

**CONSUMPTION OF BUSHMEAT AFTER THE COVID-19: IMPLICATIONS FOR  
FOOD SECURITY IN GHANA**

**BY**

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### DECLARATION

I, Joshua Kwao Oduah, the author of this thesis, "CONSUMPTION OF BUSHMEAT AFTER THE COVID-19: IMPLICATIONS FOR FOOD SECURITY IN GHANA" do hereby declare that, with the exception of the properly listed references, all work done for this thesis was done by me at the Department of Agricultural Economics and Agribusiness, University of Ghana, Legon.



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## **DEDICATION**

This thesis is dedicated to my parents, Mr. & Mrs. Oduah and siblings for their undaunted support, love and encouragement throughout my studies.



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I am deeply thankful to God for giving me the strength, determination, and clarity of mind to complete this master's program and thesis.

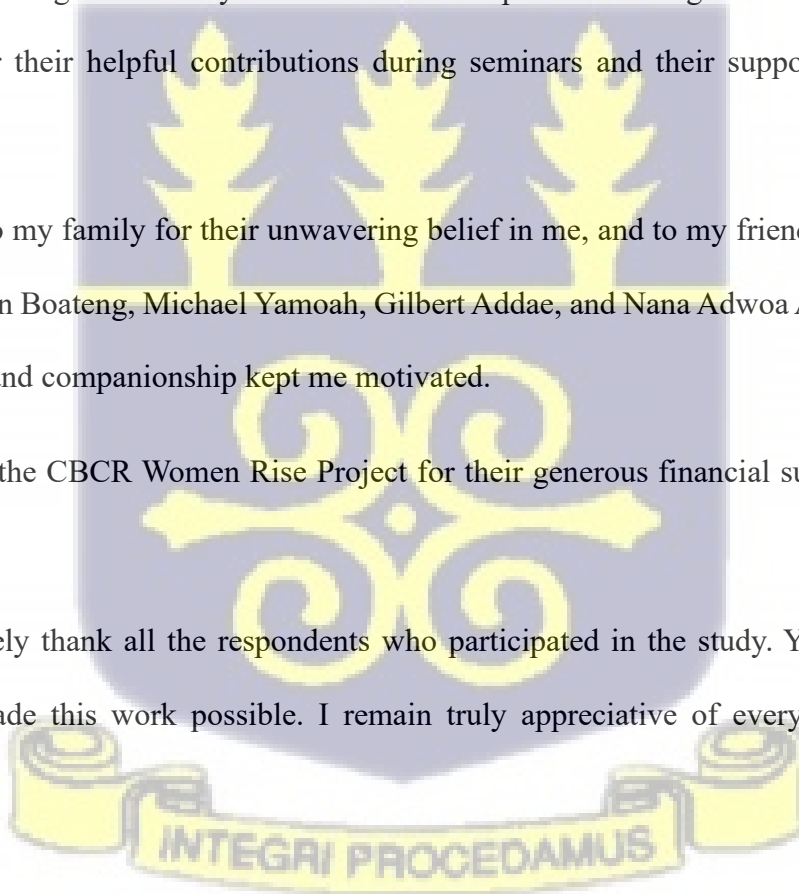
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## ABSTRACT

The COVID-19 pandemic has had far-reaching effects on various aspects of life, including food consumption. In Ghana, bushmeat has traditionally been an important source of protein and income for many households. However, the pandemic has influenced the dynamics of bushmeat consumption, raising questions about its implications for food security. This study aimed to assess the consumption of bushmeat after the COVID-19 and its implications for food security in the Greater Accra, Ashanti, and Bono-East regions of Ghana. This explored the diversity of bushmeat consumed after the COVID-19 and analyzed the factors influencing consumer preferences for different types of bushmeat. Additionally, the study examined the implications of consumer perceptions of bushmeat on food security. Finally, the study identified and ranked the constraints faced by bushmeat consumers in the post-COVID-19 period. Descriptive statistics, particularly a bar chart, were used to analyze the diversity of bushmeat consumed. A Multinomial Logistic Regression Model was used to investigate the factors influencing consumer preferences for different types of bushmeat. For the analysis of consumer perceptions on food security, the Structural Equation Model was employed. Kendall's Coefficient of Concordance (W) was used to examine the level of agreement between respondents' ranking of identified constraints. Data was collected from three hundred (300) bushmeat consumers located in the Greater Accra, Ashanti, and Bono-East regions. The statistical analyses were conducted using STATA 17. The findings reveals that the three most consumed types of bushmeat across the study area are grasscutter, rat, and antelope, which may be attributed to their availability and taste preference. Results from the multinomial logistic regression shows that gender, income, region, health risk, and price of bushmeat are key factors influencing consumer preferences for different types of bushmeat. The results also reveal that both the variety and quantity of bushmeat available positively influence its accessibility, with a significant level of 1%. The taste and nutritional value of bushmeat significantly enhance its utilization, both at the 1% level. In contrast, high prices and low income significantly reduce its accessibility, at the 1% and 5% levels, respectively. Also, access to information and community advocacy also had a negative influence on agency. Additionally, factors such as taste distortion, illegal hunting, public health concerns, and economic instability negatively influenced the stability and sustainability of bushmeat, all at 1% significant level. The four most prevalent constraints among respondents in the study area, in order of magnitude, are high price for the bushmeat, income, health risk of zoonotic diseases, distance of bushmeat sales outlets, and environmental concerns. To improve accessibility, bushmeat suppliers should consider selling their bushmeat in smaller, more affordable portions. This could make bushmeat accessible to a broader range of consumers, including those with lower income. By offering various portion sizes, bushmeat traders could cater to diverse consumer preferences and budget thereby potentially increasing their customer base and sales.

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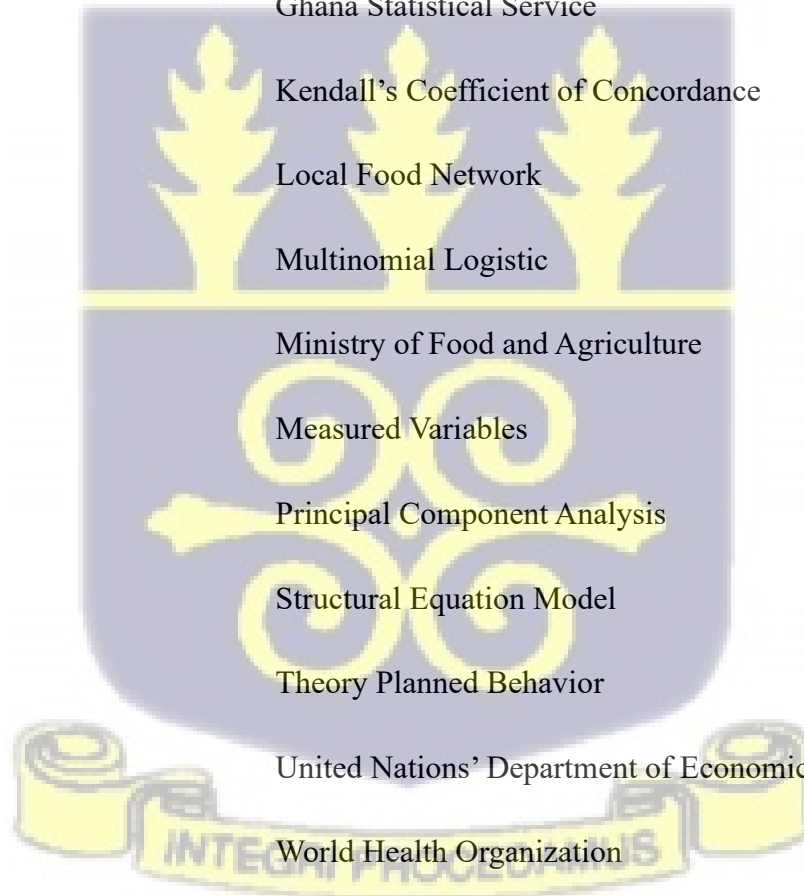
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## LIST OF ACRONYMS

CBCR	Centre for Biodiversity Conservation Research
COVID-19	Coronavirus Disease 2019
EFA	Exploratory Factor Analysis
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GHS	Ghana Cedis
GSS	Ghana Statistical Service
KCC	Kendall's Coefficient of Concordance
LFN	Local Food Network
MNL	Multinomial Logistic
MoFA	Ministry of Food and Agriculture
MVs	Measured Variables
PCA	Principal Component Analysis
SEM	Structural Equation Model
TPB	Theory Planned Behavior
UN DESA	United Nations' Department of Economic and Social Affairs
WHO	World Health Organization



## CHAPTER ONE

### INTRODUCTION

#### 1.1 Background

Bushmeat refers to the edible parts of undomesticated animals such as mammals, amphibians, reptiles, birds, and insects that are harvested from the wild either for sustenance or as a means of livelihood. It plays a role in ensuring food access, especially in rural communities where it often constitutes a major component of dietary protein (Nasi *et al.*, 2008). This study investigates how bushmeat consumption in Ghana has evolved in the post-COVID-19 era, with particular attention to species diversity, consumer preferences, food security perceptions, and the challenges consumers face.

In Ghana, many individuals rely on bushmeat both for nutritional needs and economic survival, including hunters and women involved in the local trade (Bannor *et al.*, 2022; Mendelson *et al.*, 2003). Indeed, the scale of this reliance is considerable, Ghana's annual bushmeat harvest was estimated at around 385,000 metric tons in the late 1990s, with an approximate value of US\$350 million (Swensson, 2005). Bushmeat remains a needed protein source as well, accounting for up to 80–90% of the animal protein in certain rural areas of West and Central Africa (Bannor *et al.*, 2022)

Throughout African history, bushmeat consumption has been closely tied to local customs. Some individuals choose bushmeat because of its distinctive flavor, cultural beliefs, or the absence of alternative protein sources (Luiselli *et al.*, 2019). It is embedded in everyday diets and is often exchanged or sold for income. Commonly preferred species include antelopes and large rodents, while others such as bats, monkeys, and snakes are less frequently eaten.

In Ghana, the practice of hunting and consuming bats is often associated with certain cultural or tribal groups, with regional traditions shaping the way bushmeat is sourced and distributed (Schulte-Herbruggen, 2012). Frog meat, in particular, holds dietary and economic importance for traders in the northern parts of the country (Sackey *et al.*, 2023). Grasscutters are highly valued and widely consumed due to their rich protein content (Schröder *et al.*, 2004). The trade involves a variety of species that may be sold fresh or preserved, fulfilling culinary, nutritional, and even medicinal purposes (Glover & Glover, 2014). These patterns emphasize bushmeat's embeddedness in local food culture and its relevance to rural economies.

Among the commonly consumed species are black duikers, brush-tailed porcupines, bushbucks, grasscutters, Maxwell's duikers, giant rats, squirrels, and various types of antelope (Gbogbo *et al.*, 2020; Ampofo *et al.*, 2017). These animals form a key part of household diets and are an affordable protein choice for many families, particularly in economically challenged areas (Sackey *et al.*, 2023). Notably, Ghana's bushmeat trade has continued to grow in recent years. Reports indicate that demand for wild meat is soaring in both rural and urban markets (Trefon, 2023; Vliet *et al.*, 2021), driven by cultural preferences and limited affordable alternatives (Ingram, 2020; Teye *et al.*, 2020). Consumer surveys across different regions found that about 67% of respondents consume bushmeat, with grasscutter (a type of cane rat) being the most preferred species (Wajah *et al.*, 2022). Demographic factors also influence consumption patterns: younger people have become an emerging segment of bushmeat consumers (Davies and Brown, 2008; Opare-Ankrah, 2007) while factors such as high prices, older age, and certain religious restrictions can discourage bushmeat eating (Molinari and Zane, 2023 and Morsello *et al.*, 2015)

Both urban and rural populations regularly consume bushmeat. Schulte-Herbruggen (2012) noted that urban demand has seen consistent growth, providing rural sellers with a profitable market. This demand has nurtured a commercial supply chain composed of hunters, intermediaries, food vendors, and final consumers (Nielsen *et al.*, 2016).

Commercial hunters, usually based in rural areas, are the first actors in the supply chain. They supply wild meat to towns and cities (Mendelson *et al.*, 2003). Various capture techniques are employed, including guns, snares, traps, netting, and other improvised methods (Luiselli, 2015). Gun hunting is the most common technique, representing nearly 68 percent of all hunts, significantly surpassing other methods like trapping or using bait (Ampofo *et al.*, 2017).

Once the animals are caught, traders often handle processing, packaging, and sales. Women play a key role in this part of the chain, overseeing tasks like smoking and cooking the meat (Brown, 2007). Because it requires minimal initial investment and offers income potential, bushmeat trading is a viable option for many women, especially in rural settings with limited employment options (Trefon, 2023).

However, large-scale bushmeat hunting has sparked concern about its ecological impact. Overhunting has been linked to wildlife population declines and threats to biodiversity (Brodie *et al.*, 2019; Gonçalves *et al.*, 2019). It has also been identified as a possible pathway for zoonotic disease transmission (Abukari & Kankam, 2023).

Prior to the pandemic, Ghana's socioeconomic context underscored the importance of bushmeat as a safety net. Poverty and limited formal employment opportunities especially in rural areas meant that many households depended on wild meat for both daily sustenance and supplemental

income. When COVID-19 struck in 2020, it highlighted the fragility of rural livelihoods and their reliance on bushmeat as a safety net. Nationwide lockdown measures and an economic slowdown caused widespread hardship, as more than three-quarters of Ghanaian households reported a decline in income following the imposition of COVID-19 restrictions (Onyango *et al.*, 2023). This upheaval disrupted food supply chains and livelihoods: market closures and movement limits made it difficult for bushmeat hunters and traders to operate, while consumers faced higher prices and reduced access to protein sources (Kwakudua *et al.*, 2025)

The COVID-19 pandemic, which the World Health Organization formally recognized in March 2020, brought heightened global concern about health risks associated with wildlife. The disease is believed to have originated in bats, with transmission likely occurring in a wildlife market setting (Milbank & Vira, 2022). Understandably, such events have amplified public concerns about food safety. Liu *et al.* (2013) observed that people tend to avoid foods they associate with health risks. In West Africa, previous outbreaks like Ebola and avian flu have already influenced bushmeat consumption habits. . For example, Kuukyi *et al.* (2014) found that more than half of surveyed consumers in Accra stopped eating bushmeat due to fears about Ebola. Sainge *et al.* (2023) also noted similar consumer beliefs in Sierra Leone. In Ghana, consumption of wild meat dropped from 72 percent to 50 percent during COVID-19 lockdowns, partly due to supply chain disruption and fears about disease transmission (Abukari & Kankam, 2023).

Globally, about three quarters of newly emerging infectious diseases are zoonotic, and most originate in wild animal species (Milbank & Vira, 2022). Thus, heightened caution during health crises like COVID-19 is justified. Beyond health concerns, the pandemic disrupted food systems on a global scale. Labor shortages caused by lockdowns led to lower productivity and disrupted

food supply chains (Kubatko *et al.*, 2023). Even before the pandemic, food insecurity was already a challenge in many low- and middle-income countries (Ruel & Fanzo, 2021). Factors like natural disasters, insect infestations, and socio-economic instability were already undermining food systems (World Bank, 2022).

COVID-19 made these problems worse. Hassen & El Bilali (2024) reported that the pandemic worsened existing weaknesses in food production and distribution networks. Devereux *et al.* (2020) emphasized that disruptions occurred at multiple levels, from farming to consumer access. This highlighted the fragility of agri food systems in many countries.

In sum, bushmeat remains a valuable food source and cultural asset in Ghana, but its future is complicated by ecological risks, changing consumer behavior, and health-related uncertainties.

## **1.2 Problem statement**

In Ghana, bushmeat has historically held a place in both food traditions and rural economies. It provides protein to households and supports the livelihoods of hunters and traders. However, challenges such as unregulated hunting and weak enforcement of conservation laws pose serious risks to its long-term availability (Festus & Omoboye, 2014; Layade & Layade, 2020; Enuoh & Bisong, 2014; Van Vliet *et al.*, 2017). These problems highlight the tension between bushmeat's contributions and its sustainability, stressing the importance of balanced management.

The emergence of COVID-19 in 2020 brought new dimensions to this issue. The pandemic severely disrupted economies and livelihoods worldwide, causing profound social and economic shocks comparable to the Great Depression (Maiti & Locke, 2021; Kaftan *et al.*, 2023; UN DESA, 2020). In Ghana, as in many countries, these disruptions extended to food systems: lockdowns,

job losses, and reduced incomes affected the affordability and availability of foods, including bushmeat (Tibiru *et al.*, 2022). At the same time, increased global awareness about the dangers of zoonotic diseases brought renewed focus on the health implications of wild animal consumption (Meseko & Adedeji, 2020). For example, bushmeat hunting, sales, and consumption can facilitate the transmission of severe zoonoses (Van-Vliet *et al.*, 2017), and COVID-19 itself is potentially linked to zoonotic transmission from wildlife (Trefo, 2023). This increased awareness of health risks could alter consumer attitudes toward bushmeat, making some people more wary of consuming wild animal meat. Surveys confirm that bushmeat consumption in Ghana declined dramatically at the height of the pandemic due to such fears and market disruptions, one study found that only about 27% of previous consumers continued eating wild meat during the COVID-19 lockdown, compared to virtually all consumers before the pandemic (Kwadua *et al.*, 2025). Even after restrictions eased, bushmeat consumption did not fully rebound (only 47% of people returned to consuming it regularly) reflecting a lasting effect of health risk perceptions on consumer behavior.

With people's livelihoods in jeopardy, bushmeat prices rising due to inflation, and greater awareness of disease risks, there is now significant uncertainty in consumer behavior towards bushmeat. On the other hand, the economic hardships caused by the pandemic could have driven some Ghanaians to rely more on bushmeat as an accessible food source or income option (McNamara *et al.*, 2020). This interplay of economic hardship and health concern provides a strong rationale to investigate bushmeat consumption patterns in Ghana after the pandemic. In particular, it prompts the question of how the diversity of bushmeat species consumed may have changed post-COVID-19.

Empirical observations suggest that demand for bushmeat remains resilient despite these challenges. For instance, a recent study shows that the demand for bushmeat including pangolins (locally known in Akan as *aprawa*) remains high despite elevated prices (Nguyen *et al.*, 2021), indicating that some consumers are still willing to purchase bushmeat even at a high cost. Similarly, despite the health risks, a considerable number of people continue to consume bushmeat (Kuukyi *et al.*, 2014). Likewise, during the COVID-19 crisis, some Ghanaians persisted in eating bushmeat specifically because of its perceived nutritional benefits and cultural significance (Kwakudua *et al.*, 2025) This persistence in consumption suggests that there are multiple underlying factors driving bushmeat consumption in the post-COVID-19 context. However, these factors have not been thoroughly investigated, which warrants further research to understand the motivations and determinants of bushmeat consumption after COVID-19.

Furthermore, most scholarly attention on bushmeat has focused on the supply side and biological aspects of the trade, rather than on consumer perspectives or food security outcomes. Previous studies have examined hunting practices, market operations, and regulatory frameworks (Pangau-Adam *et al.*, 2012; Ripple *et al.*, 2016; Nasi *et al.*, 2008; Damania *et al.*, 2005), but paid scant attention to consumer perceptions and the food security implications of bushmeat consumption. Bowen-Jones *et al.* (2002) noted that most scientific studies examine ecological aspects rather than food security or human livelihoods, underscoring a significant gap in the literature. Notably, the limited research on consumer behavior shows that bushmeat can be important for nutrition and income security. For instance, Schulte-Herbrüggen *et al.* (2013) found that households harvesting bushmeat were able to consume most of it (about 64%), enabling them to spend roughly 30% less on meat and fish purchases (Schulte-Herbrüggen *et al.*, 2013). Likewise, Brashares *et al.* (2011) demonstrated that wild meat often serves as a protein source when other foods are unavailable or

unaffordable, contributing up to 80% of animal protein in certain communities (Cawthorn and Hoffman, 20215)

This literature gap underscores the need to study bushmeat consumption from a food security perspective. In today's context, this knowledge gap is even more pressing. Changes in consumer behavior influence all aspects of food security including availability, access, utilization, agency, stability and sustainability.

Bushmeat hunters and traders are known to face various constraints that affect the sustainability of their activities, including inadequate environmental awareness, ineffective legislation, and socio-economic challenges (Festus & Omoboye, 2014; Layade & Layade, 2020). Unsustainable hunting practices, human population growth, cultural food preferences, and conflicts over land rights have further compounded these challenges (Enuoh & Bisong, 2014). To date, research has largely focused on these supply-side constraints, with limited attention to the challenges faced by bushmeat consumers. Given the altered context of the bushmeat trade after COVID-19 (such as new health concerns and market disruptions), it is essential to investigate consumer-side constraints as well. Understanding what difficulties consumers encounter (for example, in obtaining bushmeat or in addressing safety concerns) will help in formulating effective policies and interventions in this era.

