation in the country (Camerini, 2023; Da Costa Semedo et al., 2023; Dumbia, 2023; Lefebvre & Desramaut, 2023; Perea Alonso, 2023; Santos, 2023). Climate change is drastically affecting agriculture and productivity, especially in coastal areas. While some crops may benefit from changing weather conditions, many crops and especially rice, show a lower yield. Rice crops are particularly vulnerable, as irregular rainfall and sea level rise result in excessive saltwater intrusion, especially in rice fields located in mangroves, leading to the destruction of anti-salt dikes and the submersion of agricultural land (GNB, 2021). Therefore, climate resilient agriculture practices and the promotion of relevant policies are key (Lefebvre & Desramaut, 2023). The strong regional differences across the country also impact required adaptation practices and field management (Camerini, 2023).

As temperatures increase, precipitation decreases and sea levels rise, groundwater, which serves as the main source of drinking water, faces significant impacts in availability and quality (GNB, 2021). In general, there may be enough water in the country on average, but the country is facing extremes during strong droughts and the heavier but shorter rainy season (Lefebvre & Desramaut, 2023). Therefore, the improvement of water management and water security is crucial for the country (Camerini, 2023).

The livestock sector also faces significant challenges due to temperature increases and reduced rainfall, resulting in water scarcity, decreased grazing areas, and a severe decline in grazing land, milk, and meat production (GNB, 2021). Additionally, climate change indirectly affects food security in Guinea-Bissau by impacting natural resources that support food production. For instance, the destruction of mangrove forests by rising sea levels and coastal erosion pose a threat to critical habitats for fish, shellfish, and other marine species (GNB, 2021).

In recent decades, Guinean farmers have shifted their focus towards cashew production, resulting in a consistent decline in domestic rice cultivation, which has adversely affected local food production (GNB, 2021). While the country has placed significant emphasis on cashew production, it is crucial to note that rice holds a more direct importance as a food source (Camerini, 2023). Given the impact of climate change on agriculture, it is evident that ensuring food security extends beyond mere production; it also hinges on sustaining a stable income. If cashew production faces challenges due to market fluctuations, the subsequent reduction in income can directly impede access to essential items like rice (Santos, 2023). Furthermore, this can have ripple effects on critical areas such as education and healthcare (Dumbia, 2023). Therefore, achieving true food and water security necessitates a broader approach to agricultural sustainability and financial stability (Santos, 2023).

Within the context of the local population's perception of climate change, it is essential to consider Guinea-Bissau's diverse geographical landscape, which features notable distinctions between urban and rural areas (Santos, 2023). Experts concur that while communities may struggle to articulate the complexities of climate change, they are aware of observable impacts within the country (Camerini, 2023; Da Costa Semedo et al., 2023; Dumbia, 2023; Lefebvre & Desramaut, 2023; Perea Alonso, 2023; Santos, 2023). For the most vulnerable parts of the population, immediate needs like ensuring food and water security are key concerns. These urgent concerns, which are further exacerbated by climate change, understandably overshadow the capacity to prioritize climate education, as survival remains the primary focus (Camerini, 2023). Consequently, several organizations and projects have dedicated themselves to enhancing education regarding climate change to achieve effective adaptation, with a particular emphasis on rural areas (Camerini, 2023; Dumbia, 2023; Perea Alonso, 2023).

3.3 The rural population's perception of climate change

During the research trip to Guinea-Bissau, four communities in Oio were interviewed to gain insights into their perspectives on climate change and implications for agriculture. Discussions were held with the women associations responsible for agricultural activities within Binar, Canico Tumana, Djalicunda and Embunhe. Notably, these communities collaborate with ByC, KAFO and other organizations and have acquired experience in adapting to climate change and have had the opportunity to receive education on this subject (Perea Alonso, 2023).

The communities were asked if they can describe climate change or whether they perceive an effect from climate change and how it impacts agriculture and ultimately food security. The people in Canico Tumana and Binar stated that they cannot describe the overall issue of climate change, but they clearly notice climatic changes. All four communities perceive a notable change in the rainy season. They experience a shorter rainy season and observe a longer drought period. The communities also stated that precipitation is becoming less predictable which affects their agricultural patterns and planning ability. All communities mentioned an impact on agriculture and especially rice production. The people in Djalicunda emphasized this problem as they observe a much shorter timeframe to grow food supplies. Each of these communities has adopted a new rice seed variety that has been provided to them through collaborative projects with NGOs. This new variety is adapted to the shorter rainy season, ensuring better crop yields. Nevertheless, the people in Binar specifically stated that they still perceive a lower production rate, and their food supply is negatively affected by the reduced precipitation. The Embunhe community highlighted a decrease in agricultural diversity and nutritional options. Previously, they cultivated a wide range of thriving plants. However, certain crops have a reduced productivity due to the impacts of climate change. Consequently, despite their consistent efforts, the community has experienced an overall decline in agricultural production.

All communities were asked if they require any additional measures to enhance their climate change adaptation efforts. They stated that they receive a lot of helpful information and support from NGOs and projects which is crucial. The communities receive education about agricultural schedules and how to adapt their agriculture to climate change to improve food security. Nevertheless, most communities also stated that they would like to receive more information on the topic in general. The Binar community stated, that they need more education, more seeds adopted to climate change and generally more materials for agriculture. The community in Embunhe stated, that they are actively seeking information by listening to local news, but they would like to receive more support against reduced food supplies.

Finally, all communities were asked to identify who they believed was responsible for climate change. Each community arrived at the consensus that climate change is human induced, but they initially approached this question from different angles. In Djalicunda, people pointed out that deforestation, primarily driven by government actions, contributes to climate change. In Canico Tumana, there was an initial mention of God being responsible, but finally they collectively agreed that humans are causing climate change. The Embunhe community initially attributed climate change to God, but with additional information, they realized that human activities, particularly tree-cutting for monoculture farming, negatively impact the climate and environment. Consequently, they shifted their stance, recognizing human responsibility. Therefore, they are also putting more emphasis on sustainable practices and care for the environment.

4 Data, main variables, and empirical methodology

This chapter describes the analysed data, main variables and empirical strategy used in the econometric analysis of this paper. In the first section, the data and sources are highlighted. The second part, the main dependent and independent variables of interest and control variables are described. In the third section, the empirical strategy is defined.

4.1 Data

The analysed secondary data used in this work is based on DEMOS' "*Voices of the People*" project. The project entailed the country's first public opinion survey conducted in mid-2018 to gain additional scientific knowledge on Guinea-Bissau's society and politics. The survey included topics such as perceptions, hopes, impact of history, geography, social conditions, political environment, religious, ethnic and gender issues. The survey was based on the methodology and questionnaire developed by Afrobarometer, which is Africa's leading public opinion research network. It includes 1,184 valid responses from 148 census districts including remote and isolated parts of the country (Carter & Cardoso, 2021). DEMOS kindly provided the dataset as well as required background information. To anonymize the original data, the participant names were removed before conducting this analysis.

To be able to observe climatic patterns and changes in Guinea-Bissau, annual regional precipitation and temperature data was obtained from the WBG Climate Change Knowledge Portal and combined with the DEMOS dataset (WBG, 2023d).

4.2 Main variables

The analysed dataset includes the following demographic and socio-economic characteristics that are used as independent (control) variables in the multivariate regressions: gender (female), age, education (post-secondary / university degree) and living in a rural area. Moreover, as

measures of poverty, the variables self-assessed bad living conditions, water insecurity, and food and/or income insecurity are included in the analysis.

Additionally, the decrease in precipitation (Δ mm/year) as well as increase of mean temperatures ($\Delta^\circ\text{C}$) over the last ten years compared to the prior 30-year average are included. Based on their low variation, these variables are standardized to a standard deviation of one.

Descriptive statistics	Observations	Mean	Std. Dev.	Min	Max
Variable					
Gender (female)	1,184	0.531	0.499	0	1
Age	1,163	36.460	13.235	18	96
Education (post-secondary / university)	1,170	0.612	0.240	0	1
Living in a rural area	1,184	0.561	0.496	0	1
Self-assessed bad living conditions	1,142	0.634	0.481	0	1
Water insecurity	1,184	0.240	0.427	0	1
Food/income insecurity	1,184	0.632	0.483	0	1
Decreased precipitation last 10 years vs. prior 30-year average	1,184	0.000	1.000	-1.968	1.437
Higher mean temperatures last 10 years vs. prior 30-year average	1,184	0.000	1.000	-1.502	1.206

Table 1: Explanatory variables: summary statistics

The objective of the first part of the analysis is to understand which characteristics determine the population's understanding of climate change. Therefore, the selected dependent variable represents the population's perception of climate change. The exact question from the original survey is defined as "*Is climate change a problem?*" The respondents could answer 0 "*No problem*", 1 "*Small problem*", 2 "*Medium problem*" or 3 "*Big problem*". A large proportion of the survey respondents view climate change as a problem for the country and overall, 9 percent identify climate change as medium problem and 86 percent as big problem (see appendix 2 for frequencies of dependent variables).

In the second question, the decrease in precipitation and increase of mean temperatures in the country is investigated in the context of its impact on agriculture. The data is based on the survey question “*Would you say that the climatic conditions for agriculture in your area have improved, deteriorated or stayed the same over the last 10 years?*” The responses are defined as 0 “*Better / Neutral*”, 1 “*Worse*”, 2 “*Much Worse*”. Of the total population, 20 percent regard agricultural conditions due to climate change over the last ten years as worse and 48 percent as much worse.

In the third part, it is examined how the perception of climate change and actual climatic changes influence satisfaction with environmental efforts. This section is based on the survey question “*In this country, are you satisfied or dissatisfied with efforts to care for the environment?*” defined as 0 “*satisfied*” or 1 “*dissatisfied*”. In general, 58 percent of the population are dissatisfied with environmental policies.

In the final section, it is tested how climatic changes and dissatisfaction with environmental efforts influence trust in the president and government of Guinea-Bissau based on the question “*To what extent do you trust: The president, the government*” defined as 0 “*No trust*”, 1 “*A little bit*”, 2 “*More or less*”, 3 “*A lot*”. Based on the sample, in total 29 percent have no trust in the president and 47 percent have no trust in the government.

Descriptive statistics	Observations	Mean	Std. Dev.	Min	Max
Variable					
Perception of climate change as a problem	1,136	2.794	0.548	0	3
Negative effect of climate change on agriculture over the last 10 years	1,136	1.156	0.879	0	2
Dissatisfaction with environmental efforts	1,129	0.579	0.494	0	1
Trust in the president	1,157	1.720	1.299	0	3
Trust in the government	1,151	1.015	1.151	0	3

Table 2: Dependent variables: summary statistics

4.3 Econometric methodology

The empirical analysis of this work is conducted with the aim to understand the perception of climate change by the poorest parts of the population and investigate how this ultimately translates into government trust. Multivariate regression analysis is used as primary statistical technique to examine the correlation between multiple independent variables and the dependent variable of interest with robust standard errors.

The population's perception of climate change as a problem is analysed based on general characteristics of the population and measures of poverty including facing bad living conditions, water insecurity and food/income insecurity. Additionally, it is measured if the poorest people which are most affected by climate change and perceiving it as a bigger problem are generally also dissatisfied with environmental efforts.

$$(1) y_i = \alpha_0 + \alpha_1 \text{living_bad} + \alpha_2 \text{water_insecure} + \alpha_3 \text{food_income_insecure} + \alpha_x X_i + \varepsilon_i,$$

where y_i represents the outcome variable which is the perception of climate change and dissatisfaction with environmental efforts;

and X_i represents the control variables gender, age, education and living in a rural area.

In the next step, the perception of the impact of climatic changes on agriculture over the last ten years is measured based on lower annual precipitation (Δ mm/year) and higher mean temperatures ($\Delta^\circ\text{C}$) over the last ten years compared to the prior 30-year average.

Additionally, it is investigated if the change in precipitation and mean temperatures leads to higher dissatisfaction with environmental efforts. Finally, it is analysed how changes in climatic conditions translate into mistrust in the president and government.

$$(2) \hat{y}_i = \beta_0 + \beta_1 \text{climatic_conditions}_i + \beta_z Z_i + \varepsilon_i,$$

where $\hat{y}_i$ represents the outcome variable which is the perception of negative effect of climate change on agriculture over the last ten years, environmental dissatisfaction, trust

in the president, trust in the government;

climatic_conditions entail the change in precipitation over the last ten years compared to the prior 30-year average, increase in mean temperatures over the last ten years compared to the prior 30-year average;

and Z_i represents the control variables gender, age, education, living in a rural area.