### **1.3 Research Questions**

1. What is the diversity of bushmeat consumed after the COVID-19 pandemic?
2. What are the factors influencing consumers' preferences for different types of bushmeat after the COVID-19 pandemic in the study area?

3. What are the implications of consumers' perceptions of bushmeat on food security after the COVID-19 pandemic?

4. What are the constraints faced by bushmeat consumers after the COVID-19 pandemic in the study area?

#### **1.4 Research objectives**

The main objective of the study is to analyze the bushmeat consumption after the COVID-19 pandemic and its implications on food security in Ghana.

The specific objectives of the study are:

1. To identify and describe the diversity of bushmeat consumed after the COVID-19 pandemic.
2. To examine the factors influencing consumer preferences for different types of bushmeat after the COVID-19 pandemic.
3. To examine the implications of consumer perceptions of bushmeat on food security after the COVID-19 pandemic.
4. To identify and rank the constraints faced by bushmeat consumers after the COVID-19 pandemic.

#### **1.5 Significance of study**

By examining the variety of species consumed, this study contributes to a clearer understanding of local demand. This can help shape conservation strategies, inform public policy, and support food security efforts.

Understanding what drives consumer preferences is especially relevant after the pandemic. First, it can reveal new trends in consumer behavior and demand. Second, it highlights how economic,

cultural, and health related factors shape purchasing decisions. Third, it can help develop practical strategies that serve both community needs and long-term sustainability goals.

Analyzing how bushmeat consumption is perceived in relation to food security offers valuable insights for policy makers. If bushmeat remains important to household diets, then policies must account for its role and risks. The findings can support more inclusive approaches to food system planning, balancing safety, equity, and ecological responsibility.

Additionally, by identifying consumer level challenges such as affordability or safety concerns, this study helps pinpoint the areas where support is most needed. Ranking these constraints provides a roadmap for government bodies, researchers, and community stakeholders. The results aim to spark dialogue and cooperation among different actors to support both food security and biodiversity conservation. This study also addresses a key gap in the literature by providing updated consumer focused insights into bushmeat use.

### **1.6 Organization of study**

This study is organized into five chapters. Following the chapter one which involves the background of the study, problem statement, objectives, and justification of the study, the chapter two reviews the existing literature that are important to the study. The methodology of the study is presented in Chapter three. This includes a discussion on the conceptual, theoretical frameworks, analytical framework and data description. It also discusses the method of data analysis, study area and sampling technique. The results and discussion for each study objective are presented in Chapter four. The conclusion and policy implications of the study are presented in Chapter five.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Introduction

This chapter reviews relevant literature related to this study. It highlights the history and cultural significance of bushmeat trade in Ghana, food security indicators, the global and Ghanaian food security situation, COVID-19 and its effect on food systems, effects of COVID-19 on bushmeat trade and consumption, COVID-19 and consumer attitude, pandemic driven demand for alternative proteins, cultural significance of bushmeat, analytical tools and empirical studies.

#### 2.2 History and cultural significance of bushmeat trade in Ghana

The history of the bushmeat trade in Ghana dates to ancient times when hunter-gatherers inhabited the region. As society transitioned to animal husbandry and agriculture around 1500 BC (Sackey *et al.*, 2023), wildlife continued to be served as a means of sustenance for livelihood. Over the centuries, migrations and trade networks have evolved, with kingdoms such as the Dagomba and Mamprusi engaged in trade with Sudanese counterparts influenced by Islam. Bushmeat became embedded in Ghanaian cultural and economic practices, offering both sustenance and commodities for exchange. In modern times, bushmeat trade networks in Ghana operate over long distances, with large-bodied species commonly traded and resold in urban markets in the south. Research in Ghana's Upper East Region revealed that a vast majority of animals sold over 80% are made up of frog species, underscoring their role as an affordable protein option and important income source for sellers in less privileged communities (Turner *et al.*, 2014; McNamara *et al.*, 2015). However, hunting pressure, habitat disturbance, and distances to markets increasingly challenge sustainability (Ward, 2023). This market structure underscores the economic importance of bushmeat, yet raises concerns about sustainability and health risks, particularly due to trace metal contamination in various species (Bannor *et al.*, 2022). The evolving bushmeat trade system in

Ghana supports diverse actors including local hunters, market intermediaries, and vendors (Sackey *et al.*, 2023) ensuring bushmeat remains a food source for people in both urban and rural settings. Yet scholars warn that extensive bushmeat harvesting is leading to declines in many wildlife populations. Balancing its cultural importance with conservation and public health priorities is essential; overly narrow, wildlife-only preservation approaches risk failure unless local people's needs are also considered (Sankaran *et al.*, 2024; Cawthorn and Hoffman, 2015)

In Ghana, bushmeat hunting remains an integral part of livelihood strategies, combining cultural tradition and economic necessity, especially for rural households, and supports food security and financial stability (Kyei-Poakwah *et al.*, 2023). However, hunters report dwindling bushmeat supplies due to overhunting, habitat loss, and environmental changes (Asibey, 1974). Overhunting not only depletes wildlife populations but, when combined with habitat loss driven by agricultural expansion, logging, and infrastructure development, further threatens wildlife diversity (Ntiamoa-Baidu, 1997; Apaza *et al.*, 2002). Wildlife product trade, including bushmeat, remains a significant income source for economically disadvantaged individuals, yet poses serious threats to biodiversity on local, regional, and international scales (McNamara *et al.*, 2016).

Trends in bushmeat commerce also reflect rising demand in cities coupled with falling wildlife stocks. Analysis of trade data from 1975 to 2018 revealed that reptiles were the most commonly exchanged animals, followed by birds, mammals, and amphibians. These shifts were shaped in part by disease outbreaks linked to wildlife (Bempah *et al.*, 2021). Additionally, spatio-temporal analyses around Kumasi from 1978 to 2004 show a rise in rodent trade over ungulates, influenced by factors like habitat disturbance and hunting pressure. The demand for bushmeat in urban areas highlights a supply-side challenge, as diminished resources struggle to meet demand, indicating a need for sustainable interventions targeting hunting practices (Turner, 2014).

Traditional beliefs and practices surrounding bushmeat consumption in Ghana are shaped by cultural and religious influences. Studies reveal that certain species, like the cane rat, are commonly consumed due to low health risks from trace metals (Colecraft *et al.*, 2022). In some communities, conservation has begun to blend with traditional knowledge systems to safeguard plant and animal diversity, exemplified by initiatives like the Zukpiri Community Resource Management Area (CREMA) (PLOS Neglected Tropical Diseases Staff, 2023).

Throughout pre-colonial, colonial, and post-colonial periods, bushmeat has served as a crucial protein source for rural households (Van Vliet *et al.*, 2017; Lee *et al.*, 2020). In post-colonial Ghana, bushmeat has also provided a safety net for urban populations affected by conflicts, contributing to both food security and peace-building, though its sustainability remains contentious (Alexander *et al.*, 2015). Economic status influences bushmeat consumption, with poorer households relying more on it as a primary protein source than wealthier households (Buck *et al.*, 2017). However, recent large-scale studies challenge the assumption that bushmeat is an increasingly commercial and essential protein source for all rural households. Nielsen *et al.* (2018), using data from 24 countries, found that while 39% of rural households engage in hunting, bushmeat contributes on average only about 2% of household income primarily for subsistence consumption. This contradicts earlier narratives of a booming commercial bushmeat economy and suggests its importance is as a seasonal “gap-filler” for nutrition rather than a major cash earner (Sackey *et al.*, 2022; Nielsen and Meilby, 2015). The authors stress that improving rural food security (through alternatives and poverty reduction) can complement wildlife conservation, rather than viewing local bushmeat use and biodiversity protection as inherently conflicting goals (Nielsen *et al.*, 2018). As the bushmeat trade continues to evolve, balancing its cultural importance with conservation and public health priorities is essential to ensure sustainable wildlife harvests

and nutrition Moving forward, ensuring the continued availability of bushmeat for food and cultural practices must be balanced with environmental stewardship and health safeguards. Debate in the academic community reflects this balance: some argue that strict bans on bushmeat trade (to protect wildlife and prevent zoonoses) are necessary, while others contend that such bans could undermine livelihoods and food security. For instance, in the wake of COVID-19, some experts called for permanent wildlife trade bans, whereas others advocated maintaining regulated bushmeat use for the sake of local development (Roe *et al.*, 2020; Sills *et al.*, 2020). Yale researchers Zhou *et al.* (2022) highlight that global conservation policies often prioritize global health outcomes over local welfare, placing undue burden on communities who depend on bushmeat (Zhou *et al.*, 2021) They caution that prescriptive bans and promoting Western-style livestock in developing countries may not effectively prevent pandemics or biodiversity loss and can even backfire. These debates underscore the need for integrated and flexible approaches that reconcile the requirements of both animals and people a viewpoint increasingly emphasized in recent literature (Cawthorn and Hoffman, 2015).

### **2.3 Food security indicators**

Food is a fundamental necessity for human life, encompassing substances that provide energy, nutrients, and psychological satisfaction (Allen, 1994). Food security refers to a state where everyone has both physical and economic access to adequate, safe, and nutritious food that aligns with their health needs and dietary preferences (Acheampong *et al.*, 2022; Siegel & Siegel, 2021; Nnakwe, 2018). Food security is determined by six key indicators: availability, accessibility, utilization, stability, sustainability and agency (Manikas & Sundarakani, 2023). These indicators cover dimensions such as household dietary diversity, caloric sufficiency, lived experiences of food access, and broader socio-economic conditions that shape national food provision systems

(Markina *et al.*, 2020). Below is a review of each indicator and its relevance, including specific links to bushmeat and the context of COVID-19.

### **Availability**

This component captures the extent to which food can be supplied either through farming, trade, or aid mechanisms (Kerr, 2023). The Food and Agriculture Organization (FAO) frames availability as the consistent presence of enough food to support nutritional well-being through domestic production or imports (Rai, 2023). As a core input in food systems, availability complements other pillars by ensuring people have actual access to food, whether through market transactions or household production (Barrett & Lentz, 2015). It plays a foundational role in securing food for daily consumption by tracking how food moves through supply chains and ensuring quality and quantity at all levels (Calloway, 2023). Assessing food availability involves considerations of production, distribution, and the overall supply chain to guarantee that food is consistently accessible to the population, contributing significantly to the overall food security status of a region or country (Rai, 2023). Carletto *et al.*, (2013) and Tora (2023), highlighted the need for harmonized indicators, including food quantity and variety, to improve the accuracy of household food security assessments and essential for understanding food availability.

In the context of bushmeat, food security is closely linked to its supply through hunting and trading activities. These practices play a critical role in ensuring the availability of bushmeat, particularly in rural and economically deprived regions. Once sourced, bushmeat serves as a significant source of protein and income for many communities, contributing to overall food availability especially where alternative protein sources are scarce or costly. However, the sustainability of bushmeat hunting and trade is essential to maintain its role in food availability because unsustainable harvesting can quickly erode wildlife populations, jeopardizing future supply. Overexploitation

and habitat destruction can lead to a decline in wildlife, threatening the long-term availability of bushmeat and, consequently, local food security. Thus, availability of bushmeat must be managed with conservation in mind to remain a reliable pillar of food security.

### **Accessibility**

Accessibility in food security refers to people's ability, physically, economically, and socially, to acquire food that meets their health and nutrition needs. This aspect of food security is crucial as it ensures that people have the means to acquire the necessary food for a healthy and active life. Factors affecting accessibility include physical access to food outlets, economic constraints, mobility issues, and affordability (Almalki, 2022; Andrade, 2022). Also, some other research indicates that accessibility is influenced by factors such as agricultural productivity, donor aid, governance quality, and institutional capacity (Denny *et al.*, 2018; Sesay *et al.*, 2021). It is emphasized that good governance and institutional qualities play a significant role in enhancing food accessibility in the region (Dembélé & Staatz, 2010)

Enhancing accessibility often involves addressing challenges such as lack of purchasing power, inadequate transportation, and inequitable distribution. For instance, improving rural roads and market information systems can lower transaction costs and make food more accessible. Leveraging technology (like big data in warehousing or mobile market apps) has been suggested to provide timely information to farmers and consumers, thus improving food distribution efficiency and reducing hunger and malnutrition rates (Capone, 2013). Reliable and equitable access to safe, nutritious, and high-quality food is crucial for ensuring long-term food and nutrition security worldwide.

Accessibility is a factor in ensuring that bushmeat, as a source of protein remains available to those who rely on it. Bushmeat provides an affordable and accessible source of nutrition for many rural

and economically disadvantaged communities. Physical access to bushmeat markets, economic affordability, and social acceptance are key components that influence the accessibility of bushmeat. In a study conducted by Sassi (2015), income and price were incorporated into the conceptual framework, specifically under the access to food pillar, underlining that household purchasing power and food prices directly affect access to food. During the COVID-19 pandemic, accessibility of bushmeat was influenced by disrupted supply chains and market closures – hunters faced travel restrictions and consumers in cities had limited market days, reducing physical and economic access to bushmeat. Ensuring that bushmeat remains accessible in the post-COVID era involves restoring these supply chains, supporting the income of hunters/traders, and addressing any new barriers (like transport or regulatory hurdles). This requires sustainable hunting practices, effective governance (to allow safe trade of legal species), and improved market infrastructure (such as cold storage or organized bushmeat markets that can operate even during disruptions). By doing so, bushmeat can continue to contribute to food security as a dependable source of protein and income for communities that rely on it.

### **Utilization**

Utilization, as it relates to food security, encompasses the effective use of food resources to ensure optimal nutrition and health outcomes for individuals and communities. It represents one of the three core pillars of food security alongside availability and access emphasizing how individuals and households utilize the food available to them (Mangesti, 2020). Utilization involves aspects such as dietary diversity, intake of essential nutrients, and the ability to utilize food effectively for nourishment and well-being. Enhancing utilization involves promoting sustainable agricultural practices, value addition to food products, and ensuring that individuals have the knowledge and means to prepare and consume food in a nutritious manner (Ejemeyovwi, 2021; Barrett, 2015). By

improving utilization practices, food security initiatives can better address issues of malnutrition, food waste, and overall community health and resilience. According to Aldaz *et al.* (2022), they explored taste perceptions as indicators of food security and health. Furthermore, studies emphasize the need to incorporate nutrition across all four pillars of food security, highlighting that food insecurity is a key indicator of multiple forms of malnutrition, such as stunting and obesity (Bahn *et al.*, 2021). Utilization in the context of bushmeat is essential for ensuring that this food resource contributes effectively to nutrition and health outcomes. Methodologically, utilization is often assessed via household surveys that track diet diversity, meal frequency, and anthropometric measures of nutritional status (de Araújo Cabral *et al.*, 2022; Nyango *et al.*, 2025). These tools help identify if food is being converted into adequate nutrition or if there are gaps. In the context of bushmeat, utilization means ensuring this food resource contributes effectively to nutrition and health (Gerber *et al.*, 2016). Bushmeat is an important source of protein and micronutrients (like iron and zinc) for communities that consume it (Sarti *et al.*, 2015). Proper utilization of bushmeat involves safe handling and cooking practices to avoid foodborne illnesses (critical given that bushmeat can carry zoonotic pathogens or spoil without refrigeration) (Attrey, 2017). It also involves cultural knowledge on how to prepare various game meats in ways that maximize nutritional value and acceptability. For bushmeat to positively impact nutrition, consumers must be able to incorporate it into a varied diet, for instance, complementing it with vegetables and staples rather than over-relying meat alone. Post-COVID-19, promoting the safe and nutritious utilization of bushmeat is especially important. This means educating communities on thorough cooking of bushmeat (to kill any pathogens), proper preservation methods (smoking or freezing, as available), and monitoring for any contaminants (such as trace metals that Colecraft *et al.* (2022) found to be low in cane rat, making it a safer choice). It also means dispelling any

misinformation, for example, during COVID-19 there were fears linking bushmeat to disease, so public health guidance is needed on which meats are safe and how to handle them. By improving how bushmeat is utilized (safe preparation, moderation in consumption, combining with other foods for a balanced diet), its benefits to food security can be fully realized without compromising health.

### **Stability**

Stability in food security refers to ensuring uninterrupted access to sufficient, nutritious, and high-quality food for all individuals, regardless of time or location (Ghalibaf *et al.*, 2022). Building resilient food systems is crucial to withstand crises such as climate change, economic volatility, and political instability (Wang *et al.*, 2023; García-Diez *et al.*, 2021). The stability of food production and supply is key to addressing challenges like increasing food waste, high food prices, and the need for food imports, which can hinder access to affordable food and threaten food security (Subramaniam, 2023). Moreover, maintaining stability in global agricultural trade networks is crucial for balancing food supply and demand, particularly amid uncertainties such as climate change and pandemics, to protect both national and global food security (Elinder, 2023). The COVID-19 pandemic starkly illustrated the importance of stability: when borders closed and supply chains fractured, even food-secure regions experienced instability in supplies and prices (Hamid and Mir, 2021). Ultimately, maintaining stability in food production, supply chains, and trade relations is essential for promoting food security and preventing food insecurity crises worldwide.

The stability of bushmeat supply chains is influenced by various factors, including environmental changes, regulatory frameworks, and economic conditions. Climate change and habitat destruction can affect wildlife populations, leading to fluctuations in bushmeat availability (Almeida and

Tavares, 2024). Economic volatility and political unrest can hinder market access and disrupt trade networks, threatening the livelihoods of individuals who rely on bushmeat for both income and nutritional needs (van Vliet *et al.*, 2017; Lescuyer and Nasi., 2016)

Ensuring stability in the bushmeat trade requires a multifaceted approach that includes sustainable hunting practices, effective governance, and resilient market infrastructure. By addressing these factors, communities can maintain a stable supply of bushmeat, contributing to food security even in the face of crises. This approach also involves integrating conservation efforts to protect wildlife populations and their habitats, ensuring that bushmeat remains a viable and sustainable food source.

In Ghana's post-COVID context, enhancing the stability of bushmeat supply chains is needed. This might include measures like community-based wildlife reserves (to regenerate animal populations), alternative livelihood programs (so that over-hunting pressure reduces and incomes stabilize), and improved transport links (so that bushmeat can reach markets year-round even if some sources decline). The stability pillar highlights that food security is not just about meeting needs today, but also about the capacity to sustain those needs into the future despite shocks. The pandemic has prompted Ghana and many countries to reconsider how to bolster the stability of all food sources, bushmeat included, in preparation for future crises (Apaliya *et al.*, 2022 and Berry, 2023).

### **Sustainability**

Sustainability in food security refers to the ability to ensure reliable access to a sufficient quantity of affordable, safe, and nutritious food for all people while also considering the long-term environmental, social, and economic impacts of food production and distribution (Vassilopoulou, 2023). Achieving sustainable food security involves addressing various challenges such as food

availability, stability, access, and utilization through initiatives like the Local Food Network (LFN) and incorporating sustainability aspects into food security models (Provin *et al.*, 2022). Sustainable agriculture plays a crucial role in enhancing food security by providing fresh, nutritious products year-round, improving economic access for vulnerable populations, and supporting small-scale farming producers (Perdana *et al.*, 2022). By integrating sustainability principles into food security policies and practices, it is possible to ensure the continuous availability of food resources while minimizing negative impacts on the environment and society, ultimately contributing to long-term food security goals.

Sustainability is critical for ensuring that this resource continues to contribute to food security in Ghana. The COVID-19 pandemic has underscored the importance of sustainable food systems, as disruptions in supply chains and market access have highlighted vulnerabilities. Sustainable bushmeat practices involve managing wildlife populations to prevent overexploitation, ensuring that hunting practices do not harm the environment, and supporting the livelihoods of those who depend on bushmeat for income and nutrition.

Sustainable bushmeat practices include implementing regulations that control hunting seasons and quotas, promoting alternative livelihoods to reduce hunting pressure, and engaging local communities in conservation efforts. These measures help maintain wildlife populations and ensure that bushmeat remains a viable food source without depleting natural resources.

Additionally, integrating sustainability into bushmeat trade involves improving market infrastructure to support fair trade practices, enhancing the economic resilience of communities, and ensuring that bushmeat is processed and consumed in ways that maximize its nutritional benefits while minimizing health risks. Education and awareness campaigns can also play a role

in promoting sustainable consumption patterns and reducing demand for unsustainable bushmeat sources.

By adopting sustainable practices, Ghana can ensure that bushmeat continues to provide a reliable source of protein and income, contributing to long-term food security. This approach aligns with broader sustainability goals, balancing the need for food security with the preservation of biodiversity and the well-being of local communities in the aftermath of COVID-19.