Regressions for dissatisfaction with environmental efforts additionally control for self-assessed bad living conditions, water insecurity and food/income insecurity (see table 3).

Due to the nature of the survey and strong differences across regions of the country, region-fixed effects are used throughout the analysis to understand effects on the whole country (MacKinnon et al., 2023). This method was not applied for parts including climate data as precipitation and mean temperatures are based on regional data.

5 Empirical findings

In this chapter, the findings of the econometric analysis are described. In the first part, the population's characteristics that correlate with the perception of climate change are investigated. Additionally, the influence of lower precipitation and higher mean temperatures on agriculture over the last ten years are observed. In the second part, the influence of the perception of climate change and actual changes in precipitation and temperature levels on satisfaction with environmental conditions is examined. Finally, it is tested how this translates into mistrust in the president and government.

5.1 The perception of climate change and perceived impact on agriculture

For the first analysis, a multivariate regression is used to determine which characteristics of the population have a significant correlation with the perception of climate change. The dependent variable is the perception of climate change as a problem. The analysed independent variables are gender, age, university degree and living in a rural area. Additionally, it is analysed if the poorest who are most affected by climate change realize the extent to which they are affected. The variables indicating poverty are self-assessed bad living conditions, water insecurity and food/income insecurity.

The variables gender, age and living in a rural area are not significantly correlated with the perception of climate change in this model. Having a post-secondary / university degree leads to a significant positive relationship at the 1%-level with the perception of climate change as a larger problem. This could be explained by the fact that individuals that are better informed perceive climate change as a bigger problem.

Of the country's regions, only Bolama has a significant positive correlation with the perception of climate change as a problem. Due to its characteristics as coastal and island region, it is specifically threatened by climate change which might lead to greater awareness.

A significant correlation at the 5%-level between bad living conditions and the perception of climate change can be observed. Moreover, a significant correlation at the 1%-level between water insecurity as well as food/income insecurity and the perception of climate change as a larger problem can be observed.

These results are very interesting and show that the poorest and most vulnerable which are often most affected by climate change are aware of it being a threat.

Guinea-Bissau is highly dependent on agriculture which also strongly influences the food security and livelihood of the population. Therefore, it is examined how the population perceives the effect of climatic changes in their region on agriculture. A multivariate regression is used to determine the effect of lower precipitation levels and higher mean temperatures over the last ten years compared to the previous 30-year average.

A significant correlation at the 1%-level between the decrease in average precipitation levels over the last ten years and a perceived deterioration in agriculture can be found. Moreover, higher mean temperatures over the last ten years also show a significant negative effect at the 1%-level on the perceived agricultural productivity of the country.

These results highlight that the population is aware of ongoing climatic changes and the negative impact on agriculture.

5.2. Satisfaction with environmental policies and trust in the government

For the final part of the analysis, multivariate regressions are used to determine the effect of the perception of climate change on the general satisfaction with environmental efforts in the country. The poorest and most vulnerable parts of the population regard climate change as a bigger problem. Therefore, it is interesting to understand if these groups are also generally dissatisfied with environmental policies. Additionally, the effect of changes in precipitation and

mean temperatures on satisfaction with environmental efforts is analysed. Finally, these results are translated into the effect on trust in the president and government in Guinea-Bissau.

The results show a strong significant correlation at the 1%-level with dissatisfaction with environmental efforts for people that are suffering from bad living conditions, water, and food/income insecurity. The poorest parts of the population are aware of climate change being a threat and at the same time, they are generally dissatisfied with environmental efforts. Additionally, lower precipitation and higher mean temperatures lead to stronger dissatisfaction with environmental efforts. The results are significant at the 1% and 5%-level, respectively.

In the final part of the analysis, the impact of changing climatic conditions on general trust in the president and government are investigated. Reduced precipitation and higher temperatures are significantly correlated at the 1% with lower trust in the president and government. These results highlight that climate change such as lower precipitation and higher mean temperatures may translate into increased mistrust in the president and government.

The findings underscore the awareness of climate change and environmental challenges among Guinea-Bissau's population, with a disproportionate impact on the poorest and most vulnerable. Variations in precipitation and higher average temperatures contribute to deteriorating agricultural conditions and increased discontent with environmental efforts. These results emphasize the significance of effective climate policies. Moreover, as climatic changes correlate with reduced trust in the president and government, it can serve as a pivotal factor compelling the government to prioritize addressing climate change.

Explanatory variables:	Perception of climate change as a problem	Effect of climate change on agriculture last 10 years	Dissatisfaction with environmental efforts	Trust in the president	Trust in the government
Self-assessed bad living conditions	0.083** (0.037)		0.112*** (0.032) 0.117*** (0.032) 0.122*** (0.031)		
Water insecurity	0.099*** (0.033)		0.215*** (0.034) 0.188*** (0.033) 0.184*** (0.033)		
Food / income insecurity	0.124*** (0.036)		0.159*** (0.032) 0.143*** (0.031) 0.138*** (0.031)		
Decreased precipitation last 10 years vs. prior 30-year average		0.099*** (0.029)	0.042*** (0.016)	-0.240*** (0.040)	-0.172*** (0.038)
Higher mean temperatures last 10 years vs. prior 30-year average		0.076*** (0.027)	0.030** (0.015)	-0.171*** (0.037)	-0.136*** (0.035)

Note: *** p<0.01, ** p<0.05, * p<0.1. General controls include gender, age, dummy for secondary / university degree, living in a rural area, living bad, water insecurity, food/income insecurity. Regional-fixed effects were applied for all questions excluding the variables of precipitation and temperatures.

Table 3: Empirical findings

6 Conclusion and future outlook

Climate change disproportionately affects the Global South and the poorest and most vulnerable populations globally (IPCC, 2023). Developing countries are often contributing less to global emissions but are burdened with climate change mitigation and adaptation in addition to their general development struggles (IPCC, 2023). Guinea-Bissau is one of the poorest (WBG, 2023a) and least developed countries in the world (UNDP, 2022) but the fourth most affected by climate change globally (Notre Dame, 2023). The difficult political economy of the country further contributes to development challenges (GNB, 2015).