### **Agency**

Agency represents individuals' autonomy in deciding how to grow, obtain, and prepare their food, often with special emphasis on women's contributions in farming and food systems (Tkaczyk & Moseley, 2023). It involves the ability to access and prepare food, influenced by factors like physical environment, income, and time constraints (Morgan, 2020). The ability to exercise agency, as seen in strategic provisioning practices and preferred actions, helps individuals overcome barriers like physical distance from food sources and financial constraints (Morgan, 2020). In rural areas with limited access to affordable and high-quality food, agencies are demonstrated through creative coping strategies to negotiate food access within challenging environments (Dean *et al.*, 2017).

The concept of agency is crucial for understanding how livelihoods empower individuals to take control of their well-being and act as stewards of their environment, highlighting their active role in shaping food security outcomes (Morgan, 2020). By integrating agency into food security frameworks, policymakers can create more just food systems and address constraints such as socioeconomic barriers and environmental changes that impact individuals' ability to access and prepare food (Ehlert & Voßemer, 2015).

In the context of bushmeat, agency plays a role in how individuals and communities manage and utilize this resource for food security. The ability to hunt, trade, and consume bushmeat is influenced by various factors, including access to hunting grounds, market dynamics, and socio-economic conditions. Women, in particular, often play a crucial role in the preparation and sale of bushmeat, contributing to household food security and income.

The pandemic has affected individuals' agency in managing bushmeat resources, limiting their ability to make independent decisions regarding its use, access, and conservation. Restrictions on mobility, financial strain, and shifts in market accessibility have limited people's ability to manage their own food production and consumption, thereby constraining their autonomy and decision-making in securing food. Enhancing agency in the post-COVID-19 era involves supporting local communities with sustainable hunting practices, improving market access, and providing education on the safe and nutritious preparation of bushmeat.

By empowering individuals and communities to exercise greater control over their bushmeat resources, food security can be improved. This includes addressing barriers such as physical distance from hunting areas, financial constraints, and ensuring that individuals have the knowledge and means to utilize bushmeat effectively. Incorporating agency into food security frameworks empowers individuals to actively influence their food security outcomes, fostering more resilient and sustainable food systems in Ghana, particularly in the aftermath of COVID-19.

#### **2.4 Food security situation in the world**

Globally, food security is challenged by a confluence of factors, and progress has been uneven across regions. This section provides an overview of the world food security situation, highlighting critical regions such as sub-Saharan Africa and South Asia to contextualize Ghana's food security landscape. Food insecurity remains a pressing issue worldwide. Over 820 million people suffered

from hunger in 2018, and that number has risen in recent years due to factors like conflict, climate extremes, economic slowdowns, and the COVID-19 pandemic (Bahtiyarovna, 2020; Boliko, 2019). Food security is achieved when all individuals have access to sufficient, safe, and nutritious food for an active and healthy life (Boliko, 2019). The Global Food Security Index assesses food security levels worldwide, with countries like Finland, Ireland, and the Netherlands leading the rankings, while Ukraine ranks 54th (Syhyda & Bondarenko 2021). Challenges persist, as one-third of global food production is lost or wasted annually, contributing to greenhouse gas emissions and exacerbating food insecurity and malnutrition. Despite improvements in some regions, achieving the Sustainable Development Goal of "Zero Hunger" by 2030 remains a daunting task, especially in regions like Africa South of the Sahara and South Asia. Factors such as inequality and population growth have been shown to significantly increase hunger levels in the region Akinbode, (Okuneye & Onyeukwu, 2022), while poverty and unemployment rates have a substantial positive relationship with poverty in the area (Atangana, 2022). Additionally, malnutrition remains a major health concern for children under five (5) years in Sub-Saharan Africa, emphasizing the urgent need for intervention (Chen, 2022). Moreover, the impact of food prices, food production, per capita income, and financial inclusion indicators on reducing undernourishment underscores the complexity of addressing hunger in the region (Mtambo *et al.*, 2023).

Sub-Saharan Africa is the region with the highest prevalence of food insecurity. Parts of Africa have recorded high levels of food insecurity due to various factors. For instance, the Horn of Africa, particularly East Africa, has faced severe droughts leading to food insecurity, with 22 million people at risk of starvation in the region (Oduoye *et al.*, 2023). Additionally, countries like Chad, Liberia, Central African Republic, The Democratic Republic of Congo, Zambia, and Zimbabwe in sub-Saharan Africa have shown a high prevalence of undernourishment, highlighting

the challenges in ensuring food security in these regions (Onyenakie, *et al.*, 2022). Moreover, the economic fallout from climate change, conflict, and the Covid-19 pandemic has exacerbated food insecurity in Africa, with over 20% of the continent's population facing hunger, the highest proportion globally (Chiawo & Otiende 2021).

South Asia is another region with severe food security challenges, often rivaling sub-Saharan Africa in scale. Approximately 900 million people face food insecurity or severe food insecurity, with Pakistan having about 2.5% of the world's population and facing significant food insecurity issues due to factors such as high population growth, urbanization, income distribution, rising irrigation expenditures, and inadequate distribution systems (Gumma *et al.*, 2020; Akbar *et al.*, 2018). South Asia as a region is regarded as the most food-insecure globally, with an estimated 323 million people living on less than USD 1.90 a day and 280 million undernourished individuals (Rahman & Bari, 2020). The region faces challenges like faster population growth, unplanned urbanization, declining arable land, low productivity, and climate change, which threaten food security and nutrition status, highlighting the need for comprehensive strategies to address these issues (Khalid *et al.*, 2020). These challenges underscore the urgent need for comprehensive interventions to address the complex interplay of factors driving food insecurity in various African countries.

The global food security situation is marked by stark contrasts: some parts of the world have plentiful food and robust systems, while others struggle with chronic hunger and acute crises. Factors such as climate extremes (droughts, floods), conflicts (displacing people and disrupting farming), economic downturns (like those induced by COVID-19), and systemic issues like food waste all interplay to shape this landscape. Inequality, both between and within countries, often determines who goes hungry and who does not. These global patterns set the stage for

understanding Ghana’s food security context, a country that, while relatively stable, is embedded in the broader African challenges and has been impacted by the worldwide disruptions of recent years.

## 2.5 Food security situation in Ghana

The COVID-19 pandemic in 2020 dealt a significant blow to Ghana’s food security, revealing and worsening underlying vulnerabilities. The pandemic disrupted food supplies globally and Ghana was no exception: the food system experienced disturbances that resulted in reduced agricultural output due to limited labor mobility and logistical constraints (Tibiru *et al.*, 2022). Lockdowns, especially the major one in March–April 2020, meant many farmers could not get labor or transport for harvests, and truck drivers faced delays, causing some food to spoil before reaching markets. These shocks led to increased food prices and shortages, negatively affecting about 77.4% of Ghanaians, according to one survey (Afele *et al.*, 2022). Urban areas were hit hard – as movement restrictions cut off the flow of food from rural producers, markets in cities saw supply dips and price hikes. Many urban residents, who rely on daily markets, suddenly struggled to afford basic staples. Studies of urban Ghanaian households found that income losses during the pandemic were a significant predictor of food insecurity, as people who lost jobs or earnings could not buy enough food (Onyango & Crush, 2023). For example, during a COVID lockdown in Accra, the proportion of households classified as “highly food secure” dropped dramatically, with many falling into the “very low food secure” category once their livelihoods were disrupted (Tibiru *et al.*, 2022). This regression from food secure to food insecure was directly tied to the lockdown period. When asked, families reported coping by reducing meal portions, withdrawing savings, or relying on food aid, highlighting how precarious their access to food became. The situation grew so dire that it was projected hunger could kill more vulnerable Ghanaians than the virus itself if strict restrictions

continued, which influenced the government's decision to lift the national lockdown earlier than many expected (Tibiru *et al.*, 2022). This underscores that the food security impact of COVID-19 was an immediate crisis: it prompted government interventions like feeding programs in Accra and Kumasi for the needy, and later a stimulus program (like the "Ghana CARES" initiative) to boost food production and job recovery in agriculture (Afele *et al.*, 2022). The pandemic experience has since spurred Ghana to start building more resilient food systems (e.g., investing in domestic rice, maize, and poultry production to cut reliance on imports that can be disrupted).

Prior to the pandemic, Ghana had been making gradual progress in improving food security, though not without challenges. From 1980 to 2019, governance dynamics played a crucial role: improvements in political stability, regulatory quality, government effectiveness, and corruption control correlated with better food security outcomes (Asare-Nuamah *et al.*, 2023). In essence, periods of stable, accountable governance helped agriculture and markets to function, thereby enhancing food availability and access. Ghana's policy frameworks, such as the Food and Agriculture Sector Development Policy (FASDEP) and the Medium-Term Agriculture Sector Investment Plan (METASIP), provided some structure to address food security and nutrition. However, coordination among stakeholders was suboptimal. Awoyemi *et al.* (2023) observe that in the food and nutrition policy space, power tussles between ministries (for example, Agriculture vs. Health) and other actors led to weak multi-sectoral collaboration, hindering comprehensive approaches to food security. Sackey *et al.* (2023) similarly note that while various stakeholders (government, NGOs, private sector) are involved in agriculture-for-nutrition policymaking, their efforts were not always harmonized, reducing overall effectiveness. In terms of food production and consumption trends, Boadi & Aryeetey (2022) provide an insightful picture for 2010–2020: Ghana's per capita food production generally kept up with or exceeded per capita food

consumption for staples like cereals and tubers, indicating that domestic production was, on average, sufficient in those categories. However, there were concerns such as declining fruit and vegetable intake among Ghanaians (signaling potential future nutrition problems) and a rising import bill for processed foods and poultry. Ghana became heavily reliant on imported rice, frozen chicken, and processed wheat products, which raised questions about long-term sustainability and vulnerability to global market fluctuations. Indeed, Ghana imports over half of its national rice and the vast majority of its chicken meat (Onumah & Ayeduvor, 2023). This dependence meant that even before COVID-19, global price changes or trade policies could affect local food security. For instance, when Nigeria enforced strict import restrictions on poultry (to boost local production), it indirectly affected Ghana by increasing demand for imported chicken in Ghana and raising prices – illustrating how regional policies can have spillover effects (Obese *et al.*, 2021). Ghana's food security at the national level was thus a mix of positive strides (in governance and production of some foods) and persistent issues (diet quality, import reliance, poverty-related access problems). Ghana's progress in reducing hunger also showed in some indicators: the prevalence of undernourishment declined from the early 2000s to late 2010s, and childhood malnutrition rates improved modestly (GSS reports, 2015–2019). Yet the pandemic in 2020 reversed some gains, especially in urban food security as noted above. Onyango & Crush (2023) found that households with disrupted income (like those in the informal sector unable to work during lockdown) had much higher odds of being food insecure. This suggests that economic access is currently the weakest link in Ghana's food security chain, food might be available in markets, but not everyone can afford enough of it at all times. Going forward, Ghana has been focusing on recovery initiatives such as promoting urban agriculture (planting backyard gardens in cities to cushion food access) and strengthening social protection (cash transfers, etc., to help the urban poor). The experiences

and data from 2020 have been instructive: they revealed that alongside long-term strategies (like improving governance and boosting local production), there is a need for shock-responsive food systems that can handle emergencies without a collapse in food security. In summary, Ghana's food security situation has been one of overall improvement tempered by significant challenges, and the COVID-19 crisis highlighted both the progress made and the gaps that remain.

## **2.6 COVID-19 pandemic and its effect on food systems**

The COVID-19 pandemic has had a profound and multifaceted impact on food systems worldwide. The immediate effects of lockdown and restrictions on supply chains were profound, impacting various stages from production to distribution. The Lockdown led to disruptions in the food supply chain, causing issues such as increased transportation costs, labor shortages, insufficient storage facilities, and reduced farm-to-market arrivals (Abu Nahleh *et al.*, 2023; Victor *et al.*, 2023). These disruptions destabilized the balance between production, supply, transport, distribution, and consumption, affecting food and nutritional security globally (Gupta *et al.*, 2023). The pandemic highlighted the vulnerabilities of both rural and urban food supply chains, leading to decreased availability and accessibility of food items, impacting consumer behavior and creating stress regarding food access, quality, safety, and pricing (Tonnang *et al.*, 2023; Peterson *et al.*, 2023).

On a personal and behavioral level, the pandemic significantly influenced consumer behavior and food demand by altering purchasing habits, food preferences, and eating habits. Wells *et al.* (2023) describe a “three-step cycle” of consumer response: an initial reactive phase (characterized by fear-driven stockpiling of food and essentials), a coping phase (adjusting to new norms like cooking at home more and making fewer shopping trips), and a long-term adaptation phase (where some of the new habits become ingrained). Indeed, impulsive bulk buying of shelf-stable foods was observed in many countries at the start of lockdowns. As the pandemic continued, consumers

deeply altered their choices and habits: for instance, there was a major shift from dining out to home cooking, given restaurant closures and infection fears. Many people experimented with baking and cooking, leading to spikes in demand for baking supplies and basic ingredients. At the same time, there was a rise in the use of food delivery services and online grocery shopping – even consumers who had never ordered food online before were forced to try it, accelerating a digital transformation in food retail (Kaplan *et al.*, 2023). Research also noted changes in nutritional habits. Some studies (Nosi *et al.*, 2023) found that with more time at home, certain consumers improved their diets (cooking fresh meals, trying healthier recipes), while others went the opposite way, increasing consumption of snacks, comfort foods, or alcohol. An interesting trend was a reported increase in the use of dietary supplements and traditional medicinal foods – likely as people became more health-conscious and sought foods perceived to boost immunity (Nosi *et al.*, 2023). For example, sales of vitamin C, herbal teas, ginger, and garlic surged in some markets. Another change was in food waste management: with food being precious and shopping trips reduced, many households became more careful to use leftovers and avoid waste. Surveys indicated people were planning meals more meticulously and freezing foods to extend their shelf-life. However, it was not all positive, the stress and anxiety of the pandemic led some to adopt unhealthier eating patterns (stress-eating, overeating, or conversely skipping meals due to disrupted routines). Overall, the pandemic prompted a reevaluation of food – its source, its safety, and its role in well-being – in the minds of consumers around the world. The economic impacts of COVID-19 on the food industry have been profound, affecting various sectors. For example, in China, policy responses to COVID-19 caused sharp short-term fluctuations in food prices, though long-term effects were milder. One study also found that government lockdowns and control measures in China led to immediate price spikes for certain foods – pork and fresh vegetables rose

significantly month-on-month – while staple grains like rice and flour remained more stable (Cui *et al.*, 2023). In Greece, agri-food enterprises experienced challenges in distribution and increased production costs, leading to labor shortages and financial insecurity, despite minimal effects on food quantity and quality (Cui *et al.*, 2023). Informal food vendors globally, like those in Kolkata, faced lower income, health risks, and logistical difficulties, prompting adaptations and support from governments and NGOs. Overall, the pandemic has disrupted food systems, influenced farmers, small-scale producers, and informal vendors, while also affected food prices and affordability in various ways.

The COVID-19 pandemic significantly exposed and exacerbated vulnerabilities in food systems globally, particularly in developing countries. The pandemic led to a sudden increase in food insecurity and malnutrition due to reduced labor mobility, lockdowns, and economic contractions (Ovchynnykova, 2022). Vulnerabilities were intensified among marginalized populations, including precarious workers, as the pandemic catalyzed new vulnerabilities and worsened existing economic uncertainties (Hobbs, 2022). National food systems faced challenges in resilience and integrity, highlighting the need for additional government support and stimulation of food production and transportation (Vaccaro *et al.*, 2023). The pandemic underscored the importance of preserving and enhancing resilient food systems, especially in Africa, where existing health shocks and livelihood disruptions posed significant risks to food security and sustainable agricultural practices (Kapustina *et al.*, 2022). Efforts to address these vulnerabilities require a multifaceted approach that considers social determinants, economic factors, and the impact of external triggers on food systems worldwide.

Policy responses and innovations emerged globally in response to the pandemic's impact on food systems, encompassing various strategies. China implemented lockdown policies and food

security emergency measures, stabilizing food prices and enhancing resilience (Halim-Lim,2023). In the USA, stakeholders in Charlotte, North Carolina, highlighted both challenges and opportunities, emphasizing the need for innovation and collaboration within the food system (Njora, *et al.*, 2023). Developing countries utilized Information and Communication Technology (ICT) to enhance agri-food system resilience, addressing obstacles like transportation barriers and low pricing, ultimately promoting sustainability and food security (Alam *et al.*, 2023) Furthermore, the shift towards digital innovations in the food industry, particularly blockchain and IoT technologies, has improved food safety and sustainability components globally, emphasizing traceability and monitoring as key areas of enhancement (Hammelman & Turner, 2022). These diverse responses and innovations underscore the multifaceted approach required to address the complex challenges faced by food systems during the pandemic.

### **2.7 Effect of COVID-19 on bushmeat trade and consumption**

From an economic standpoint, the Lockdown and movement restrictions during the COVID-19 pandemic significantly affected both urban and rural areas of Ghana. Studies in Côte d'Ivoire revealed that the bushmeat trade dynamics were negatively affected by governmental measures, leading to a decline in trade activities during lockdown periods, but a quick recovery post-lockdown once restrictions were lifted (Adu-Gyamfi, 2022). Furthermore, urban food security in Ghana was notably affected by the pandemic, with a shift towards more households experiencing lower food security levels post-COVID-19 lockdowns, emphasizing the importance of interventions like urban agriculture to combat food insecurity in urban areas (Gossé *et al.*, 2023)

The border closures and trade restrictions implemented in response to the COVID-19 pandemic in Ghana had significant impacts on the importation and exportation of bushmeat. These measures disrupted the border economy, leading to increased deprivation and marginalization of borderland

populations (Hlovor & Botchway, 2021). Additionally, the restrictions on trade and movement affected the livestock production sector, including the supply chain for animal products, such as bushmeat, in Ghana (Annan *et al.*, 2018). Furthermore, restrictive import policies for chicken meat, similar to those in Nigeria, highlighted the complexities of border policies on meat trade, stimulating domestic production but also imposing costs on consumers and encouraging illicit trade, which could extend to bushmeat as well (Obese *et al.*, 2021). Overall, the border closures and trade restrictions had multifaceted impacts on the importation and exportation of livestock in Ghana, affecting both local populations and the broader livestock industry.

The economic downturn resulting from the pandemic significantly affected consumer demand for bushmeat, especially among low-income households. Studies in West Africa revealed that the COVID-19 pandemic and related governmental measures had a negative effect on the bushmeat trade dynamics, leading to decreased activities and fewer clients for bushmeat vendors (Wells *et al.*, 2023). Additionally, research conducted in Nairobi, Kenya, showed that low-income households, particularly those in informal settlements, experienced dire food insecurity situations during the pandemic, including limitations in food variety and smaller portions consumed, with a notable decline in the consumption of nutritious foods like fruits, vegetables, and animal products (Chege *et al.*, 2023). For instance, a recent study in Ghana reported a marked decline in bushmeat demand during the pandemic due to fear and mobility restrictions, leading to significant disruption of the wild meat value chain and causing income losses and even business closures among traders (Kwakudua *et al.*, 2025). Many traders especially women who dominate retail-level bushmeat trading had to adopt coping strategies (e.g. using personal savings) to survive this downturn, prompting calls for targeted financial support and investments in market infrastructure to help the sector recover in the post-pandemic period. These findings suggest that the economic challenges

brought about by the pandemic significantly influenced consumer behavior towards bushmeat, particularly affecting vulnerable low-income households reliant on such food sources.

## **2.8 COVID-19 and consumer attitudes towards bushmeat**

From a public health perspective, the pandemic significantly influenced consumer attitudes towards bushmeat safety and risk, subsequently affecting demand. Studies in West Africa and East Africa highlighted the negative effect of COVID-19 on wild meat consumption, with varying perceptions on zoonotic disease risks associated with consuming bushmeat (Patel *et al.*, 2023; Gaubert *et al.*, 2022). Consumers' risk perception and attitudes towards food safety were altered during the pandemic, affecting their willingness to purchase products from restaurants (Li *et al.*, 2022; Jainonthee *et al.*, 2022). The bushmeat trade dynamics were disrupted, leading to a decline in activities and the number of clients. For example, during previous zoonotic outbreaks like Ebola, wild meat consumption dropped significantly in some countries (e.g., Liberia and Nigeria) but continued in others (e.g., Togo) despite official bans (Sainge *et al.*, 2023). Similarly, the COVID-19 lockdowns caused bushmeat sales to fall in Nigeria, whereas consumers in Sierra Leone largely maintained their consumption habits (Patel *et al.*, 2023). Likewise, in parts of East Africa, over 70% of surveyed consumers reported no reduction in bushmeat consumption during COVID-19 (some even noted an increase in availability). These contrasting outcomes suggest that local context including the cultural importance of bushmeat, the effectiveness of public health messaging, and the degree of economic dependency on wild meat plays a crucial role in shaping consumer responses to disease outbreaks. Overall, the pandemic-induced changes in consumer attitudes towards bushmeat safety and risk had a notable influence on demand for wild meat products.