Food and water insecurity is a prevailing issue in Guinea-Bissau and large parts of the population are struggling with covering their basic needs (WFP, 2023a). Therefore, adaptation to climate change in the agricultural sector is a key issue for the country, especially in the context of rice production (Adesina, 2005; Barrucand et al., 2017; Martiarena & Temudo, 2023; Sousa et al., 2023; Sousa & Luz, 2018; Temudo, 2011). Scientific literature shows that the population's perception of climate change is a key factor in the successful adaptation to climate change (Adesina, 2005; Ceci et al., 2021; Deressa et al., 2011; Maddison, 2007; Niles & Mueller, 2016).

This study investigates the population's perception of climate change within the unique context of Guinea-Bissau. Through in-depth interviews conducted in rural communities, we gain insights into how individuals including the poorest parts of the population understand climate change and its significance for agricultural adaptation. The quantitative analysis, based on secondary data from DEMOS' "Voices of the People" survey and climate data, reveals that a substantial portion of the population in Guinea-Bissau views climate change as a pressing concern. Further analysis reveals that poverty is a strong determinant in the perception of climate change as a threat and the most vulnerable parts of the population realize the extent to which it affects them. Moreover, agriculture is negatively impacted by changing precipitation

levels and higher mean temperatures. This translates into overall dissatisfaction with environmental efforts and diminished trust in both the president and government. Results highlight that the implementation of development policies aimed at climate change adaptation is crucial for helping the poorest and most vulnerable parts of the population. Moreover, these efforts also have the potential to foster greater confidence in public governance.

It is important to state that this study represents one of the initial investigations into this subject matter in the context of Guinea-Bissau. Consequently, there is a need for more extensive research encompassing a broader dataset and a wider scope. Given the constraints of this paper, the in-depth interviews were conducted solely in four communities within the country, leaving room for further exploration to capture diverse perspectives from various regions. Additionally, expert interviews were conducted with selected organizations which might be expanded further also including government bodies. Furthermore, the data utilized from the “Voices of the People” survey dates to 2018, and results may differ based on more recent data. The newest round of the Afrobarometer is currently being conducted in Guinea-Bissau and this survey will include more extensive questions on climate change and reveal more recent data as basis for further research.

All aspects considered, this work presents one of the first studies of this form in Guinea-Bissau, providing interesting results as basis for further analysis. The study gives a comprehensive overview of how the poorest parts of the population perceive and comprehend climate change. The findings underscore the dual significance of robust climate policies: not only to address climate change effectively and help the poorest parts of the population, but also as a pathway for the government to cultivate greater public trust, recognizing the population's acute awareness of climate change as a pressing concern in Guinea-Bissau.

Table of contents

1	Introduction	2
1.2	Literature review	3
2	Background information on Guinea-Bissau	7
2.1	Country overview and context	7
2.2	Political economy	8
3	Climate change and food security in Guinea Bissau	11
3.1	Climate change	11
3.2	Climate change and effects on food security	12
3.3	The rural population's perception of climate change	15
4	Data, main variables, and empirical methodology	17
4.1	Data	17
4.2	Main variables	17
4.3	Econometric methodology	20
5	Empirical findings	22
5.1	The perception of climate change and perceived impact on agriculture	22
5.2	Satisfaction with environmental policies and trust in the government	23
6	Conclusion and future outlook	26
	List of Abbreviations, List of Tables, List of Appendix	29
	Appendix	30
	Bibliography	43

List of Abbreviations

AFDB	African Development Bank
ByC	Bosque y Comunidad
CCDR	Country Climate and Development Reports
EU	European Union
GNB	Republic of Guinea-Bissau
GCF	Green Climate Fund
GEF	Global Environment Facility
HDI	Human Development Index
NDC	Nationally Determined Contribution
NGO	Non-governmental organization
SDGs	Sustainable Development Goals
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WBG	The World Bank Group
WFP	World Food Programme

List of Tables

Table 1: Explanatory variables: summary statistics	18
Table 2: Dependent variables: summary statistics	19
Table 3: Empirical findings.....	25
Table 6: Dependent variables: frequencies	35

List of Appendix

Appendix 1: Navigating climate change and food security	30
Appendix 2: Detailed overview of dependent variables	35
Appendix 3: Detailed survey as suggestion for future research.....	36

Appendix

Appendix 1: Navigating climate change and food security

Addressing climate change in Guinea-Bissau requires comprehensive strategies that promote mitigation, resilience, and adaptation. This includes implementing sustainable agricultural practices, investing in irrigation infrastructure, and promoting climate-smart farming techniques in particular for vulnerable communities. Additionally, international support and collaboration are essential to help Guinea-Bissau mitigate and adapt to the challenges posed by climate change (GNB, 2021).

In 2021, Guinea-Bissau published their updated Nationally Determined Contribution which represents the country's climate action plan to mitigate and adapt to climate change (GNB, 2021). Due to its low greenhouse gas emissions, the country's primary objectives revolve around reducing the carbon intensity of its development, safeguarding national carbon sinks, and enhancing predictive capabilities for assessing the effects of climate change for effective adaptation (GNB, 2021). The main government institutions engaged in climate change are the Ministry of Environment and Biodiversity, National Institute of Meteorology, Institute of Biodiversity and Protected Areas and Ministry of Agriculture and Rural Development. Additionally, there are important actors from the private sector as well as research institutes and NGOs involved. Key international partners include UNDP, WBG, African Development Bank (AFDB) and the European Union (EU) (GNB, 2021).

Interviews with experts from various organizations were conducted to better understand their ongoing work in the country regarding climate change. This represents a small selection of the overall work that is being done and some other requested organizations and government bodies did not agree to an interview. Nevertheless, the work provides an interesting overview of the different levels at which organizations are operating across the country.

Bosque y Comunidad is a Spanish NGO with the goal of improving living conditions of the rural population in developing nations. Their approach is rooted in sustainable practices, active community involvement, and a gender-inclusive perspective. One of their ongoing projects in Guinea-Bissau is focused on bolstering food security and building resilience against the challenges posed by climate change. This initiative encompasses the development of agricultural techniques tailored for climate adaptation, as well as measures to enhance overall agricultural productivity, led by local women's associations. Bosque y Comunidad collaborates closely with the local organization KAFO and actively engages with the community. Together, they are working to improve agricultural productivity through various means, including the construction of water fountains, optimizing field designs, and offering valuable agricultural education (Perea Alonso, 2023).