Notably, there remains a research gap regarding long-term post-pandemic behavior. Many studies captured only the immediate effects of COVID-19, and few have examined whether changes in bushmeat demand persisted after restrictions were lifted or how new trends (such as heightened health consciousness or sustained shifts to alternative proteins) are influencing consumption patterns. This gap is evident in the literature, which has historically focused more on supply-side issues than on evolving consumer perceptions (Kwakudua *et al.*, 2025).

Consumer behavior regarding bushmeat purchasing habits in urban Central Africa and online shopping motives in the city of Bima reflect distinct trends. In urban Central Africa, bushmeat consumption is positively perceived culturally, with pangolin being a desired and illegally traded item despite legal protection (Nguyen *et al.*, 2021). Conversely, online shopping motives in Bima focus on factors like price and convenience, with consumers prioritizing cheap prices over quality and being satisfied with the online shopping experience (Doughty *et al.*, 2021; Marina *et al.*, 2022).

## **2.9 Pandemic-driven demand for alternative proteins**

The COVID-19 pandemic has indeed led to an increased demand for alternative protein sources, such as plant-based options, due to various factors. The expected population growth, rising demand for animal proteins, disruptions in the food chain caused by the pandemic, and conflicts have all placed food security and sustainable diets at the forefront of the political agenda (La Barbera, *et al.*, 2023). Additionally, the global population reaching 9.8 billion by 2050 necessitates a 50% increase in food production, prompting the exploration of sustainable protein resources like plant proteins and underutilized sources such as algae, insects, and fungi (Aldalur *et al.*, 2023). Furthermore, changes in food consumption practices during the pandemic have highlighted the importance of alternative consumption linked with agroecological agri-food networks, potentially increasing the demand for alternative protein sources like plant-based options (Gengatharan *et al.*,

2023). The shift towards alternative protein sources is also reflected in consumer trends post-pandemic, with a notable increase in interest in sustainability, just food, and protein ingredients (Díez *et al.*, 2022).

Consumer preferences for bushmeat processing and packaging underwent significant changes during the pandemic, with a shift towards more convenient and safer options like pre-cooked or frozen products. The pandemic-induced uncertainties and risks altered consumer behavior, leading to modifications in shopping habits and food choices (Wells *et al.*, 2023; ÜMİT *et al.*, 2022). Studies have shown that during the COVID-19 pandemic, there was an increased interest in stockable food products and personal hygiene items, indicating a preference for safer and more convenient options (Ben Hassen *et al.*, 2023). Additionally, the impact of the pandemic extended to the packaging of food products, with consumers showing a decreased purchasing trend for unpackaged products, possibly due to hygiene concerns and a shift towards more packaged and processed options (Jumadewi *et al.*, 2023; Kaya *et al.*, 2022). These shifts suggest that consumers became more health-conscious about meat handling and safety during COVID-19, an emerging trend that future studies will need to examine in terms of its persistence post-pandemic. Such changes highlight the importance of understanding consumer behavior and preferences during times of crisis to adapt to evolving needs and ensure food safety.

#### **2.10 Cultural significance of bushmeat among Ghanaian ethnic groups**

Research indicates that the Akan ethnic group values the cultural use of pangolins for traditional medicine, with differences observed in the selection and use of pangolin body parts among various ethnicities (Sackey *et al.*, 2023)

Bushmeat plays a significant role in traditional Ghanaian ceremonies by serving as a crucial element in festivals, arts, drama, and folklore. Wildlife, including various species from insects to

mammals, not only provides animal protein in the local diets but also acts as totemic symbols for different clans, enhancing the cultural and socio-economic fabric of rural communities in Ghana (Sackey *et al.*, 2023)

Bushmeat in Ghanaian culture holds significant symbolic meanings and values. It serves as an affordable protein source for consumers and a vital income stream for traders in economically deprived regions. Additionally, bushmeat plays a crucial role in diversified livelihood strategies for hunters and traders, especially during peak hunting seasons. Despite concerns about zoonotic disease transmission, a considerable percentage of consumers prefer bushmeat over domestic meat, with grass cutter being a popular choice (Kuukyi *et al.*, 2014). In rural areas, bushmeat hunting is deeply embedded in livelihood strategies, with professional hunters expressing worries about declining availability and the sustainability of their livelihoods (Alexander *et al.*, 2015). Furthermore, bushmeat acts as a safety net for vulnerable households during economic hardships, contributing to income smoothing and reducing household expenditure on meat/fish purchases (Schulte-Herbrüggen *et al.*, 2013).

### **2.11 Multinomial logistic regression**

A logistic regression model is an analytical tool that explains the relationship that exists between one dependent variable and one or more independent variables. While the dependent variable is binary, the independent variables can be nominal, ratio-level, interval, or ordinal.

In general, the multinomial and logistic regression models have been used by several analysts and documented. Adu (2018) applied a binary logistic model to reveal the factors affecting rice farmers' choices of marketing outlets. The choice alternatives in her study were direct market outlet (processors) and indirect market outlet (middlemen). Ouko (2016) applied the multinomial logit

model to determine how socioeconomic characteristics influence the choice of Seed Sources of Smallholder Bean Farmers in Bondo Sub-County in Kenya whereby his choice alternatives were his own saved seed source, neighbouring farmers Local and grains market seed source. Fertó & Szabó (2002) made use of the multinomial logistic model in analysing the various factors determining the selection of supply outlets in the Hungarian fruit and vegetable sector. The various choice alternatives identified in his study were found to wholesalers, marketing cooperative chains, and production lines. Meanwhile, Tadesse (2011) adopted the multiple linear regression as an analytical tool to examine the factors influencing the supply of avocado and mango in Gomma.

Woreda, Jimma Zone, Oromia National Regional State in Ethiopia. The choice alternatives identified in his study were wholesalers, retailers, assemblers, and processors. Additionally, Jari & Fraser (2009) employed the multinomial logistic regression model in analyzing institutional and technical factors that influence agricultural marketing channel selection amongst the smallholder and emerging farmers in the Kat River Valley in South Africa. In the model, the smallholder farmers were interviewed on their choice of the three possibilities of market participation, viz. formal markets, informal markets, and not participating in markets, which was set as the dependent variable.

### **2.12 Structural equation model**

Structural equation modelling (SEM) is a tool for analyzing multivariate data, as described by Bagozzi in 1980. Hoyle (1995) provides a definition of structural equation models as a comprehensive statistical approach for testing hypotheses about relationships among observed and latent variables. According to Rigdon (1998), SEM is a methodology for representing, estimating, and testing a theoretical network of mostly linear relations between variables. SEM encompasses a wide range of techniques and methods used by researchers in observational and experimental

research, primarily in the social and behavioral sciences, but it also finds applications in other domains such as epidemiology, business, and more (Boslaugh & McNutt, 2008; Shelley, 2006). In the field of social work research, Structural Equation Modelling (SEM) is frequently utilized as an analytical approach that integrates simultaneous regression equations and factor analysis, as noted by Ecob and Cuttance in 1987. SEM is employed to test hypothesized patterns of directional and nondirectional relationships among a set of observed (measured) and unobserved (latent) variables, as highlighted by MacCallum and Austin in 2000. The primary objective of the model is to provide an account for the variation and covariation observed in the measured variables (MVs).

Path analysis, which includes techniques like regression analysis, assesses models and relationships among measured variables (MVs). Confirmatory factor analysis, on the other hand, tests models describing relationships between latent variables (LVs or common factors) and MVs, where the latter serve as indicators of the common factors. Latent Growth Curve Models (LGM) are used to estimate the initial level (intercept), rate of change (slope), structural slopes, and variance. Structural Equation Modeling (SEM), a broader framework that encompasses path analysis, confirmatory factor analysis, and latent growth curve models, can be seen as a general model encompassing various commonly used statistical models. These include analysis of variance, multiple regression, factor analysis, path analysis, econometric models of simultaneous equations and non-recursive modeling, multilevel modeling, and latent growth curve modeling, providing a unified and versatile approach to statistical modeling (Kline, 1998; Bowen *et al.*, 2011). Factor analysis models test hypotheses about how well sets of observed variables in an existing dataset measure latent constructs. Beyond standard regression models, structural equation models also include many independent and dependent variables as well as potential latent constructs that could be represented by collections of observed variables, thus, also give a means

of putting the predetermined set of connections between the observable and latent variables under test, and thus enable theory testing even in the absence of experiments. As a result, all social and behavioral sciences now routinely use these techniques (MacCallum & Austin, 2000).

### **2.13 Kendall coefficient of concordance**

The Kendall Coefficient of Concordance is a statistical tool employed to evaluate the degree of agreement or concordance among multiple participants when they rank various items. This metric aids in ascertaining whether a consensus exists in the order of opinions and furnishes a quantifiable gauge of the agreement level. The utilization of the Kendall Coefficient of Concordance is driven by the requirement for an unbiased and structured method to analyze ranking data gathered from numerous respondents. Through the application of the Kendall Coefficient of Concordance, we can appraise the overall concurrence or divergence in how respondents rank the constraints.

In a study by Mensah *et al.* (2017), the Kendall's Coefficient of Concordance was employed in evaluating the constraints to development of agricultural insurance for cashew crop farmers in Brong-Ahafo Region of Ghana. The study aimed to identify and analyze the perceived constraints to developing agricultural insurance for cashew crop farmers. Kendall's coefficient of concordance was used in the study to test the agreement of the rankers (respondents) among the constraints identified. This statistical measure assesses the degree of agreement among multiple rankers or raters. Using Kendall's coefficient of concordance, the study can evaluate the level of consensus or disagreement among the respondents regarding the identified constraints to agricultural insurance development.

In another study by Steinke *et al.* (2017), Kendall's Coefficient of Concordance was employed to assess the accuracy of farmer-generated data in an agricultural citizen science methodology. The study aimed to test whether farmer-generated data in agricultural citizen science methodologies

are accurate enough to generate valid statements about the research topic. It focused on evaluating the reliability of data collected by farmers through an agricultural citizen science approach. Kendall's W was employed as a measure of reliability in this study. Kendall's W is a statistical measure that assesses the degree of agreement among multiple rankers or raters. In the context of this study, Kendall's W was used to measure the agreement or concordance among farmers' rankings of plant vigor. The results of the study provide insights into the accuracy and reliability of farmer-generated data in the agricultural citizen science methodology. By using Kendall's W, the study quantified the level of agreement among farmers' rankings on plant vigor, indicating the reliability of the data collected through this approach.

Azumah *et al.* (2018) used Kendall's Coefficient of Concordance to assess the perceived effectiveness of agricultural technology transfer methods. The study identified the most effective technology transfer methods for rice farmers in Northern Ghana and to assess the level of agreement among the respondents. Kendall's W was used in the study to test the agreement of the rankers (respondents) on their perceived effectiveness of the technology transfer methods.

#### **2.14 Empirical studies**

A study conducted by Martins *et al.* (2019), indicated that bushmeat consumption is widespread in rural South Africa, with 30-60% of households in communal areas reporting its use. This suggests a significant cultural and dietary reliance on bushmeat in these communities. Despite the prevalence, the paper highlights a critical lack of research on bushmeat hunting practices, motivations, and the ecological impact of such activities. Only five studies explicitly address these issues in South Africa, indicating a need for more comprehensive research. The review notes that bushmeat hunting is predominantly a male activity, with hunting methods varying by location. The most common method involves hunting with dogs, targeting small to medium-sized species. The

paper discusses the cultural aspects of bushmeat hunting, noting that it is often tied to traditions and social status within communities. Young boys participate in hunting as a rite of passage, which adds a layer of cultural importance to the practice. With regards to the market dynamics, there is a notable absence of bushmeat markets in South Africa, likely due to its illegal status. The paper mentions that while there is literature on the sale of animals for traditional medicine, bushmeat itself is not commonly found in local markets. The authors argue for a national assessment of bushmeat use across all biomes in South Africa, rather than focusing solely on savanna habitats. This broader perspective could inform better policy responses and conservation strategies. The paper concludes that urgent and in-depth research is needed to understand the implications of bushmeat hunting on wildlife populations and to develop appropriate management strategies to ensure sustainability and public health

A study conducted by Luiselli *et al.* (2020), the results showed a significant demand for bushmeat in urban centers of West Africa, with 62.2% of men and 72.1% of women indicating they would never eat bushmeat. However, 12.8% of men and 8.8% of women reported liking and regularly consuming it, highlighting a divide in consumption patterns based on gender and age. Also, the research found that younger generations, regardless of gender, are less likely to consume bushmeat. This trend was consistent across all six cities studied, suggesting a shift in dietary preferences among the youth. The frequency of bushmeat consumption varied significantly between cities, with Ouagadougou showing a higher-than-expected number of respondents who rarely eat bushmeat. This indicates that local cultural and economic factors may influence consumption patterns. In the data analysis, the study employed statistical methods, including the chi-squared test, to analyze differences in consumption frequency among various demographic groups. The results indicated no significant differences in the proportions of those who reported

eating bushmeat rarely. The paper discusses the implications of rapid urbanization in West Africa, projecting that the urban population will double, which may lead to increased demand for bushmeat and potential environmental consequences. For future actions, the findings suggest the need for targeted campaigns to change bushmeat consumption behaviors, particularly among specific demographic groups identified in the study. This could help mitigate the threats to wildlife and promote sustainable practices.

The study conducted by Van Vliet *et al.*, (2017) provides a systematic review of the relationship between bushmeat consumption and human health, focusing on nutritional content, medicinal uses, and zoonotic risks. According to the paper, bushmeat is recognized as a significant source of nutrition, providing essential fats, micro and macro-nutrients. However, there is a noted scarcity of data on the nutritional content of many common bushmeat species. The review highlights that despite the lack of comprehensive nutritional studies, existing research indicates that bushmeat can contribute positively to the diets of forest peoples . The paper identifies 19 studies that document the zoo-therapeutic uses of bushmeat across various countries, including India, Nigeria, and Brazil. These studies illustrate how different parts of bushmeat species are utilized for treating or preventing illnesses. A total of 76 bushmeat species were reported to have medicinal uses, showcasing the cultural significance of bushmeat beyond mere nutrition. The paper emphasizes the health risks associated with bushmeat consumption, particularly the potential for zoonotic diseases. It notes that pathogens found in bushmeat can be transmitted to humans through consumption or exposure to body fluids and feces during handling . The paper cites 72 studies that describe the zoonotic pool in bushmeat species, indicating a significant concern regarding the transmission of diseases from wildlife to humans. The authors stress the necessity for more in-depth studies to better understand the complex interactions between bushmeat consumption and

human health. They call for innovative practices in handling, conservation, and cooking to mitigate health risks while acknowledging the nutritional and medicinal benefits of bushmeat. The review also highlights the importance of a transdisciplinary approach, integrating various fields such as epidemiology, anthropology, and food technology, to address the multifaceted issues surrounding bushmeat consumption. In conclusion, the paper provides a comprehensive overview of the benefits and risks associated with bushmeat consumption, advocating for a balanced understanding that considers both health implications and cultural practices. The findings underscore the need for collaborative research efforts to inform policy and improve health outcomes in communities reliant on bushmeat.

The study conducted by Iwajomo and Ogunsola (2024) provides valuable insights into the factors influencing bushmeat trade and the associated health risks. The study highlights that bushmeat trade contributes significantly to wildlife depletion and population decline. This is a critical concern as it affects biodiversity and ecosystem balance. Data was collected through 150 structured questionnaires administered to vendors and buyers at the Oluwo Market in Epe, Lagos, Nigeria, using the KoboCollect survey tool. This method ensures a systematic approach to gathering information on consumption patterns and perceptions of zoonotic risks. The research identifies the top three bushmeat species sought after by consumers: Grasscutter (*Thryonomys swinderianus*), Pangolin (*Phataginus tricuspis*), and Antelopes. This information is necessary for understanding consumer preferences and the species at risk due to hunting. Interestingly, the study found no significant association between household income and bushmeat consumption patterns ( $p > 0.05$ ). Instead, non-financial factors such as taste, aroma, and cultural customs emerged as the primary drivers of bushmeat consumption. This suggests that cultural and sensory factors play a more significant role than economic ones in influencing consumer behavior. Among occasional

consumers, 67% indicated a preference for cheaper alternative protein sources over bushmeat. However, the study noted that price increases would not deter purchasing behavior in both regular and occasional consumers. This indicates a strong cultural attachment to bushmeat that transcends economic considerations. A significant finding of the study is the lack of knowledge regarding zoonotic disease transmission among both sellers (79%) and buyers (47%). This highlights a gap in public health awareness that could exacerbate the risks associated with bushmeat consumption. The paper emphasizes the urgent need for establishing safety standards among buyers and sellers, along with public health education to address the risks of zoonotic diseases. The uncommon use of protective measures, such as gloves when handling animals, further underscores the need for improved health practices in the bushmeat trade. In summary, this empirical review of the paper reveals significant insights into the dynamics of bushmeat consumption in Nigeria, highlighting the interplay between cultural practices, economic factors, and health risks. The findings call for targeted interventions to enhance public health awareness and promote sustainable practices in the bushmeat trade.

The paper by Aragão Silva *et al.* (2023) provides a comprehensive analysis of the consumption and trade of bushmeat in Brazil, focusing on various aspects such as species richness, regional distribution, and socio-economic factors. The paper emphasizes the significance of understanding bushmeat dynamics in a megadiverse country like Brazil, where wildlife consumption is prevalent. The authors conducted a systematic survey of publications from 2011 to 2021, selecting 63 scientific articles from various databases, including Google Scholar and Scopus. The articles were categorized into three groups: those focusing exclusively on consumption, those on bushmeat trade, and those addressing both aspects. The review identified a total of 321 species of wild vertebrates mentioned in the context of bushmeat consumption. Birds were the most frequently

cited group, with 170 species, followed by mammals (107 species), reptiles (40 species), and amphibians (4 species). In terms of trade, 57 species were noted, with mammals being the most represented group (29 species). The research revealed that publications were predominantly concentrated in the Northeast (36 articles) and North (26 articles) regions of Brazil, with a notable lack of studies from the Southeast region. This highlights a significant gap in research that needs to be addressed to understand bushmeat dynamics across the entire country. The paper discusses various predictors of bushmeat consumption and trade, including socioeconomic, biological, environmental, and sociocultural factors. It notes that public markets and open-air fairs are the primary venues for buying and selling bushmeat, indicating the informal nature of this trade. The authors stress the need for a multidimensional understanding of hunting activities to address socio-ecological challenges and improve conservation efforts for species exploited for bushmeat. They advocate for more research to understand consumption patterns and trade dynamics, which are crucial for developing effective conservation strategies. In conclusion, this empirical review of the paper highlights the complexities surrounding bushmeat consumption and trade in Brazil. It underscores the importance of addressing research gaps, understanding regional differences, and considering socio-economic factors to inform conservation efforts and public health initiatives. The findings contribute to a broader understanding of wildlife use and its implications for biodiversity and human health.

The study conducted by Van Velden *et al.*, (2020) addresses a critical gap in understanding bushmeat hunting and consumption in African savannah systems, particularly in southern Africa. It highlights the significance of this issue as a key threat to biodiversity, emphasizing the need for more research in this area due to its illicit nature and sensitivity. The researchers conducted a substantial field study involving 1,562 interviews with community members living near four

protected areas in Malawi. This large sample size enhances the reliability of the findings and provides a comprehensive view of the community's practices regarding bushmeat. The study found that bushmeat consumption was more prevalent than hunting, with up to 39% of the population consuming wild meat compared to 4-19% engaging in hunting activities. This disparity indicates that while many people consume bushmeat, fewer are involved in the act of hunting it. The research revealed that consumption of bushmeat was more common among poorer households, while hunting was more prevalent in wealthier households. This suggests that economic status influences the motivations behind bushmeat consumption and hunting, with poorer households relying on it for sustenance and wealthier households possibly hunting for leisure or income. Interestingly, the study found that increased involvement in community projects initiated by protected areas did not consistently lead to reduced hunting or consumption. This indicates a disconnect between community engagement and conservation outcomes, suggesting that projects need to be more effectively linked to conservation goals to be successful. The paper identifies key drivers for bushmeat consumption, including a preference for the taste of wild meat and the desire for dietary diversity. In contrast, hunting was primarily motivated by the need for income. This distinction highlights the different underlying factors that drive these two related behaviors. The findings underscore the pervasive nature of bushmeat consumption and hunting as threats to biodiversity, despite significant investments in community projects and enforcement efforts. The study calls for a more nuanced understanding of the socio-economic dynamics at play and suggests that conservation strategies need to address these complexities to be effective. In summary, this empirical review of the paper reveals critical insights into the dynamics of bushmeat hunting and consumption in Malawi. It emphasizes the need for targeted conservation strategies that consider

the socio-economic factors influencing these behaviors and the importance of effectively linking community projects to conservation outcomes.