Ianda Guiné! Arrus is financed by the European Union and is dedicated to uplifting the livelihoods of mangrove rice producers by bolstering the mangrove rice sector in targeted areas. Their primary objective is to sustainably increase production, thereby ensuring enhanced income and reduced food insecurity among the local communities. The organization actively engages in projects encompassing crop protection and coastal erosion, with a strong emphasis on safeguarding mangrove ecosystems. Notably, the organization recognizes the pivotal role of rice in deterring mangrove deforestation, as it provides a compelling economic incentive for preserving them. Consequently, the concept of mangrove rice is intrinsically linked with environmental conservation and the safeguarding of mangroves. The central challenge lies in establishing the financial viability of rice production and making it economically accessible for the population. To address this, the organization has devised an evaluation system employing key indicators to calculate self-sufficiency until the next harvest. This approach aims to reduce dependency on external sources of rice, ultimately empowering the community to achieve self-

sufficiency year-round. The organization contributes to the preservation of mangroves, prevention of coastal erosion and improvement of food security (Camerini, 2023).

UNDP highlighted one climate-specific project in the country which is a 5-year \$12mm Global Environment Facility (GEF) funded project that started in 2021. The main topic is coastal area adaptation to climate change and prevention of coastal erosion. It includes building dykes, promoting gender equality, agriculture protection and adaptation support. The project is focussed on the coastal area in the country as it is the most populated area and includes the strongest economic activity of the country. In this context, UNDP is working on two studies regarding the mapping of coastal areas as well as a social and environmental assessment. Upcoming projects include an energy-related project and the development of an early warning system to detect extreme weather events and enhance climate predictability (Dumbia, 2023).

WBG emphasized its overarching commitment to addressing climate-specific issues. The central focus remains on fostering collaborative partnerships with governments, dedicated to providing support to government-led initiatives, thereby creating benefits that extend to local organizations. WBG is developing Country Climate and Development Reports (CCDRs) to align development with the Paris Agreement and climate targets. Guinea-Bissau is currently in the final phase of a reporting cycle and in the process of updating country strategy and reports. The CCDR report, to be published in the fall, highlights several key issues related to climate change and development planning in Guinea-Bissau. Sectoral development plans lack adequate inclusion of climate concerns, leading to malpractices and insufficient climate integration in project design. It is crucial to align development with climate targets and the Paris Agreement. Early adoption of good practices is essential, especially in sectors like transportation, where road infrastructure must account for risk of flooding (Lefebvre & Desramaut, 2023).

WBG currently operates mainly one climate-related project in Guinea-Bissau with a \$30mm commitment signed in February 2021. The project's primary objective is to enhance resilience

in coastal regions. It comprises three pillars: the provision of data and information to inform strategic coastal planning, the reinforcement of environmental impact management practices, and supporting the preservation of coastal ecosystems while promoting sustainable practices (Lefebvre & Desramaut, 2023).

WFP recently published the updated country strategic plan covering the period from 2023 to 2027, which highlights climate change as one of the main areas of action. This includes building resilience against the impact of climate change. Projects entail the provision of climate-resilient seeds to farmers, construction, and rehabilitation of dykes to block rising sea levels from entering fields and working with women associations (claiming their right to land). Additionally, WFP is engaged in shock assistance including emergency support and the provision of food vouchers or cash for people affected by floods and fires. A key priority for WFP is its collaboration with local organizations. Globally, WFP is guided by a clear directive to partner with national NGOs and organizations. The overarching objective is to effectively transition project management to local organizations and government entities, thereby achieving sustainable, long-term development within the country (Da Costa Semedo et al., 2023).

International agencies are involved in technical assistance and providing know-how but also mobilizing financial resources. Certain agencies allocate their own funds for projects, while others secure financial resources from funding bodies like the GEF and the Green Climate Fund (GCF). These international funds have played a crucial role, contributing to over 73% of the adaptation projects implemented in the country (GNB, 2021). Guinea-Bissau is highly impacted by climate change, requiring approximately \$688.8 million in climate finance to address mitigation and adaptation efforts from 2021 to 2030, aiming to reduce greenhouse gas emissions by 30%. While some committed finance has been secured from development partners and climate funds, investment from the private sector, including banks, is virtually nonexistent. This

is due to the absence of a suitable regulatory framework, limited expertise and experience, and the inflated cost of investment (AFDB, 2023).

At the same time, distinguishing between the development finance gap and the climate gap presents challenges due to their strong interconnection. Capacity limitations constitute significant obstacles. Although a substantial financing gap exists, attracting additional investment proves difficult due to political issues and elite influence. It is essential to establish a robust foundation and address political economic considerations before enhancing investment potential. Climate concerns do not always take precedence, as other pressing issues prevail. Nevertheless, aligning development initiatives with climate goals remains key. This focus encompasses both the construction of sustainable new infrastructure and the adaptation of existing infrastructure to integrate climate considerations. (Lefebvre & Desramaut, 2023).

Appendix 2: Detailed overview of dependent variables

	Frequency	Percent	Cum.
Perception of climate change as a problem			
No problem	8	0.7	0.7
Small problem	54	4.75	5.46
Medium problem	101	8.89	14.35
Big problem	973	85.65	100
Negative effect of climate change on agriculture over the last 10 years			
Better / Neutral	364	32.04	32.04
Worse	231	20.33	52.38
Much worse	541	47.62	100
Dissatisfaction with environmental efforts			
Satisfied	475	42.07	42.07
Dissatisfied	654	57.93	100
Trust in the president			
No trust	332	28.69	28.69
A little bit	186	16.08	44.77
More or less	113	9.77	54.54
A lot	526	45.46	100
Trust in the government			
No trust	539	46.83	46.83
A little bit	270	23.46	70.29
More or less	128	11.12	81.41
A lot	214	18.59	100

Table 4: Dependent variables: frequencies

Appendix 3: Detailed survey as suggestion for future research

The following survey was developed based on Afrobarometer and DEMOS as a suggestion for future research to obtain a more detailed picture of the population's perception of climate change in Guinea-Bissau (Afrobarometer, 2022; Carter & Cardoso, 2021). A Portuguese version and Kobo toolbox code are also available.

	SURVEY QUESTION	CODE
	Personal questions	
0	Do you agree to participate in this study?	
	Yes	1
	No	2
1	Please state your age.	
	—	
2	Gender	
	Woman	1
	Man	2
	Other	3
	Prefer not to answer	-8
3	In which region do you live?	
	Not in Guinea-Bissau	0
	Bafata	1
	Biombo	2
	Bissau	3
	Bolama	4
	Cacheu	5
	Gabu	6
	Oio	7
	Quinara	8
	Tombali	9
4	What is your ethnic community	
	Balanta	1
	Biafada	2
	Bainuk	3
	Bijago	4
	Cape Verdean Guinea-Bissauan	5
	Fula	6
	Jola	7
	Landuma	8
	Manjaco	9
	Mandinga	10
	Mankanya	11
	Nalu	12
	Papel	13

	Susu	14
	Other (specify)	15
	Prefer not to answer	-8
	Dont know	-9
5	Religion	
	Muslim	1
	Christian	2
	Animista	3
	Other (specify)	4
	Prefer not to answer	-8
	Dont know	-9
6	How many years of formal education did you have?	
	Did not attend school	0
	Primary school (1-6 years)	1
	Secondary (7-9 years)	2
	Undergraduate (university, Bachelor's)	3
	Post graduate (Master's)	4
	PhD	5
	Other	6
	Dont know	-9
7	What is your occupation?	
	Never had a job	0
	Student	1
	Housewife	2
	Agriculture / Farming / Fishing / Forestry	3
	Retail / Shop	4
	Cleaner, domestic help, babysitter	5
	Electrician, mechanic	6
	Secretarial	7
	Supervisor / Foreman / Senior manager	8
	Security services (police, army, private security)	9
	Teacher, nurse	10
	Banker / finance, doctor, lawyer, engineer, accountant, professor	11
	Politician / Ministry / Government	12
	Other (specify)	13
8	Which of these things do you or someone in your household own?	
	Radio	1
	Television	2
	Car or motorcycle	3
	Computer	4
	Bank account	5

	Mobile phone	6					
	Fridge	7					
	Solar panel	8					
	Climate and environment						
9	Have you heard about climate change and do you know what it is?						
	Yes	1					
	No	0					
	Dont know	9					
10	Do you think climate change is making life in Guinea Bissau better or worse?						
	Much worse	1					
	Somewhat worse	2					
	Neither worse nor better	3					
	Somewhat better	4					
	Much better	5					
	Dont know	-9					
11	In your opinion, how is climate change affecting the following areas?						
		Making it much worse	Making it a little worse	Neutral	Making it better	Making it much better	Don't know
	Food / Agriculture						
	Farming / Agriculture	1	2	3	4	5	-9
	Fishing	1	2	3	4	5	-9
	Food shortage / Famine	1	2	3	4	5	-9
	Drought	1	2	3	4	5	-9
	Lack of water supply?	1	2	3	4	5	-9
	Infrastructure						
	Transportation	1	2	3	4	5	-9
	Communications	1	2	3	4	5	-9
	Infrastructure / Roads	1	2	3	4	5	-9
	Electricity	1	2	3	4	5	-9
	Health						
	Sickness / Disease	1	2	3	4	5	-9
	Governance						
	Political instability / Political divisions	1	2	3	4	5	-9
	Ethnic tensions	1	2	3	4	5	-9
	Local tensions or conflicts	1	2	3	4	5	-9
	International war	1	2	3	4	5	-9
12	Is there education provided by the government on the following topics?						
		Strongly disagree (No education provided)	Disagree	Neither agree nor disagree	Agree	Strongly agree (a lot of education provided)	Don't know
	The risks of climate change	1	2	3	4	5	-9
	The impact of climate change on agriculture?	1	2	3	4	5	-9
	Government action on climate change	1	2	3	4	5	-9

	International organization action on climate change	1	2	3	4	5	-9
13	Is there education provided by international organizations on the following topics?						
		Strongly disagree (No education provided)	Disagree	Neither agree nor disagree	Agree	Strongly agree (a lot of education provided)	Don't know
	The risks of climate change	1	2	3	4	5	-9
	The impact of climate change on agriculture?	1	2	3	4	5	-9
	Government action on climate change	1	2	3	4	5	-9
	International organization action on climate change	1	2	3	4	5	-9
14	In your experience, have the following events become more or less severe over the past 10 years?						
		Much more severe	A little more severe	Neutral	Less severe	Much less severe	Don't know
	Drought	1	2	3	4	5	-9
	Flooding	1	2	3	4	5	-9
	More than usual extreme heat	1	2	3	4	5	-9
	Impact of climate on agriculture	1	2	3	4	5	-9
	Food shortage / famine	1	2	3	4	5	-9
	Lack of water supply	1	2	3	4	5	-9
	Increased sea level	1	2	3	4	5	-9
	Amount of mosquitos	1	2	3	4	5	-9
15	For each of the following statements, please tell me whether you disagree or agree.						
		Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Don't know
	Is it important for the government to take steps to limit the effect of climate change	1	2	3	4	5	-9
	It is important for the government to take steps to limit climate change, even if it is causes some job losses or harm to our economy.	1	2	3	4	5	-9
	Is it important for international organizations to take steps to limit the effect of climate change	1	2	3	4	5	-9
	It is important for the international organizations to take steps to limit climate	1	2	3	4	5	-9

	change, even if it is causes some job losses or harm to our economy.				
16	Who do you think should have primary responsibility for trying to limit climate change and reduce its impact?				
	Ordinary people	1			
	Business and industry	2			
	The government	3			
	Rich or developed countries	4			
	Traditional leaders	5			
	International organizations (UN etc.)	6			
	Everyone	7			
	Other (specify)	8			
	Don't know	-9			
17	Do you think each of the following are doing enough to limit climate change, or do they need to do more?				
		Doing enough	Need to do somewhat more	Need to do a lot more	Don't know
	Yourself	1	2	3	-9
	Ordinary people	1	2	3	-9
	Business and industry	1	2	3	-9
	The government	1	2	3	-9
	Rich or developed countries	1	2	3	-9
	International organizations (UN etc.)	1	2	3	-9
18	In your community, how serious is the problem of trash / garbage pollution?				
	Very serious	1			
	Somewhat serious	2			
	Neutral	3			
	Not very serious	4			
	Not at all serious	5			
	Don't know	-9			
19	Which of the following is the most important environmental issue in your community today?				
	Air pollution	1			
	Pollution of water sources	2			
	Sanitation or human waste management	3			
	Trash disposal, including plastics	4			
	Deforestation	5			
	Some other issue (specify)	6			
	None of these / There are no problems	0			
	Don't know	-9			