Onumah & Ayeduvor (2023) conducted research on the dynamics of poultry market in Ghana. The study focused on the trends and content of poultry imports, their sources, driving factors, and the potential for domestic poultry to replace imports. The findings revealed that Ghana relies heavily on imports, with 80% of poultry meat coming from high-income countries in the form of branded cut-parts. Despite a 35% increase in tariffs, imported poultry remains 27-30% cheaper than locally produced chicken. The paper recommended government prioritizing policies that support local production by investing in processing (cut-parts), packaging, and marketing facilities.



## CHAPTER THREE

### METHODOLOGY

#### 3.1 Introduction

This chapter consists of four sections. Section 3.2 presents the theoretical framework, Section 3.3 presents the conceptual framework, Section 3.4 presents the method of analysis which entails models used for analyzing the various objectives, and Section 3.5 presents the study area and sampling techniques used.

#### 3.2 Theoretical framework

This study's theoretical foundation combines elements of the Theory of Planned Behaviour (TPB) and Utility Theory to explain consumer behavior regarding bushmeat consumption. The TPB posits that an individual's intention to perform a particular behavior is the immediate antecedent to that behavior, and this intention is influenced by three key factors: attitude, subjective norm, and perceived behavioral control (Kumar *et al.*, 2019). In other words, a person's positive or negative evaluation of bushmeat consumption (attitude), the social pressure or cultural norm they feel regarding bushmeat (subjective norm), and their perceived ease or difficulty in obtaining and consuming bushmeat (perceived behavioral control) together shape their intention to consume bushmeat.

In the context of this study, for example, an individual's attitude might be influenced by beliefs about the taste or health risks of bushmeat. Subjective norms might involve cultural expectations or family traditions around eating bushmeat. Perceived behavioral control could relate to how easily they can obtain and afford bushmeat in their community. The stronger the intention (driven by these factors), the more likely the person will follow through with the behavior of consuming bushmeat, assuming they have actual control over the decision.

Utility Theory complements the TPB by offering an economic perspective: it proposes that consumers are rational decision-makers who make choices based on the expected outcomes or utility of those choices. In other words, individuals are assumed to weigh the costs and benefits of consuming bushmeat and will choose to consume it if the perceived utility (satisfaction or benefit) exceeds that of the alternatives. By combining TPB with Utility Theory, the framework captures both the social-psychological drivers of intention and the rational cost–benefit calculations that culminate in the decision to consume bushmeat.

According to Ngcamu *et al.* (2023), consumers generally prioritize their self-interest and will seek to maximize personal benefit. Cultural, social, personal, and psychological factors all feed into the utility that a consumer derives from a product. Previous studies have found that consumers' decisions to purchase a food product depend on attributes such as convenience, variety, price, availability, packaging, cleanliness, and freshness (Fansia *et al.*, 2023; Citamani & Firdausy, 2024; Roy *et al.*, 2023). Price, in particular, has been found to have a somewhat less significant influence on meat purchasing decisions, consumers who are highly price-conscious are less likely to purchase meat frequently (Hestermann *et al.*, 2020) though there is debate about how product quality influences behavior.

Applied to bushmeat in Ghana, this means a consumer's choice to buy bushmeat may depend on a combination of its perceived advantages (for example, taste, nutritional value, and cultural significance) and its downsides (such as cost or perceived health risk). When purchasing bushmeat, Ghanaian consumers typically choose between forms (e.g., fresh or smoked) and species, evaluating which option gives them the highest overall satisfaction. Within the framework of random utility theory, a household's choice to consume bushmeat can be modeled by assuming that the individual will choose the option that maximizes their utility. In formal terms, the utility

$U_{aj}$  that consumer  $a$  derives from choosing alternative  $j$  (for instance, choosing bushmeat over other protein sources) can be expressed as:

$$U_{aj} = V_{aj} + \varepsilon_{aj} \quad (1)$$

Where  $U_{aj}$  is consumer  $i$ 's utility from choosing alternative  $j$ ,  $V_{aj}$  is the deterministic (observable) component of total utility and  $\varepsilon_{aj}$  is a stochastic element that represents unobservable influences on the consumer's choice. Following equation (1), an individual will choose an alternative  $j$  to other alternatives  $k$  if;  $U_{aj} > U_{ak}, j \neq k$ . The probability that any particular respondent prefers option  $j$  in the choice set to any alternative option  $k$ , can be expressed as the probability that the utility associated with option  $j$  exceeds the probability associated with the other options:

$$P_{aj} = \text{Pr ob}(V_{aj} + \varepsilon_{aj} > V_{ak} + \varepsilon_{aj}; \forall k \in C \setminus \{j\}) \quad (2)$$

Rearranging the above, to put the observables and unobservable together gives,

$$P(j | C_n) = \text{Pr ob}(V_{an} - V_{kn}) > (\varepsilon_{kn} - \varepsilon_{an}) \forall k \in C \quad (3)$$

In simpler terms, the probability of a consumer choosing bushmeat is the probability that the perceived utility of bushmeat exceeds that of any alternative. For example, if bushmeat is culturally preferred and provides a unique taste (high utility) that alternatives lack, and if its price or health risk (disutility) is not prohibitive, the model predicts the consumer will choose bushmeat. Empirical evidence supports the relevance of these factors: a study in Ghana found that the fear of contracting diseases (a negative factor) and the price of bushmeat tended to deter consumption, whereas the nutrition and taste of bushmeat, as well as its availability, positively influenced people's decision to consume (Bannor *et al.*, 2022).

These findings align with both the TPB (health risk perception affecting attitude; social/religious norms affecting behavior) and Utility Theory (weighing of nutritional benefit and taste against cost and risk).

While TPB and Utility Theory provide a robust framework for analyzing bushmeat consumption behavior, it is important to acknowledge their limitations. Utility Theory assumes that consumers are perfectly rational and have complete information, but in reality, decisions might be influenced by imperfect knowledge, emotions, or habits that cause people to deviate from purely rational choices (Yang and Lester, 2008). Likewise, the TPB emphasizes rational planning (intentions) and does not explicitly account for habitual or impulsive behavior, nor does it include factors beyond an individual's control (except as indirectly captured by perceived behavioral control).

In the context of bushmeat, for instance, a consumer might habitually eat bushmeat due to tradition (which might not involve conscious intention each time), or they might be constrained by factors like sudden market unavailability that no amount of intention can overcome. By recognizing these limitations, the study remains cautious in interpreting the results, understanding that human behavior around food choices can be complex and sometimes depart from theoretical predictions. Nonetheless, the combined use of TPB and Utility Theory offers a valuable lens, as it addresses both the intentional and utilitarian aspects of why people may or may not consume bushmeat in the aftermath of COVID-19.

By grounding this research in TPB and Utility Theory, the choice of analytical methods is directly informed by these theories. For instance, variables derived from TPB (such as risk perception or cultural norms) and Utility Theory (economic factors like price and income) are examined using appropriate models. The multinomial logistic regression (MNL) allows us to test how attitudes and economic considerations influence bushmeat choice, aligning with utility maximization and

behavioral intention concepts. Similarly, the Structural Equation Model (SEM) evaluates how bushmeat-related perceptions (rooted in these theoretical constructs) influences overall food security outcomes. This alignment between theory and method ensures that the selected analytical techniques are well-suited to test the study's hypotheses in the post-COVID-19 context.

### 3.3 Conceptual framework

The conceptual framework of this study (Figure 3.3) outlines the pathways through which the COVID-19 pandemic has influenced bushmeat consumption dynamics and the resulting implications for food security in Ghana. It captures a multi-dimensional view of the issue by considering socio-economic factors, health risk perceptions, market dynamics, and environmental implications together.

On the socio-economic and health side, the COVID-19 pandemic triggered significant disruptions: many consumers experienced income losses and job insecurity, and there was a heightened concern about diseases transmitted from animals. These changes have in turn shaped attitudes toward bushmeat consumption, particularly through the lens of perceived health risks. For example, someone who lost income might find bushmeat either harder to afford or, conversely, might turn to it if it became a relatively accessible protein source when other foods were scarce.

At the same time, a heightened awareness of zoonotic diseases could discourage some consumers from eating bushmeat out of fear of infection. However, cultural or nutritional needs might still compel others to continue consuming it. The pandemic period also brought about cultural and behavioral shifts (such as changes in dining practices and food preferences), potentially altering long-held practices related to wild meat consumption.

On the market side, the bushmeat trade itself was disturbed by the pandemic. Supply chains were disrupted by travel restrictions and market closures, leading to reduced availability of bushmeat in

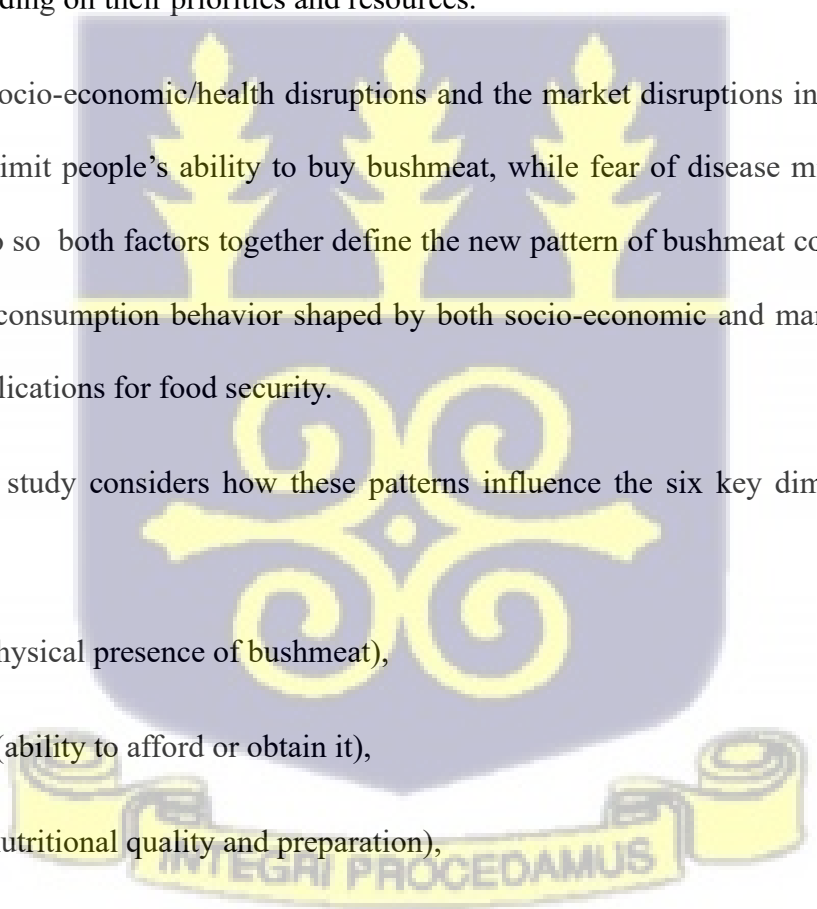
many areas. Many traders exited the market, and local outlets often faced fluctuating supply. These disruptions led to increased prices and reduced accessibility of bushmeat for consumers. In turn, such market dynamics have directly impacted consumer behavior influencing not only how often people can consume bushmeat but also which types of bushmeat are available and chosen.

For instance, if certain wild species became scarcer or prohibitively expensive, consumers might shift to other species or protein alternatives, thereby changing the diversity of bushmeat being consumed. Economic constraints (like higher prices) and availability issues may have forced consumers to either seek substitutes or continue buying smaller quantities of their preferred bushmeat, depending on their priorities and resources.

In essence, the socio-economic/health disruptions and the market disruptions interact: economic hardship might limit people's ability to buy bushmeat, while fear of disease might reduce their willingness to do so both factors together define the new pattern of bushmeat consumption post-pandemic. This consumption behavior shaped by both socio-economic and market forces feeds into broader implications for food security.

Specifically, the study considers how these patterns influence the six key dimensions of food security:

- i) Availability (physical presence of bushmeat),
- ii) Accessibility (ability to afford or obtain it),
- iii) Utilization (nutritional quality and preparation),
- iv) Agency (capacity to make informed food choices),
- v) Stability (consistency of access over time), and



vi) Sustainability (long-term viability without harming ecosystems or public health).

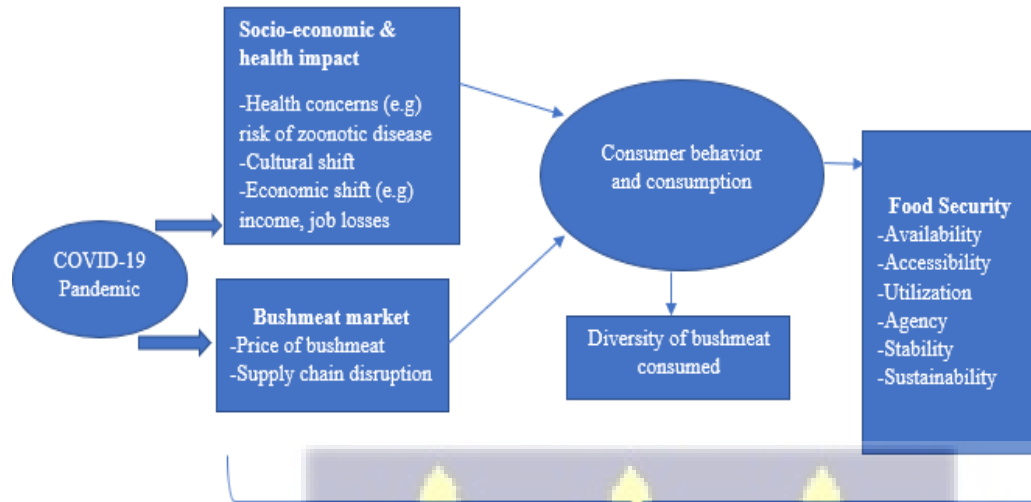
By mapping how pandemic-induced changes in socio-economic conditions and market dynamics influence bushmeat consumption, and in turn how those consumption patterns affect each of these dimensions, the framework provides a structured lens for the research.

Notably, the inclusion of sustainability reflects the environmental conservation aspect, recognizing that any post-pandemic surge or decline in bushmeat consumption has direct consequences for wildlife populations and biodiversity, which must be balanced with food security needs. This multi-faceted approach ensures that the study accounts for the complex interplay between human health, economic wellbeing, cultural practices, market forces, and environmental sustainability when examining bushmeat consumption in the post-COVID-19 era.

This conceptual framework is underpinned by the theoretical foundations discussed earlier. For example, pandemic-induced changes in health risk perception correspond to the attitude component of TPB, while economic constraints (like income loss and price hikes) relate to perceived behavioral control and the cost benefit considerations of Utility Theory. By linking these elements to the observed changes in consumption, the framework explains how COVID-19's effects translated into new bushmeat consumption behaviors and their subsequent food security outcomes.



Figure 3.1: Conceptual framework



Source: Author's own construct (2024)

Post COVID-19 era

### 3.4 Analytical framework

#### 3.4.1 Descriptive statistics

Descriptive statistics involve summarizing and describing data in a research study, providing essential insights into the characteristics of the sample (Vetter, 2017; Fulk, 2023). Bar charts are commonly used to visually represent frequency distributions, displaying the relative frequency (%) of different categories or variables within a dataset (Fulk, 2023). In this study, bar charts illustrated the number of consumers opting for each type of bushmeat across the various regions. This visual overview clearly highlights the most and least popular bushmeat types among the respondents, providing a straightforward basis for further analysis.

The descriptive statistics reveals a significant variety in the types of bushmeat consumed. The bar charts highlight the most and least preferred types, offering a clear visual summary of the consumption patterns. This approach not only helped us understand the diversity of bushmeat

consumed but also provided a solid foundation for further analysis and interpretation in the later sections of the thesis.

### 3.4.2 Factor analysis

Before applying the Structural Equation Model (SEM), factor analysis methods were employed to examine the relationships among measured variables and determine whether the observed variables could be grouped into a smaller set of underlying factors or theoretical constructs (Thompson, 2004; Worthington & Whittaker, 2006). Two primary approaches within the factor analysis family are Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA), both integral to the scale development process but serving distinct purposes (Bowen *et al.*, 2011).

In this study, EFA was utilized to assess the interactions among various variables, revealing the underlying structure connecting them. EFA aims to reduce information loss by condensing many variables into a smaller set of highly correlated factors (Crothers, 2009; Hair *et al.*, 2010). The Principal Component Analysis (PCA) method was employed to extract these factors, given that consumer perceptions on the availability, accessibility, utilization, agency, stability and sustainability of bushmeat are represented by numerous variables. Condensing correlated variables into factors helps mitigate the issue of multicollinearity.

Factor analyses were conducted using PCA with varimax rotation to evaluate consumers' overall perceptions of food security. Prior to the factor analysis, diagnostic measures were employed to assess internal consistency. Initially, inter-item correlations, which indicate the correlation among items, were examined. Factors with eigenvalues exceeding 1 were retained. Reliability was then evaluated using Cronbach's alpha ( $\alpha$ ) with a critical score set at 0.60 (Hair *et al.*, 2006). Factors with a score below 0.60 were excluded from subsequent regression analysis, ensuring that retained factors maintained a satisfactory level of internal consistency for reliable interpretation and

analysis. In summary, performing factor analysis allowed us to condense numerous perception variables into a smaller set of meaningful factors for each food security dimension. This step was crucial because it simplified the subsequent SEM and mitigated multicollinearity by grouping highly correlated variables, whereas skipping factor reduction could have resulted in an overly complex and less reliable model.

### **3.4.3 Multinomial logistic regression model**

In this study, a multinomial logistic regression (MNL) is used to examine the factors influencing consumers' preference for different bushmeat categories. The multinomial logistic regression model is suitable for analyzing data to determine the likelihood of a certain event occurring or to predict the likelihood of a specific event occurring in the presence of relevant explanatory variables. Gujarati (1992) and Tedasse (2011) explained that with explanatory variables, MNL predicts the probability of occurrence of the event under study but does not necessarily determine a numerical value for the dependent variable.

Dougherty (1992) explained that the MNL and binary logistic regression models are very similar in terms of formulation. While binary logistic regression uses only two categories as a dependent variable (dichotomous variable), MNL uses more than two categories (polytomous). As a result, MNL is a binary logistic regression extension.

Mohammed & Ortmann (2005) explained that the relationship between dependent and independent variables can be analyzed using several analytical techniques such as linear regression models, probit analysis, log-linear regression, and discriminant analysis in their study on the factors influencing the adoption of livestock insurance by commercial dairy farmers in Eritrea. However, the choice of MNL model for this study is because of its usefulness and advantages, especially when analyzing qualitative dependent variables.

Although the linear regression model (also known as Ordinary least squares regression (OLS)) has been employed by various analysts (Montshwe, 2006), Gujarati (1992) indicated that the method only becomes useful when the dependent variable is quantitative and not qualitative as in the case of this study. Thus, the OLS is inapplicable in this study because the probability has to fall between 0 and 1, especially if there are no restrictions on the values of the various independent variables. In addition, Gujarati (1992) elucidated that MNL gives the estimates from the logit model which always has its logical bounds between 0 and 1. Its mathematical simplicity and modeling capability allow for the analysis of multi-category dependent variables, assuming independence across choices and disregarding correlations or substitutions between these variables (Win *et al.*, 2015).

Multinomial logistic regression is effective in categorical data analysis because it predicts the location of a dependent variable based on many independent variables. In terms of scale, the independent variables might be dichotomous (binary) or continuous (interval or ratio). MNL is a straightforward expansion of binary logistic regression that allows for more than two dependent variable categories. MNL, like binary logistic regression, evaluates the probability of category membership using maximum likelihood estimation (Chiang, 2022). MNL necessitates careful consideration of sample size and outlying event examination. It should include univariate, bivariate, and multivariate assessments. Simple correlations between the independent variables should be used to assess multicollinearity. Multivariate diagnostics can also be used to check for multivariate outliers as well as to rule outliers or influential examples. Because it does not assume normality, linearity, or homoscedasticity, MNL is a popular analysis (Tan & Bellec, 2024; Liao *et al.*, 2021). The multinomial logit models have their grounds on the random utility theory. The main goal of this study is to better understand the significant elements that influence consumer preference for bushmeat.

The classification of animals into terrestrial, aerial, and arboreal categories highlights their adaptations to different environments. Terrestrial animals primarily inhabit land, while aerial animals are adapted for flight, and arboreal animals live predominantly in trees (Li, 2007, Tabacow *et al.*, 2009; Cloudsley-Thompson, 1999, Ishaq *et al.*, 2013).

**Terrestrial animals** primarily live and move on the ground. Based on the types of bushmeat consumed in the study, the terrestrial animals include the grasscutter (greater cane rat), maxwell duiker, antelope, bushbuck, black duiker, rat, squirrel, hippopotamus. These animals are adapted to life on the ground, with behaviors and physical characteristics suited to terrestrial environments.

**Arboreal animals** primarily live in trees. Examples include monkeys and squirrels. These animals have adaptations such as strong limbs and prehensile tails that enable them to navigate and thrive in the canopy.

**Aerial animals** are capable of sustained flight and spend a significant amount of time in the air. Examples include bats and certain bird species like the Ahanta francolin as identified in my study. These animals have adaptations such as wings and lightweight bodies that facilitate flight.

To examine the factors that influences consumers preference for the different types of bushmeat in Ghana, the multinomial logit model was used. The bushmeat category identified were further grouped into terrestrial animals only, mixed terrestrial, aerial and arboreal animals, mixed terrestrial and aerial animals

The MNL technique is used to predict multi-category dependent variables.

It implies independence across options and does not allow for correlation or substitution (Koch, 2015). As a result, the likelihood of bushmeat category preference techniques among bushmeat consumers is illustrated below:

$$Prob = (Y_i = t) = \frac{exp(\beta'_t X_i)}{\sum_{t=1}^3 exp(\beta'_t X_i)} \quad \text{for } t = 1, 2, 3 \dots \dots \dots (4)$$

Where  $Y_i$  is the probability of bushmeat consumer, say consumer prefer bushmeat type  $t$ ,  $Pr (Y_i = j)$ .

Bushmeat type  $t$ : 1 means consuming terrestrial animals only, 2 means consuming mixed terrestrial, aerial and arboreal animals, 3 means consuming mixed terrestrial and aerial animals.  $x_i$  is the vector of socioeconomic and market variables.  $\beta_j$  is the vector of coefficients associated with the type of bushmeat preference  $t$ .

The log-odds score is considered as follows:

$$ln \frac{(P_{ij})}{(P_{ik})} = \alpha + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k + e_i \dots \dots \dots (5)$$

$P_{ij}$  and  $P_{ik}$  represents the likelihood that a consumer will prefer one bushmeat category over another. The natural log of the probability of preference  $j$  relative to the probability of preference  $P_{ij}/P_{ik}$  an independent, normally distributed error component with a mean zero, and  $k$  is a constant.  $X$  is a matrix of parameters that reflect the impact of changes in  $X$  on the likelihood of preferring a specific bushmeat category.

The equation (5) is simplified below:

$$ln \frac{(P_{ij})}{(P_{ik})} = \alpha + \beta_1 (Age) + \beta_2 (Income) + \beta_3 (Region) + \beta_4 (Gender) + \beta_5 (Formal education) + \beta_6 (House hold size) + \beta_7 (Health risk) + \beta_8 (Preference for alternative) + \beta_9 (Price of bushmeat) + e_i \dots \dots \dots (6)$$

Age, income, reliable customers, region, gender among others are the  $X_1$  to  $X_k$  factors influencing preference of different types of bushmeat while  $\beta$  are parameters to be estimated and  $e$  is a randomized error. The probability of selecting outlet  $j$  from a set of  $j$  alternatives is given by:

$$Prob = (Y_i = t) = \frac{(e_{zt})}{\sum_{k=0}^t e_{zt}} \dots\dots\dots(7)$$

Where  $Z_t$  is a preference (terrestrial animals only = 1, mixed terrestrial, aerial and arboreal animals = 2, mixed terrestrial and aerial animals = 3). The model estimates are used to calculate the likelihood of selecting a market outlet based on  $j$  variables.  $X_i$  has a variety of different options.

The multinomial logit model's parameter estimates simply show the direction of the independent variable's effect on the dependent variable; they do not provide the actual degree of chance or probability. The marginal effects, also known as marginal probabilities, are functions of probability that measure the variation in the chance of making a specific option in response to a unit change in an independent variable from the mean (Green, 2009).

**Table 3.1 Categories of bushmeat consumed**

<b><i>Respondent</i></b>	Bushmeat consumer
<b><i>Bushmeat category</i></b>	<ol style="list-style-type: none"> <li>1. Terrestrial animals only</li> <li>2. Mixed terrestrial, aerial and arboreal animals</li> <li>3. Mixed terrestrial and aerial animals</li> </ol>
<b><i>Reference group</i></b>	Mixed terrestrial and arboreal animals

Source: Survey data, 2024

However, it is important to acknowledge certain assumptions and potential biases associated with the MNL model. MNL assumes that choices are independent of irrelevant alternatives (IIA), meaning the relative odds of preferring one bushmeat category over another are not affected by the presence or absence of other categories. If, in reality, consumers tend to prefer certain types of bushmeat together (i.e. if preferences for some bushmeat types are correlated), this IIA assumption could be violated, potentially leading to biased estimates. Additionally, if there are unobserved

factors that influence both the explanatory variables and bushmeat preferences (for example, a respondent's health consciousness or cultural beliefs not captured in the survey), then an endogeneity problem may arise, resulting in biased and inconsistent coefficient estimates (de Grange *et al.*, 2024). Finally, interpreting the coefficients in an MNL model can be complex because each coefficient represents the effect of a predictor on the log-odds of choosing an outcome relative to the reference group, rather than a direct effect on probability. This complexity underscores the importance of using marginal effects for meaningful interpretation of results.

The explanatory variables chosen for the MNL model reflect both theoretical and practical considerations. Key demographic factors (age, gender, education, household size, region) were included to capture personal and cultural influences on bushmeat preferences. Economic factors (income level and bushmeat price) were incorporated because affordability and cost are needed determinants of consumption choices. Additionally, variables representing health risk perception and preference for alternative protein sources were added, as fear of disease and availability of substitutes can significantly sway decisions to consume bushmeat (Bannor *et al.*, 2022). By including these variables, the model can evaluate a comprehensive range of influences from socioeconomic and cultural factors to risk attitudes, on the likelihood of preferring one bushmeat category over another.

#### **3.4.4 Structural equation model**

The Structural Equation Model (SEM) was used to analyze the implications of consumer perceptions of bushmeat on food security. SEM is a multivariate analysis approach for examining relationships between latent components and measurable variables. The SEM approach allows simultaneous analysis of complex relationships between the dependent outcome (e.g., food security) and independent variables.

Under this task, the SEM technique will capture Food Security as a latent variable.

This is considered a dependent variable and regressed on the determinants of the six dimensions of food security (availability, accessibility, utilization, agency, stability and sustainability) in relation to bushmeat consumption. The directions of the significant estimates in the model will reveal the tradeoffs and synergies between bushmeat consumption and the dimensions of food security.

**Model Specification**

The Structural equation model is specified as follows using the linear structural relations formulation (Bollen, 1989).

$$\eta = \beta\eta + \gamma\xi + \varepsilon \dots\dots\dots(8)$$

$$X = \Lambda_x \eta + c \dots\dots\dots(9)$$

$$Y = \Lambda_y \xi + \delta \dots\dots\dots(10)$$

Equation 8 shows the variable latent model whereby  $\eta$  represents the endogenous construct,  $\xi$  represents the latent exogenous construct and  $\varepsilon$  is the latent error for  $i = 1, 2 \dots N$  observations.  $\beta$  is a matrix that shows the effect of the endogenous construct on each other while  $\gamma$  is a matrix that shows the effect of the exogenous construct on the endogenous constructs.

Equations 9 and 10 show the relationship that occurs between the unobserved variable and the observed variables. The observed variables ( $Y$  and  $X$ ) are signs of the latent endogenous  $\eta$  vectors and the latent exogenous  $\xi$ . The  $\Lambda_x$  and  $\Lambda_y$  are loadings of endogenous and exogenous indicators, respectively, representing the regression coefficients relating  $Y$  to  $\xi$  and  $X$  to  $\eta$  respectively. The vectors  $c$  and  $\delta$  are measurement errors.

**Table 3.2 Explanatory variables included in the multinomial logit model**

Independent variables	Description & measurement	Variable type
Age	Years	Continuous
Monthly income	<GHS 800 (<GHS 800=1, Otherwise=0) GHS 801-1500 (GHS 801-1500 =1, Otherwise=0) GHS1501-3000 (GHS1501-3000 =1, Otherwise=0)	Categorical
Region	For Bono (Bono=1, Others =0) For Ashanti (Ashanti=1, Others=0)	Categorical
Gender	Dummy(Male=1, Female=0)	Categorical
Formal education	Number of Years	Continuous
Household size	Number of individuals	Continuous
Health risk	Dummy (1=Yes, 0=No)	Categorical
Pref. for altern. over bushmeat	Dummy (1=Yes, 0=No)	Categorical
Price of bushmeat	Dummy (Yes=1, No=0)	Categorical

Source: Author’s own construct (2024)

**Figure 3.2 SEM framework for the study**

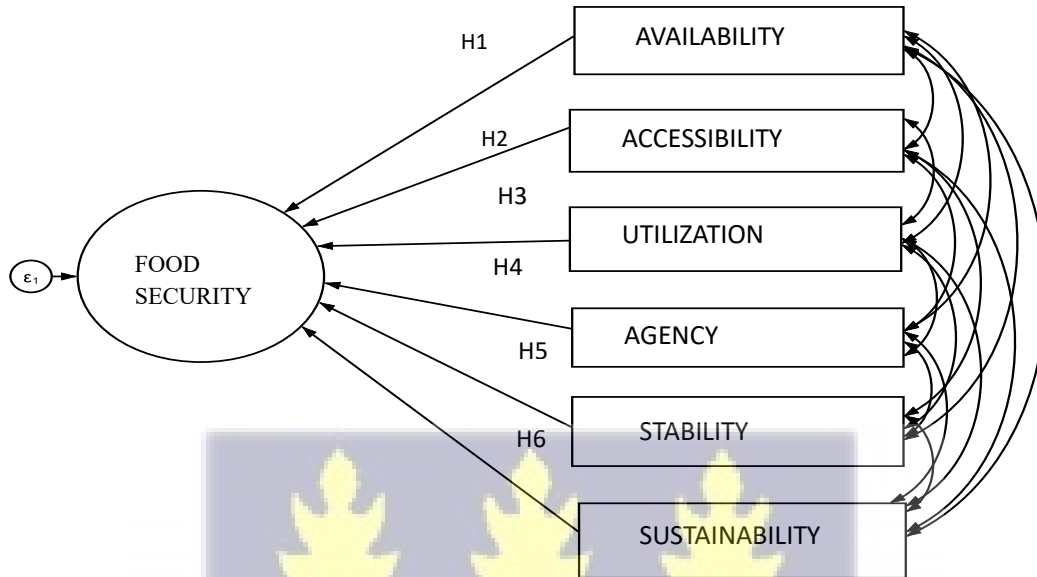


Figure 3.2 depicts a simple SEM path diagram showing how the various pillars contribute to food security as well as the linkages that exist between the various components of food security.

The operationalization stands to answer the following hypothesis:

*Hypothesis 1: The availability dimension does not influence food security.*

*Hypothesis 2: The accessibility dimension does not influence food security.*

*Hypothesis 3: Utilization dimension has no influence on food security.*

*Hypothesis 4: Agency dimension has no influence on food security.*

*Hypothesis 5: Stability dimension has no influence on food security.*

*Hypothesis 6: Sustainability dimension has no influence on food security*

**Other hypothesis of interest includes:**

*Hypothesis vii: No bi-directional relationship between Availability and Accessibility on consumer food security.*

*Hypothesis viii: No bi-directional influence of Availability and Utilization dimension on consumer food security.*

*Hypothesis ix: No bi-directional influence of Availability and Agency dimension on consumer food security.*

*Hypothesis x: No bi-directional influence of Availability and Stability dimension on consumer food security.*

*Hypothesis xi: No bi-directional influence of Availability and Sustainability dimension on consumer food security.*

*Hypothesis xii: No bi-directional influence of Accessibility and Utilization on consumer food security.*

*Hypothesis xiii: No bi-directional influence of Accessibility and Agency dimension on consumer food security.*

*Hypothesis xiv: No bi-directional influence of Accessibility and Stability dimension on consumer food security.*

*Hypothesis xv: No bi-directional influence of Accessibility and Sustainability dimension on consumer food security.*

*Hypothesis xvi: No bi-directional influence Utilization and Agency dimension on consumer food security.*



*Hypothesis xvii: No bi-directional influence Utilization and Stability dimension on consumer food security.*

*Hypothesis xviii: No bi-directional influence Utilization and Sustainability dimension on consumer food security.*

*Hypothesis xix: No bi-directional influence Agency and Stability dimension on consumer food security.*

*Hypothesis xx: No bi-directional influence Agency and Sustainability dimension on consumer food security.*

*Hypothesis xxi: No bi-directional influence Stability and Sustainability dimension on consumer food security.*

However, the analysis of the SEM begins by first conducting a factor analysis to reduce the items under each construct (Availability, Accessibility, Utilization, Agency, Stability and Sustainability). Secondly, a reliability test was conducted to establish the normality and the sampling adequacy of the data. Lastly, the Structural Equation Model was then fitted to ascertain the relationships between consumer food security and bushmeat consumption.

#### **3.4.5 Kendall's coefficient of concordance**

Kendal's coefficient of concordance(KCC), Garrett's ranking technique, and direct scoring are the few constraints measuring tools. Studies have shown that KCC gives appropriate results in the ranking of the constraints and is less sensitive to outliers compared to Garrett's coefficient, making it more reliable in diverse datasets (Koike and Hofert, 2024). According to Lewis & Jonson (1971) and Lubenets & Miroshnikov (2022), KCC is one of the popularly used methods for ranking constraints due its straightforward computation and its application across various fields, enhancing

its usability in practical scenarios. The significant test gives the conclusion about the various variables ranked. Kendall's Coefficient of Concordance (W) calculates the degree of agreement among the number of rankers (m) and the number of constraints (n). W is the index that measures the ratio of the observed variance of the sum of ranks to the maximum possible variance of the sum of ranks. This index finds the sum of each constraint ranked and examines the variability of the sum. A perfect agreement gives maximum variability among the sum of the constraints (Mattson, 1986). It is a technique that measures constraints from the most pressing one to the least pressing one and then indicates a degree of agreement among the constraints.

To identify and rank the constraints faced by bushmeat consumers in the market, a systematic approach was adopted. The constraints were obtained from a comprehensive review of relevant literature on bushmeat consumption and related agricultural studies. During the pre-testing phase of the questionnaire, a pilot survey was conducted with a small group of respondents to gather insights and feedback on potential constraints. To ensure the relevance and accuracy of the identified constraints in the local context, a pre-testing exercise was conducted. A small group of bushmeat consumers, who were representative of the study population, participated in this pre-testing phase. They were presented with the list of potential constraints obtained from the literature review. During interactive discussions and interviews, these consumers were asked to share their experiences and rank the constraints according to their perceived severity and impact on bushmeat consumption.

To analyze the ranking of constraints obtained from respondents, the Kendall Coefficient of Concordance (W) was adopted. Kendall Coefficient of Concordance is a statistical measure used to assess the level of agreement or concordance among multiple respondents when ranking items. It helps determine if there is a consensus in the ranking of constraints and provides a quantitative

measure of the level of agreement. The adoption of Kendall Coefficient of Concordance was based on the need for an objective and systematic approach to analyze the ranking data obtained from multiple respondents. By using Kendall Coefficient of Concordance, we can assess the overall agreement or disagreement among respondents in ranking the constraints. This statistical method provides a robust and objective way to summarize the data, ensuring that the results are reliable and representative of the study population's views.

Concordance coefficient (W) is given as;

$$W = \frac{12[\sum T^2 - \frac{(\sum T)^2}{n}]}{nm^2 - (n^2 - 1)} \dots\dots\dots(11)$$

Where; T = the sum of ranks of each factor being ranked,

m = number of sets of ranking by the consumers

n= the number of specific causes being ranked.

#### F-ratio Model

The F- ratio was used to test the significance of the value of Kendall's coefficient of concordance in terms of F- distribution. The F-ratio is given the model;

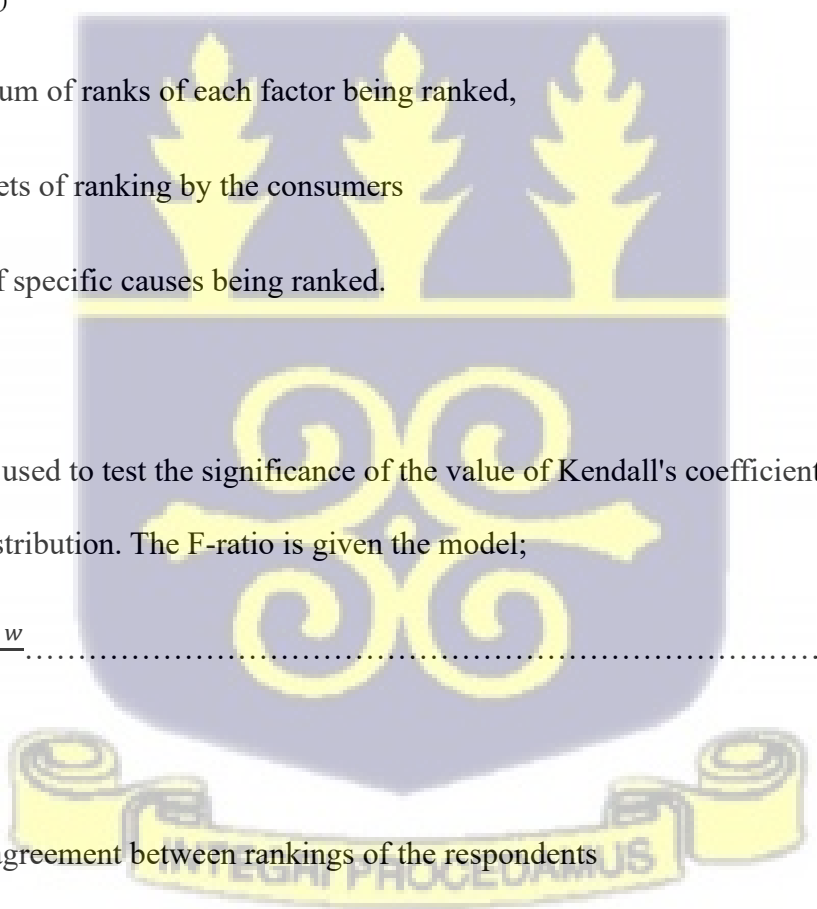
$$F\text{-ratio} = \frac{[(m-1)/w]}{(1-w)} \dots\dots\dots(12)$$

#### Hypothesis

H<sub>0</sub>: There is no agreement between rankings of the respondents

H<sub>1</sub>: There is an agreement between rankings of the respondents

Decision rule:



If  $F\text{-calc} \geq F_{\text{Crit}}$  then we reject the  $H_0$  and conclude that there is agreement among the rankings.

### **Software for data analysis**

To achieve the objectives of this study, the data collected was cleaned and organized in excel. Excel was used to visualize the diversity of bushmeat consumed in the form of bar charts, according to each region. STATA version 17 was employed for various analyses in this study. It was used to run the multinomial logistic regression model and to conduct factor analysis on perceptions regarding the pillars of food security. Additionally, STATA 17 facilitated Structural Equation Modelling, providing important insights. Finally, it was utilized to analyze the constraints faced by bushmeat consumers in their purchasing and consumption behaviors.

### **3.5 Data description**

#### **3.5.1 Study area**

The study was conducted in the Greater Accra, Ashanti, and Bono-Regions of Ghana because these regions are known for their prominent bushmeat markets and extensive bushmeat research. These areas are characterized by significant commercial activities related to the bushmeat trade, which are crucial for understanding the implications of bushmeat consumption on food security

#### **Greater Accra region**

The Greater Accra Region is the smallest of Ghana's 16 administrative regions, covering just 3,245 square kilometers, which is about 1.4% of the country's total land area (Donkor *et al.*, 2021). Despite its small size, it's the most densely populated region, with a population of 5,455,692 as of the 2021 census, making up 17.7% of Ghana's total population. The region is located in the southeastern part of the country, bordered by the Eastern Region to the north, the Volta Region to

the east, the Gulf of Guinea to the south, and the Central Region to the west (GSS, 2021). Greater Accra has a tropical climate with two main seasons: a wet season from April to mid-November and a dry season from mid-November to March. The average annual rainfall is around 810 millimeters. The region experiences relatively high temperatures throughout the year, with the hottest months being February and March.

The region is a melting pot of cultures, with the Ga-Dangme people being the largest ethnic group, making up 18.9% of the population (GSS, 2021). Other significant ethnic groups include the Akans, Ewes, and Mole-Dagbon. The dominant languages spoken are Ga, Dangme, and Akan. Greater Accra is the economic hub of Ghana, with Accra, the capital city, serving as the main commercial center. Bushmeat consumption is also notable in the Greater Accra Region. Markets in Accra and surrounding areas often feature bushmeat, including species like grasscutter, antelope, and various rodents. Bushmeat is an important source of protein for many residents and plays a role in the local economy. However, it also raises concerns about wildlife conservation and public health, especially in the context of post-COVID-19 food security

### **Ashanti region**

Ashanti region makes up 24,389 square kilometers (10.2% of Ghana's total land area) and is located in the southern portion of the nation. The region's physical location is between latitudes 5.50N, 7.46N, and longitudes 0.15W, 2.25W. After the Northern and Brong-Ahafo Regions, it is the third-largest region. The Western, Central, Eastern, and Brong-Ahafo Regions all share borders with it (GSS, 2021). There are two rainy seasons in the area, with the major season lasting from April to mid-August and the minor season lasting from September to November. The average annual rainfall is 1,270 millimeters. The Ashanti Region experiences relatively dry weather from December to March, and again from mid-August to mid-September. With a population of

approximately 5.43 million people accounting for 17.6% of Ghana's total population, it stands as one of the most urbanized regions in the country, second only to Greater Accra. The region is home to around 1.52 million households, with an average of 3.4 individuals per household. Agricultural households make up a significant portion, totaling 412,055, which is 16.5% of Ghana's national figure (Nti *et al.*, 2020). There are roughly 1.09 million farms in Ashanti, representing 16.4% of all farms nationwide. Among the major crops grown, cocoa is the most prevalent (22.1%), followed closely by cassava (21.6%), plantain (20.1%), and maize (11.3%). The Ashanti region is presently a principal pivot for the bushmeat trade in the country.