20	In your opinion, what is the most important topic that needs to be worked on to help you regarding climate change?						
	Open question						
21	Do you think that you personally are affected by climate change?						
	Very serious	1					
	Somewhat serious	2					
	Neutral	3					
	Not very serious	4					
	Not at all serious	5					
	Don't know	-9					
	Food and Water Security						
22	What is your main source of water for household use?						
	Piped water at home	1					
	Public tap or standpipe	2					
	Tube well or borehole	3					
	Dug well	4					
	Spring	5					
	Rainwater collection	6					
	Bottled water	7					
	Surface water, like a river, dam, lake, pond, stream, canal, or irrigation channel	8					
	Other (specify)	9					
	Don't know	-9					
23	What is your main food source?						
	Own agriculture	1					
	Market	2					
	Supermarket	3					
	Other (specify)	4					
24	Over the past 6 months how often have you or your family had not enough or enough:						
		Never enough	Some times not enough	Several times	Some times enough	Always enough	Don't know
	Food	1	2	3	4	5	-9
	Clean water for home use	1	2	3	4	5	-9
	Medicines or medical treatment	1	2	3	4	5	-9
	Fuel to cook your food	1	2	3	4	5	-9
	Cash income	1	2	3	4	5	-9
25	Has the following become better or worse over the past years?						
		Much worse	Somewh at worse	Neither worse nor better	Somewhat better	Much better	Don't know
	Enough food to eat	1	2	3	4	5	-9
	Enough clean water for home use	1	2	3	4	5	-9

	Medicines or medical treatment	1	2	3	4	5	-9
	Enough fuel to cook your food	1	2	3	4	5	-9
	A cash income	1	2	3	4	5	-9
26	Do you fear that climate change will make this situation worse?						
	Yes	1					
	No	0					
	Neutral	2					
	Don't know	-9					
	Economic direction of the country						
27	In general, how would you describe:						
		Very bad	Fairly bad	Neither good nor bad	Fairly good	Very good	Don't know
	The present economic condition of this country?	1	2	3	4	5	-9
	Your own present living conditions?	1	2	3	4	5	-9
28	Would you say that the country is going in the wrong direction or going in the right direction?						
	Going in the wrong direction	1					
	Going in the right direction	2					
	Don't know	-9					
29	Looking back, how do you rate economic conditions in this country compared to 12 months ago?						
	Much worse	1					
	Worse	2					
	Same	3					
	Better	4					
	Much better	5					
	Don't know	-9					
30	Looking ahead, do you expect economic conditions in this country to be better or worse in 12 months' time?						
	Much worse	1					
	Worse	2					
	Same	3					
	Better	4					
	Much better	5					
	Don't know	-9					
	Thank you for your participation!						

Bibliography

- Adesina, A. S. S. (2005). Farmers' perceptions and adoption of new agricultural technology: analysis of modern mangrove rice varieties in Guinea Bissau. *Journal of International Agriculture*, 34(4), 358–371.
- AFDB. (2023). *Mobilizing Private Sector Financing for Climate and Green Growth in Africa*.
- Afrobarometer. (2022). *Round 9 survey manual*.
- Barrucand, M. G., Giraldo Vieira, C., & Canziani, P. O. (2017). Climate change and its impacts: perception and adaptation in rural areas of Manizales, Colombia. *Climate and Development*, 9(5), 415–427. <https://doi.org/10.1080/17565529.2016.1167661>
- BTI. (2023). *Country Report 2022 Guinea-Bissau*. <https://www.bti-project.org>.
- Camerini, F. (2023). *Interview with Filippo Camerini (Ianda Guiné! Arrus) 29.06.2023*.
- Carter, M., & Cardoso, C. (2021). *Vozes do Povo: Sociedade, Política e Opinião Pública na Guiné-Bissau*.
- Catarino, L., Menezes, Y., & Sardinha, R. (2015). Cashew cultivation in Guinea-Bissau – risks and challenges of the success of a cash crop. *Scientia Agricola*, 72(5), 459–467. <https://doi.org/10.1590/0103-9016-2014-0369>
- Ceci, P., Monforte, L., Perelli, C., Cicatiello, C., Branca, G., Franco, S., Diallo, F. B. S., Blasi, E., & Scarascia Mugnozza, G. (2021). Smallholder farmers' perception of climate change and drivers of adaptation in agriculture: A case study in Guinea. *Review of Development Economics*, 25(4), 1991–2012. <https://doi.org/10.1111/rode.12815>
- Da Costa Semedo, I., Roe, M., & Soares, T. (2023). *Interview with Isis da Costa Semedo, Miguel Roe, Tiago Soares (WFP) 07.07.2023*.
- Deressa, T. T., Hassan, R. M., & Ringler, C. (2011). Perception of and adaptation to climate change by farmers in the Nile basin of Ethiopia. *The Journal of Agricultural Science*, 149(1), 23–31. <https://doi.org/10.1017/S0021859610000687>
- Ding, Q., Chen, X., Hilborn, R., & Chen, Y. (2017). Vulnerability to impacts of climate change on marine fisheries and food security. *Marine Policy*, 83, 55–61. <https://doi.org/10.1016/J.MARPOL.2017.05.011>
- Dumbia, E. (2023). *Interview with Elisabete Dumbia (UNDP) 18.07.2023*.
- EU. (2023). *Multiannual Indicative Programme 2021-2027 Guinea-Bissau*.
- FAO. (2023). *GIEWS Country Brief*.