### **Bono-East region**

The Bono East Region spans 22,952 square kilometers, making up about 8.6% of Ghana's total land area. It is situated centrally in the country, between latitudes 7.45N and longitudes 1.03W. This region was established in 2018 after a referendum, splitting from the Brong-Ahafo Region. It borders the Savannah Region to the north, Bono Region to the west, Ashanti Region to the south, and the Volta Lake to the east (GSS, 2021). Bono East enjoys a tropical climate with two main seasons: a wet season from July to November and a dry season from December to April. The annual rainfall ranges between 750 and 1050 millimeters (Ampim *et al.*, 2021). Temperatures can vary quite a bit, with the hottest periods at the end of the dry season and the coolest in December and January. During December to February, the Harmattan wind from the Sahara brings dry and hot conditions (Yeboah *et al.*, 2020). As of the 2021 census, the region's population stands at 1,203,400. It is the largest ethnic groups, with the Bonos and Akans making up 41.5% of the population. Other groups include Mole-Dagbon (22.2%), Grusi (6.9%), Mande (1.5%), Gurmas (12.3%), Guans and Ewes (4.3%), and Ga-Dangmes (1.2%) (GSS, 2021). The main languages spoken here are Bono and Akan. Agriculture is the backbone of Bono East's economy. The region

is particularly known for its yam production, especially in areas like Techiman, Yeji, Nkoranza, Kintampo, Kwame Danso, and Prang. The fertile soil and favorable climate make it ideal for growing a variety of crops. Bushmeat consumption is also significant in Bono East. The region's markets, such as the Techiman market, are known for their high inflow of bushmeat, which includes popular species like grasscutter (a type of cane rat), Maxwell's duiker, and black duiker. Bushmeat is an important source of protein and income for many households, especially in rural areas. However, it also raises concerns about sustainability and conservation.

### **3.5.2 Methods of data collection**

The study used primary data. Data was collected through the administration of a semi-structured questionnaire consisting of both open- and closed-ended questions. These were conducted through personal, formal, and informal interviews with bushmeat consumers. All interviews were carried out on-site at selected bushmeat markets across the study locations. No follow-up interviews were conducted in respondents' homes. The data collection exercise took place over a three-week period in March 2024, with visits made on different days and times to capture a mix of respondents and reduce bias from time-specific activity patterns in the markets. The questionnaire was pre-tested in Kantamanto Market through a pilot survey conducted with a randomly selected group of bushmeat consumers. This was done to test the clarity, relevance, and appropriateness of the questions, as well as to identify any weaknesses or inconsistencies. Based on insights from the pilot, the questionnaire was revised before final data collection. The pre-tested responses were not included in the final dataset. Kantamanto Market was chosen for the pilot due to its large and diverse bushmeat customer base in Accra. While this single market did not capture all regional variations, the pretest was intended solely to refine the questionnaire (ensuring clarity and relevance) rather than to provide representative data. The insights gained were incorporated into

the survey instrument before it was administered across all selected regions. During the interviews, respondents were asked about their socioeconomic characteristics (e.g., age, gender, education level, income, and experience), as well as their patterns of bushmeat consumption. Specific sections of the questionnaire gathered information on the diversity of bushmeat consumed, the frequency and means of acquisition, and the constraints faced by consumers, with some responses later ranked and analyzed using descriptive statistics.

### **3.5.3 Sampling technique and sample size**

A multistage sampling procedure was used in the selection of bushmeat consumers in the country. In the first stage, Greater Accra, Ashanti, and Bono East regions were purposively selected because they are known to have significant bushmeat markets.

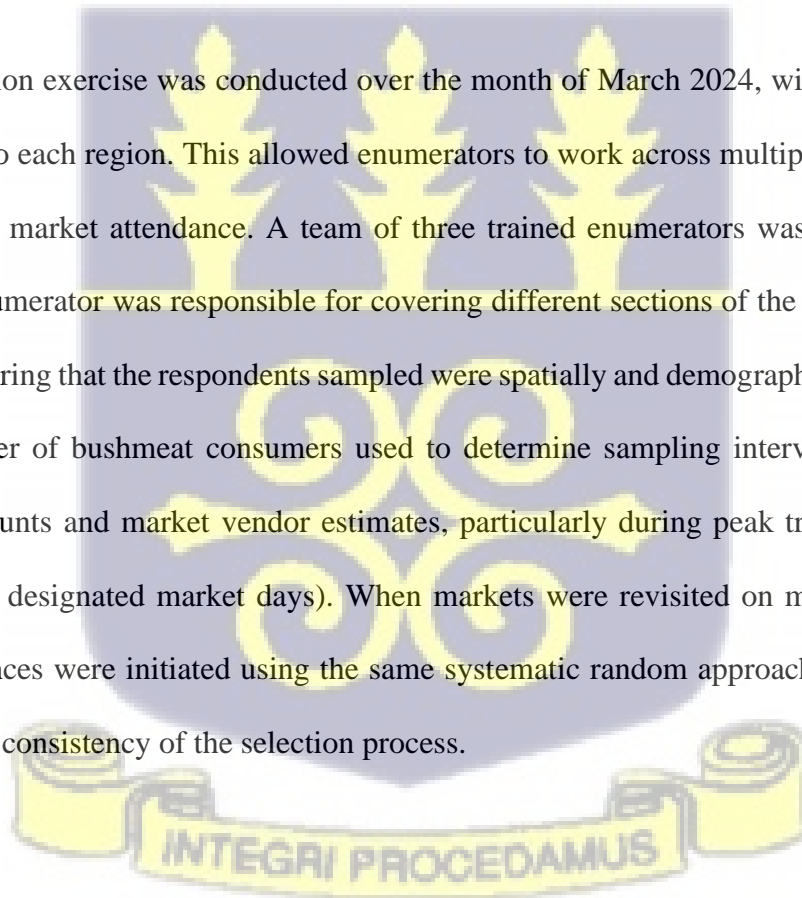
In the second stage, two districts were purposively selected from each region based on the presence of prominent bushmeat markets. From the Greater Accra region, Accra Metropolitan District and Korley Klottey Municipal Assembly were selected. From the Ashanti region, Kumasi Metropolitan District and Kwadaso Municipal District were selected. From the Bono East region, Nkoranza South Municipal District and Techiman Municipal District were selected.

In the third stage, one bushmeat market was purposively selected from each district. For Greater Accra, Kantamanto Market and Adabraka Market were selected. For Ashanti, Atwemonom Bushmeat Market and Kwadaso Market were selected. For Bono East, Nkoranza Market and Techiman Market were selected.

Finally, a systematic random sampling technique was used to select 50 bushmeat consumers from each market. In total, 100 respondents were sampled from each region, with 33 respondents from

each of two markets and 34 from the third market to make up the regional total. This resulted in a cumulative sample size of 300 respondents across all three regions. Respondents were selected on-site at the markets. The first consumer was selected at random, and subsequent respondents were chosen at regular intervals. The sampling interval was determined by dividing the estimated number of bushmeat consumers present in each market by the number of respondents to be selected. For instance, in a market with approximately 150 bushmeat consumers and a target of 33 respondents, the sampling interval was approximately 4 or 5. If the first respondent was randomly selected as number 6, subsequent respondents were numbers 10, 14, 18, and so on. All data collection was conducted within the markets during active trading hours.

The data collection exercise was conducted over the month of March 2024, with six consecutive days dedicated to each region. This allowed enumerators to work across multiple days to account for variations in market attendance. A team of three trained enumerators was assigned to each region. Each enumerator was responsible for covering different sections of the markets, reducing overlap and ensuring that the respondents sampled were spatially and demographically spread. The estimated number of bushmeat consumers used to determine sampling intervals was based on informal headcounts and market vendor estimates, particularly during peak trading hours (e.g., mid-week or on designated market days). When markets were revisited on multiple days, new sampling sequences were initiated using the same systematic random approach, maintaining the randomness and consistency of the selection process.



### 3.6 Limitation of the study

This study has several limitations. First, it relies on self-reported data from questionnaires and interviews, which may be affected by response bias. Given the legal restrictions and cultural sensitivities surrounding bushmeat consumption in Ghana, some respondents may have under-reported their behavior or provided socially acceptable answers. As a result, the true extent of consumption may be lower or higher than reported.

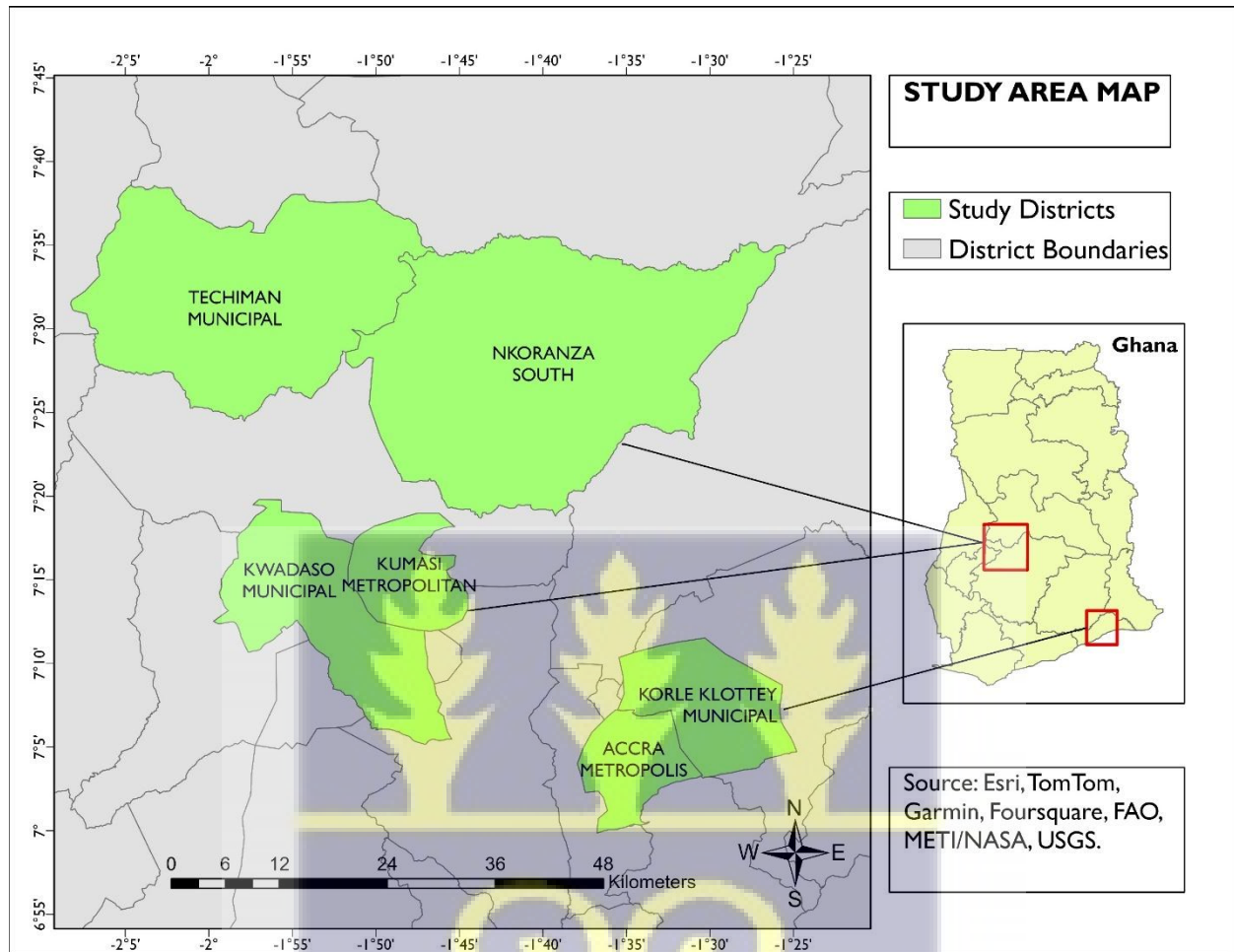
Second, the findings reflect a specific post COVID 19 context. The data represent consumer attitudes and economic conditions at a time when societies were adjusting to the aftermath of the pandemic. Consumer behavior is still evolving, and future developments in public health, economic recovery, or conservation policy could change preferences. The results should therefore be seen as a snapshot of this period rather than a long-term trend.

Third, there are analytical limitations. The multinomial logit model used assumes independence of irrelevant alternatives, meaning that the choice of one option is unaffected by the presence of others. If consumers view some bushmeat types as substitutes, this assumption may not hold. The model may also suffer from omitted variable bias if factors such as cultural beliefs or health concerns, which influence both income and consumption, were not captured. Although marginal effects were computed to ease interpretation, the model's results remain complex.

Finally, the sample was drawn from selected regions of Ghana. While large enough for analysis, it may not fully represent the national population. This limits the generalizability of the findings.

In summary, these limitations frame the scope of the study. The results should be interpreted cautiously, with future research encouraged to address these issues through broader samples, longitudinal data, and methods that reduce reporting bias.

Figure 3.3 Map of study area



Source: Author's Own Construct (2024) using ArcGIS PRO 2.8.



## CHAPTER FOUR

### RESULTS AND DISCUSSION

#### 4.1 Introduction

The findings of this study are presented and discussed in this chapter. This section discusses the socioeconomic characteristics of the respondents. This chapter presents the results on the diversity of bushmeat consumption, the factors influencing consumer preference for different types of bushmeat after the COVID-19 pandemic, consumer perception for bushmeat on food security and the ranking of the constraints faced by bushmeat consumers after the COVID-19 pandemic in Ghana.

#### 4.2 Socio-economic characteristics

The socio-economic characteristics of the respondents are presented in Table 4.1. It includes gender, marital status, age, religion, ethnic background, occupation, monthly income and educational level of bushmeat consumers.

Out of 300 bushmeat consumers, 126 (43%) were male and 171 (57%) were female. A similar female majority has been observed in other studies of protein food consumption; for instance, a study of bushmeat consumers in Nigeria found 58% were female (Olunusi, 2024). This pattern is often because in Ghana, women typically handle food purchasing decisions for their households (Teye *et al.*, 2020). The high number of females compared to males may be due to the fact that in many cultures in Ghana, women are primarily responsible for preparing meals. However, cooking responsibilities do not automatically equate to control over what meat is bought; in many households the male head ultimately makes the major food purchase decisions. Nevertheless, the study was carried out in various markets across the three regions (Greater Accra, Ashanti, and Bono-East), it was observed that women often play significant roles in selling various goods, including bushmeat.

**Table 4.1 Socio-economic characteristics of respondents**

Variable	Frequency	Percentage (%)
<b>Gender</b>		
Female	171	57
Male	129	43
<b>Marital Status</b>		
Divorced	10	3.33
Married	140	46.67
Single	127	42.33
Widowed	23	7.67
<b>Religion</b>		
Christianity	274	91.33
Islam	14	4.67
Traditionalist	10	3.33
No religion	2	0.67
<b>Ethnic background</b>		
Akan	229	76.33
Ewe	24	8.00
Ga Dangme	21	7.00
Mole Dagbon	7	2.33
Other	19	6.33
<b>Occupation</b>		
Agriculture/farming	14	4.67
Government/Public	16	5.33
Private Sector	20	6.67
Others	1	0.33
Education	21	7.00
Student	23	7.67
Trader	127	42.33
Transport/logistics	15	5.00
Unemployed	5	1.67
Self employed	58	19.33
<b>Monthly Income:</b>		
< GHS 800	59	19.67
GHS 801-1500	94	31.33
GHS 1600-3000	114	38.00
> GHS 3100	33	11.00
<b>Education</b>		
Primary school	18	6.00
JHS/middle school	88	29.33
Voc./Technical/SHS	86	28.67
Tertiary	91	30.33
No formal education	17	5.67
<b>Age</b>		
<b>Minimum</b>	<b>Maximum</b>	<b>Mean</b>
19	69	38

This prominent role in the local markets may provide them with better access to bushmeat for both purchase and consumption. This gender dimension of bushmeat consumption also opens up important conversations for public health interventions, as women who handle and process bushmeat are potentially more exposed to zoonotic risks and play a crucial role in household food decisions. This warrants deeper investigation in future studies on gendered food safety and conservation behavior (Wilkie *et al.*, 2005).

Approximately 47% of the consumers interviewed were married while 42.33% were still single at the time of the interview. About 3% and 8% of the consumers were divorced and separated respectively. Married individuals often have families to support, and bushmeat might be a significant source of protein and nutrition for their households. Also, married people might have different economic responsibilities and might turn to bushmeat as a more affordable or accessible food source compared to other meats. Similarly, in a study conducted in Kayseri province (Central Turkey), it was found that 79.2% of the respondents were married and consumed more fish compared to unmarried individuals (Deniz *et al.*, 2020).

Analysis from the study indicated that the ages of consumers who consume bushmeat ranges from 18 years to 68 years (Table 4.1). The findings further revealed that the average age for the respondents is 38 years old. This is an indication that bushmeat consumers are economically active. The economically active group refers to individuals who are currently working or actively seeking work. Similar to a study carried out in South Africa, where university students in the Eastern Cape Province of South Africa, particularly males aged 18 to 38 years, consumed meat above the recommended daily intake, showcasing age-related consumption habits among this demographic (Florence *et al.*, 2023). Also, a study focusing on understanding how consumers in Nakuru town, Kenya utilizes nutrition information when purchasing processed meat products showed that

consumers aged 29-39 years were the primary age group purchasing processed meat products in Nakuru town, Kenya (Ndiema, 2017).

Most consumers (91.33%) interviewed were Christians. Within this group, there is a diversity of views on bushmeat consumption. Some Christians may consume bushmeat as part of their cultural heritage and dietary habits. On the contrary, studies in sub-Saharan Africa showed that a significant portion of Christians do not consume bushmeat, with 62.2% of men and 72.1% of women across various cities stating they would never eat bushmeat (Luiselli, *et al.*, 2020). These findings highlight the diverse attitudes towards bushmeat consumption among Christians in different cultural and geographical contexts. In Ghana, for example, certain predominantly Christian communities have traditional taboos against eating specific wild animals while accepting others (Bannor *et al.*, 2022). Elsewhere, some Christians cite health or conservation concerns as reasons to avoid bushmeat entirely. Thus, even within the Christian faith, factors such as local culture, education, and personal beliefs create a wide spectrum of attitudes toward bushmeat consumption. A very small fraction of consumers identified as Muslims with 4.67%. This low percentage is likely because of Islamic halal dietary restrictions: many Muslims require animals to be slaughtered in a prescribed manner, which is not the case for most bushmeat hunting. Indeed, study conducted in Democratic Republic of Congo showed that 29.2% of the sample size refuse to consume bushmeat due to religious beliefs (Tshikung *et al.*, 2019).

Regarding the ethnic background of respondents, the majority (76%) were Akans. This high percentage indicates a strong preference for bushmeat within the Akan community, which is one of the largest ethnic groups in Ghana. The cultural significance and traditional culinary practices of the Akan's likely contribute to their predominant consumption of bushmeat. Similarly, a study by Mingle *et al.* (2021) revealed that among the participants, 55% were of Akan descent, indicating

that the Akan ethnicity accounts for a significant portion of the population. About 8% of the respondents were Ewes and 7% were Ga Dangme. The relatively lower share of Ewe and Ga consumers in our survey could be due to the specific market locations and sampling method, indicating a potential selection bias in the sample. ., Notably, an earlier study revealed that the Ga ethnic group in Ghana predominantly consume chicken as their choice of animal protein, with 45.2% patronage, according to the research conducted in Accra (Nkegbe *et al.*, 2013). The Mole-Dagbon ethnic group made up 2.33% of the participants, while 6.33% belonged to other ethnic groups such as Efutu and Yoruba. This demonstrates that bushmeat consumption is not confined to the major tribes; even smaller and non-indigenous groups partake, indicating a cross-cultural appeal. Moreover, research has found no significant ethnic differences in bushmeat consumption for certain species – for example, pangolin meat consumption did not vary by ethnicity in Ghana, a result attributed to food acculturation (shared food habits) across ethnic groups (Boakye, 2018). The majority of the bushmeat consumers (42%) were traders with 19.33% of consumers being self-employed, 7% were students, 7% were in the education sector, 5.33% were in the private sector, 5% were in the government/public sector, 4.67% were in transport/logistics, and 0.33% were in agriculture/farming. Only 1.67% of consumers were unemployed or retired. This significant proportion of traders suggests that those engaged in daily market activities might find bushmeat to be a convenient and accessible source of protein. Similarly, 19.33% of self-employed individuals likely include small business owners and artisans who may prefer bushmeat as a cost-effective protein source. The diverse range of occupations among bushmeat consumers highlights the broad appeal to consumers with different occupational backgrounds. In a study carried out in South Africa, majority of the respondents in the consumer research study were engaged in small-scale businesses, with self-employment through sales of prepared foods being a primary income

source (Maliwichi *et al.*, 2008). The low percentage of unemployed or retired consumers suggests that bushmeat consumption is more prevalent among the working population, possibly due to their purchasing power and the need for convenient protein sources.