- Havik, P., Monteiro, F., Catarino, S., Correia, A., Catarino, L., & Romeiras, M. (2018). Agro-Economic Transitions in Guinea-Bissau (West Africa): Historical Trends and Current Insights. *Sustainability*, 10(10), 3408. <https://doi.org/10.3390/su10103408>
- IPCC, Calvin, K., Dasgupta, D., Krinner, G., Mukherji, A., Thorne, P. W., Trisos, C., Romero, J., Aldunce, P., Barrett, K., Blanco, G., Cheung, W. W. L., Connors, S., Denton, F., Diongue-Niang, A., Dodman, D., Garschagen, M., Geden, O., Hayward, B., ... Ha, M. (2023). *IPCC Climate Change 2023: Synthesis Report*. (P. Arias, M. Bustamante, I. Elgizouli, G. Flato, M. Howden, C. Méndez-Vallejo, J. J. Pereira, R. Pichs-Madruga, S. K. Rose, Y. Saheb, R. Sánchez Rodríguez, D. Ürgen-Vorsatz, C. Xiao, N. Yassaa, J. Romero, J. Kim, E. F. Haïtes, Y. Jung, R. Stavins, ... C. Péan, Eds.). <https://doi.org/10.59327/IPCC/AR6-9789291691647>
- Lefebvre, A.-L., & Desramaut, N. (2023). *Interview with Nicolas Desramaut, Anne-Lucie Lefebvre (WBG) 11.07.2023*.
- MacKinnon, J. G., Nielsen, M. Ø., & Webb, M. D. (2023). Cluster-robust inference: A guide to empirical practice. *Journal of Econometrics*, 232(2), 272–299. <https://doi.org/10.1016/j.jeconom.2022.04.001>
- Maddison, D. (2007). *The Perception Of And Adaptation To Climate Change In Africa*. The World Bank. <https://doi.org/10.1596/1813-9450-4308>
- Martiarena, M. L., & Temudo, M. P. (2023). Endogenous learning and innovation in African smallholder agriculture: lessons from Guinea-Bissau. *The Journal of Agricultural Education and Extension*, 1–19. <https://doi.org/10.1080/1389224X.2023.2169480>
- Mayring, P. (2021). *Qualitative Content Analysis*.
- Mendes, O., & Fragoso, M. (2023). Assessment of the Record-Breaking 2020 Rainfall in Guinea-Bissau and Impacts of Associated Floods. *Geosciences*, 13(2), 25. <https://doi.org/10.3390/geosciences13020025>
- Monteiro, F., Catarino, L., Batista, D., Indjai, B., Duarte, M., & Romeiras, M. (2017). Cashew as a High Agricultural Commodity in West Africa: Insights towards Sustainable Production in Guinea-Bissau. *Sustainability*, 9(9), 1666. <https://doi.org/10.3390/su9091666>
- Niles, M. T., & Mueller, N. D. (2016). Farmer perceptions of climate change: Associations with observed temperature and precipitation trends, irrigation, and climate beliefs. *Global Environmental Change*, 39, 133–142. <https://doi.org/10.1016/j.gloenvcha.2016.05.002>
- Pacheco de Carvalho, B. R. M. H. (2015). Cashew Chain Value in Guiné-Bissau: Challenges and Contributions for Food Security: A Case Study for Guiné Bissau. *Int. J. Food System Dynamics*, 7(1), 1–13.
- Perea Alonso, N. (2023). *Interview with Nuria Perea Alonso (ByC) 30.06.2023*.

- GNB. (2015). *Terra Ranka*.
- GNB. (2021). *Updated Nationally Determined Contribution in the Framework of the Paris Climate Agreement*.
- Santos, C. (2023). *Interview 30.06.2023*.
- Santos, C., & Mourato, J. M. (2022). 'I was born here, I will die here': climate change and migration decisions from coastal and insular Guinea-Bissau. *Geografiska Annaler, Series B: Human Geography*. <https://doi.org/10.1080/04353684.2022.2154689>
- Sousa, J., Campos, R., Mendes, O., Duarte Lopes, P., Matias, M., Rosa, A. P., Mendes Fernandes, R., Cruz, C., Indjai, B., Infande, A., da Costa, M., Salvaterra, G., Lourenço, J., Tavares, D., Camala, D., Ainslie, A., & Catarino, L. (2023). The (dis)engagement of mangrove forests and mangrove rice in academic and non-academic literature on Guinea-Bissau—a systematic review protocol. *PLOS ONE*, 18(4), e0284266. <https://doi.org/10.1371/journal.pone.0284266>
- Temudo, M. P. (2011). Planting Knowledge, Harvesting Agro-Biodiversity: A Case Study of Southern Guinea-Bissau Rice Farming. *Human Ecology*, 39(3), 309–321. <https://doi.org/10.1007/s10745-011-9404-0>
- Temudo, M. P., & Abrantes, M. (2014). The Cashew Frontier in Guinea-Bissau, West Africa: Changing Landscapes and Livelihoods. *Human Ecology*, 42(2), 217–230. <https://doi.org/10.1007/s10745-014-9641-0>
- Temudo, M. P., & Cabral, A. I. R. (2023). Climate change as the last trigger in a long-lasting conflict: the production of vulnerability in northern Guinea-Bissau, West Africa. *The Journal of Peasant Studies*, 50(1), 315–338. <https://doi.org/10.1080/03066150.2021.1996355>
- Temudo, M. P., Cabral, A. I. R., & Reis, P. (2022). The Sea Swallowed our Houses and Rice Fields: The Vulnerability to Climate Change of Coastal People in Guinea-Bissau, West Africa. *Human Ecology*, 50(5), 835–850. <https://doi.org/10.1007/s10745-022-00352-2>
- UN. (2022). *Sustainable Development Cooperation Framework For Guinea-Bissau*.
- UNDP. (2022). *Human Development Report*.
- University of Notre Dame. (2023). *ND-Gain Matrix*. <https://Gain-New.Crc.Nd.Edu/Country/Guinea-Bissau>.
- U.S. Department of State. (2022). *2021 Report on International Religious Freedom: Guinea-Bissau*.
- Vasconcelos, M. J., Cabral, A. I. R., Melo, J. B., Pearson, T. R. H., Pereira, H. de A., Cassamá, V., & Yudelman, T. (2015). Can blue carbon contribute to clean development in West-Africa?

- The case of Guinea-Bissau. *Mitigation and Adaptation Strategies for Global Change*, 20(8), 1361–1383. <https://doi.org/10.1007/s11027-014-9551-x>
- WBG. (2023a). *Guinea Bissau Economic Update 2022*. <http://www.>
- WBG. (2023b). *World Bank Data*.
<https://Data.Worldbank.Org/Indicator/SP.POP.TOTL?Locations=GW>.
- WBG. (2023c). *Worldwide Governance Indicators*.
<https://Databank.Worldbank.Org/Source/Worldwide-Governance-Indicators>.
- WBG. (2023d, August 30). *Climate Change Knowledge Portal*.
- WFP. (2021). *Critical Corporate Initiative: Climate Response Analysis for Adaptation*.
- WFP. (2022). *Country Strategic Plan*. <https://executiveboard.wfp.org>
- WFP. (2023a). *Guinea-Bissau Country Brief*.
- WFP. (2023b). *Guinea-Bissau Country Strategic Plan*.