As shown in Table 4.1, the majority portion, 38%, of the respondents earn a monthly income between GHS 1,600 to GHS 3,000. This group represents a significant portion, indicating a substantial middle-income segment among the consumers. This is followed by consumers who earn between GHS 801 to GHS 1500 which makes up about 30 % of consumers interviewed. This suggests a considerably lower-middle-income group, which is nearly one-third of the total respondents. Also, 19.67% of the consumers earn a monthly income less than GHS 800. This highlights a notable low-income segment, which could be a focus for targeted interventions or support programs related to bushmeat consumption. Also, this group's consumption patterns might be influenced by traditional practices or the availability of bushmeat. Lastly, 11% of consumers earn above GHS 3,000. This smaller, higher-income group represents a relatively affluent segment of the bushmeat consumer base.

The educational background of the respondents varied, with 6% having completed primary school, 29.33% having junior high or middle school education, 28.67% having vocational, senior high, or technical education, 30.33% having tertiary education, and 5.67% having no formal education. The results showed that majority of the consumers interviewed for this study had at least a tertiary, junior high or middle school education. Tertiary education had the highest with 30.33% of the respondents interviewed having received or currently in tertiary institutions. These findings are consistent with consumer research which focused on processed meat products where the majority, specifically, 92.6% of the consumers had education above secondary level (Ndiema,2017). Individuals with tertiary education are likely to have a higher capacity for understanding complex

information, including scientific data and health advisories. They can critically evaluate the benefits and risks associated with bushmeat consumption and are more likely to appreciate the nuances of biodiversity conservation. Similarly, to a study carried out in Nigeria, more than 50% of educated respondents, particularly those under 35 years old with at least secondary school education, consume bushmeat in their daily diet in Ikorodu (Ogungbile, 2023). The second highest was JHS/middle school with 29.33% and vocation/technical school being 28.67%. Moreover, 6% of the consumers interviewed had attained the primary/basic level of education and only 5.67% of the respondents had no formal education. This is the smallest group, and they may face challenges with literacy. For them, oral communication, visual aids, and community-based education programs would be more appropriate when comes to promoting awareness campaigns and education on bushmeat sustainable consumption.

Moreover, while this study presents strong descriptive evidence on socio-economic factors, a limitation lies in the absence of qualitative insights to fully unpack the influence of cultural norms and beliefs on bushmeat consumption. Future studies may consider mixed-method approaches to examine how deep-seated traditions, spiritual beliefs, or household food priorities shape decisions beyond what can be captured in structured questionnaires. The significant presence of female consumers also raises relevant questions about their potential exposure to zoonotic disease risks, given their involvement in both handling and consumption of bushmeat. Future research could explore their awareness of such risks and the informal hygiene practices adopted at market or household levels. This is especially important in the post-pandemic context, where women's roles as food providers could influence not only family dietary patterns but also exposure to food safety hazards.

### 4.3 Diversity of bushmeat consumed post-COVID-19

The socio-economic profiles of respondents do not only shape their dietary preferences but also inform the diversity and type of bushmeat consumed. For instance, traders and middle-income earners, who formed a significant portion of the sample, may have both the market access and purchasing power that influence their ability to choose between bushmeat types. Similarly, cultural traditions within dominant ethnic groups like the Akan may explain their broader acceptance of diverse species, such as the Ahanta francolin or Maxwell duiker. This socio-demographic backdrop directly enriches our understanding of bushmeat categorization and consumption patterns.

As shown in Figure 4.1, the grasscutter, a terrestrial game animal, is the most consumed type of bushmeat, with a total of 258 consumers across the Greater Accra, Ashanti, and Bono-East regions. The grasscutter, also known as the greater cane rat, is locally referred to by respondents as “*Akrantie*” in Akan. This finding is consistent with previous research by Teye *et al.* (2020), which indicated that grasscutter meat, a popular game meat in Ghana, is widely consumed. Some consumers express a preference for wild grasscutter meat over farmed ones, citing better flavor, tenderness, and lower fat content. The second most consumed bushmeat type in the terrestrial game animal category was the rat, with 167 consumers across the three regions. The rat is locally known as “*Kusie*” in the Akan language. In a study conducted in the Ashanti region, Cudjoe *et al.* (2024) found that consumers prefer wild rat meat due to its tenderness and leaner composition compared to farmed rats, despite safety concerns associated with wild meat consumption. Rat meat consumption is influenced by various factors, including cultural preferences, availability, and economic considerations. In many parts of Ghana, rat meat is considered a delicacy and is often consumed during special occasions and festivals. In the aerial category, 21 consumers reported consuming bats, known locally in Akan as “*Ampan*,” while 65 consumers reported consuming the

Ahanta francolin, referred to as “*Akokohwede*3.” Studies have shown that the consumption of bat bushmeat is prevalent across various regions and ethnic groups in Ghana, with specific tribes being associated with its consumption (Kamins *et al.*, 2014). The Akan ethnic group, including the Bonos in Ghana, are associated with the consumption of bats, influenced by socio-cultural factors like gender, religious beliefs, and hunting practices (Ohemeng *et al.*, 2017).

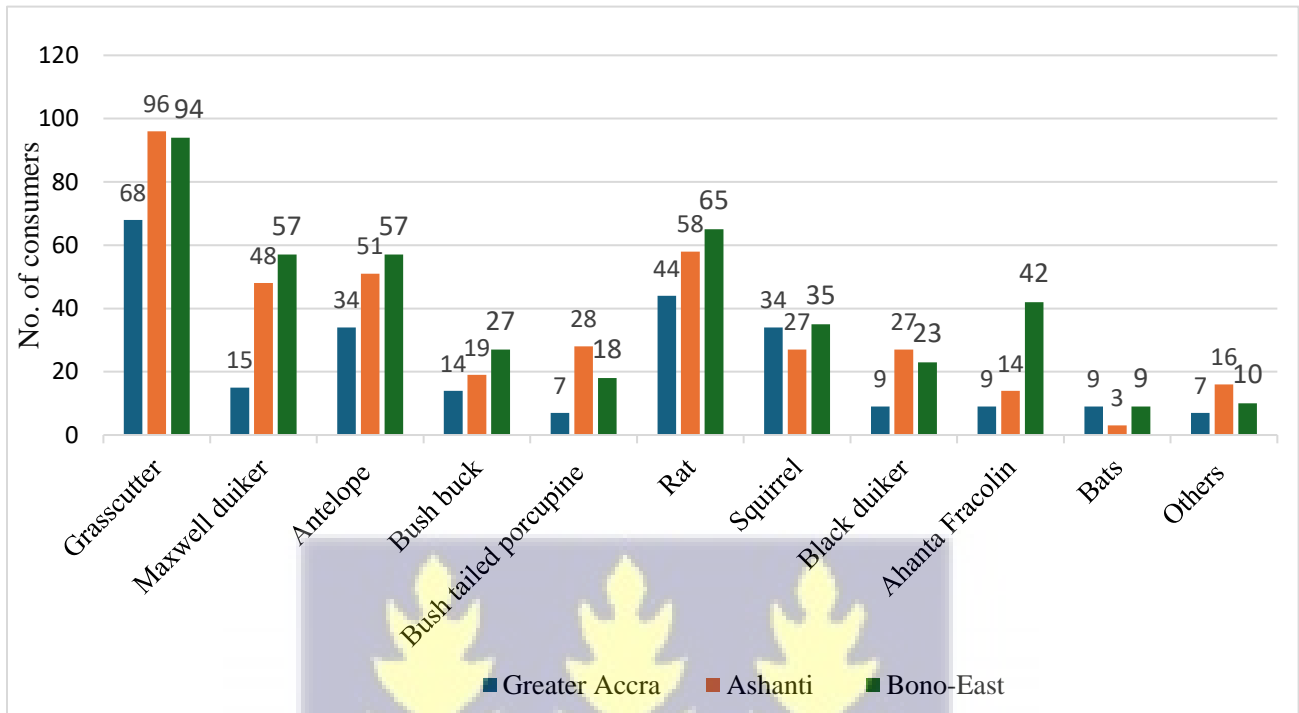
For arboreal animals, the monkey and sloth had four and three consumers, respectively, across the three regions and were captured as part of the “others” as illustrated in Figure 4.1.

The local names of the various bushmeat, as illustrated in Figure 4.1, include Maxwell duiker (*ɔtwe*), antelope (*Adowa*), bushbuck (*ɔwansane*), black duiker (*Owio*), squirrel (*Opuro*), brush-tailed porcupine (*Apese*), bushpig, and hippopotamus (*Susono*).

According to Mandiwana-Neudani *et al.* (2018), the Ahanta Spurfowl is a medium-sized bird, with males weighing around 608 grams and females about 487 grams. It features an orange bill with a black base and yellow-orange legs. Males have one to two spurs on their legs, with the lower spur being longer.

The Ahanta francolin is a preferred bushmeat in Ghana, providing animal protein and income for rural communities, reflecting the significance of wildlife in local culture and economy (Azumah *et al.*, 2002). The study also offers a valuable lens into the consumption of less common species such as monkeys and sloths. Although reported by fewer respondents, the inclusion of arboreal and aerial species raises serious conservation concerns. These animals often have slower reproduction rates and face higher extinction risks due to habitat loss. Their presence in the consumer market, even at lower frequencies, may signal unsustainable hunting practices that require urgent attention.

**Figure 4.1 Diversity of bushmeat consumed**



Source: Own Survey data, 2024

Moreover, some of these species, particularly bats and primates, are known reservoirs of zoonotic pathogens (Kamins *et al.*, 2014). This underscores the importance of viewing bushmeat consumption not just as a dietary or cultural issue but also through the lenses of public health and biodiversity policy. These insights position the study to contribute not only to Ghanaian food security discussions but also to broader global debates on pandemic preparedness, One Health approaches, and sustainable wildlife management. Comparing our post-pandemic data with historical patterns, the types of bushmeat preferred appear largely unchanged.

Even before COVID-19, grasscutter was documented as the most popular bushmeat in Ghana – for instance, it accounted for roughly 73% of bushmeat sold in certain markets (Kuukyi *et al.*,

2014) and our results confirm its continued dominance. Rodents and small antelopes (duikers) were staple bushmeat species pre-pandemic and remain so in our findings.

There may have been short-term changes during the height of COVID-19 (similar to how bushmeat consumption decreased considerably during the West African Ebola crisis (Funk *et al.*, 2021), one might expect consumers to temporarily avoid high-risk species like bats early in the pandemic), however, the post COVID-19 data suggest a return to usual habits. Even species that could have been shunned due to disease fears (e.g., bats) are still being consumed by some respondents (21 people in our sample), indicating that any pandemic-induced shifts in preference were likely temporary.

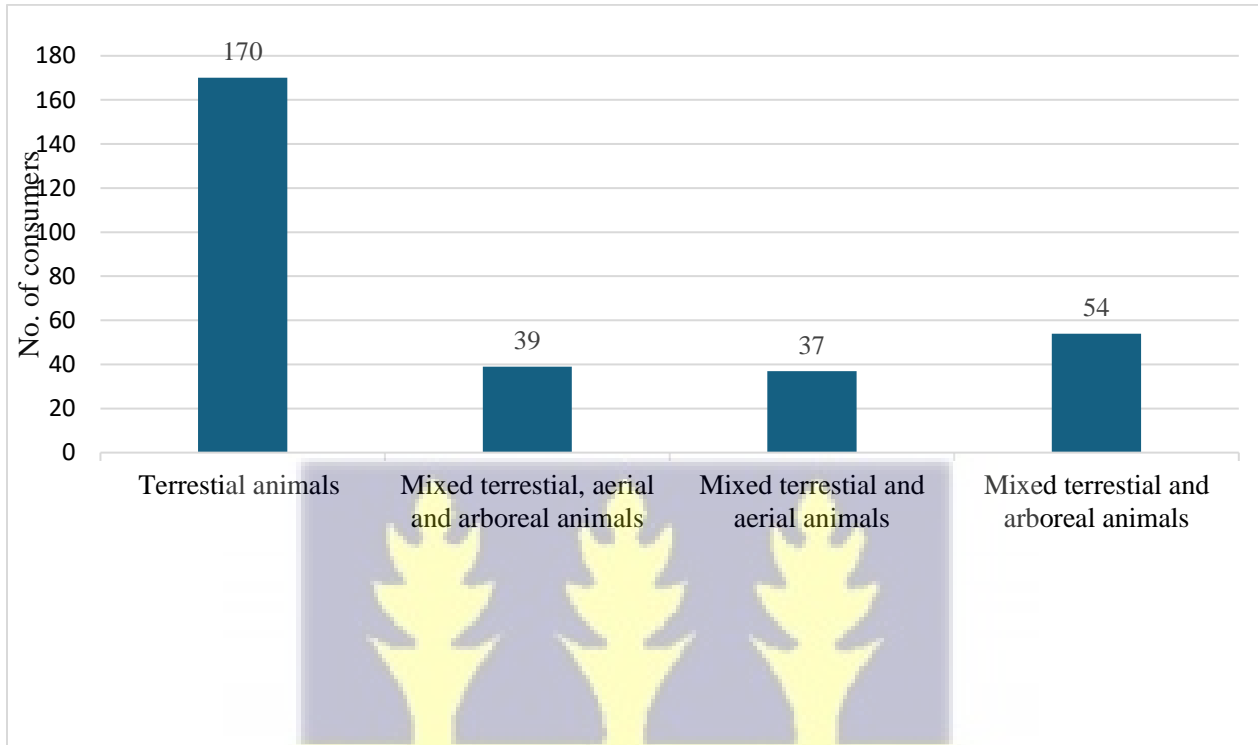
#### **4.3.1. Categorization of game animals**

The categorization of game animals is based on their primary habitat and behavior. These categorizations were employed because it best fits the diverse bushmeat consumed in the three regions. These categories include terrestrial animals, arboreal animals, and aerial animals.

The categorization was developed based on the preferences of 300 consumers interviewed. These consumers were broken down into four groups: terrestrial animals only (170 consumers), mixed terrestrial, aerial, and arboreal animals (37 consumers), mixed terrestrial and aerial animals (39 consumers), and mixed terrestrial and arboreal animals (54 consumers), as illustrated in Figure 4.2.

This categorization not only aids in understanding the ecological niches these animals occupy but also provides a structured approach for statistical analysis, enhancing the study's ability to identify significant trends and relationships.

**Figure 4.2 Categorization of game animals**



#### 4.4. Multinomial logistic regression model estimates

The MNL outcome revealed that income, region, gender, health risk and price of bushmeat are the significant variables that influence the consumers for a bushmeat type. Age, formal education, household size and preference for alternative protein are some variables that were not significant in the model. However, the discussion in this section is based on explanatory variables that were found significant.

Income was categorized into four groups: less than GHS 800, GHS 801 to GHS 1500, GHS 1501 to GHS 3000, with above GHS 3000 serving as the base outcome. The results show that consumers

who earn GHS 801- GHS 1500 had a positive marginal effect (0.108) associated with the preference for mixed terrestrial, aerial and arboreal animals at 5% significant level.

**Table 4.2 Multinomial logistic regression estimates**

Variable	Base outcome: Mixed terrestrial and arboreal					
	Terrestrial animals only		Mixed terrestrial, aerial & arboreal animals		Mixed terrestrial and aerial animals	
	Marginal effects	P> t	Marginal effects	P> t	Marginal effects	P> t
Age	-0.001	0.864	0.002	0.109	0.0007	0.699
Income						
<GHS 800	0.036	0.759	0.050	0.286	0.028	0.676
GHS 801-1500	-0.073	0.495	0.108**	0.028	0.030	0.628
GHS1501-3000	-0.142	0.159	0.095**	0.036	0.002	0.976
Region						
Ashanti	0.234***	0.003	0.035	0.477	-0.145***	0.009
Bono-East	-0.199**	0.024	0.175***	0.001	0.083*	0.065
Gender	-0.122*	0.053	0.068*	0.057	0.034	0.337
Formal education	0.008	0.300	-0.048	0.917	-0.002	0.674
Household size	-0.007	0.607	-0.005	0.504	-0.002	0.748
Health risk	0.086**	0.016	-0.053**	0.012	-0.0107	0.596
Pref. for altern. over bushmeat	0.010	0.689	-0.021	0.179	-0.016	0.308
Price of bushmeat	-0.022	0.448	0.037**	0.022	-0.013	0.440

\*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; \*  $p < 0.1$

This implies that consumers who earn GHS 801- GHS 1500 have a higher likelihood for the preference for mixed terrestrial, aerial and arboreal animals. Similarly, consumers who earn GHS 1501- GHS 3000 had a positive marginal effect (0.095) association with preference for mixed terrestrial, aerial and arboreal animals at 5% significant level. This means that consumers who earn GHS 1501- GHS 3,000 have a higher likelihood for the preference for mixed terrestrial, aerial and arboreal animals by 0.095 as compared to mixed terrestrial and arboreal animals. This suggests

that middle class consumers may have more disposable income to spend on a variety of bushmeat compared to low-income earners who might prioritize affordable protein options.

As indicated in Table 4.2, for the terrestrial animal, the marginal effect for consumer in Ashanti region was 0.175 with a significant level at 1%, signifying a positive influence for the preference of terrestrial animals. This suggests that consumers in Ashanti region have a higher likelihood for the preference for terrestrial animals only by 0.175 as compared to mixed terrestrial and arboreal animals. The strong preference for terrestrial animals in Ashanti region could be attributed to traditional hunting practices and the availability of terrestrial animals in the region. However, being in the Ashanti region is negative and significantly associated with the preference for mixed terrestrial and aerial animals. This means that consumers in Ashanti region have a lower likelihood of preferring combination of terrestrial and aerial animals by 0.145. The aversion to combinations involving aerial animals might reflect a cultural preference or a lack of familiarity with these types of bushmeat. Furthermore, the results show that consumers in the Bono-East region have a lower likelihood of preferring terrestrial animals only by 0.199 and at 5% significant level compared to the mixed terrestrial and arboreal animals. However, consumers in the Bono East region showed a positive and significant association with mixed terrestrial, aerial, and arboreal animals (0.175 at a 1% significance level) and mixed terrestrial and aerial animals (0.085 at a 10% significance level). This means that being in Bono-East region increases the likelihood of preferring mixed terrestrial, aerial animals & arboreal animals and terrestrial and aerial animals by 0.175 and 0.085 respectively compared to mixed terrestrial and arboreal animals. This could be due to the region's ecological diversity, which supports a variety of wildlife, or cultural practices that encourage the consumption of different types of bushmeat.

Gender had a negative marginal effect of -0.122, significant at the 10% level, for preferring terrestrial animals only. This indicates that being male decreases the likelihood of preferring terrestrial animals only by 0.122 compared to the base outcome of mixed terrestrial and arboreal animals. Conversely, gender is positively and significantly associated with the preference for mixed terrestrial, aerial, and arboreal animals, with a marginal effect of 0.068. This suggests that being male increases the likelihood of preferring a mix of terrestrial, aerial, and arboreal animals by 0.068 compared to the base outcome. These findings align with existing literature on gender differences in preferences and risk perception. Studies, such as those by Zelezny, *et al.* (2000), have shown that women tend to exhibit higher levels of environmental concern and are more likely to engage in pro-environmental behaviors. This heightened awareness and empathy might explain their preference for terrestrial animals only, which they may perceive as a more sustainable and ethical choice. On the other hand, men may be more inclined towards a diverse mix of animals due to their generally higher tolerance for risk and novelty, as supported by the findings of Byrnes *et al.* (1999).

From Table 4.2, health risk perception of bushmeat had a positive marginal effect of 0.086 at 5% significant level for terrestrial animals only compared to mixed terrestrial and arboreal animals. This implies that consumers perceiving high health risk associated with bushmeat consumption increases the likelihood of preferring terrestrial animals only by 0.086 compared to mixed terrestrial and arboreal animals. However, health risk perception had a negative marginal effect (-0.053) and significant at 5% for mixed terrestrial, aerial and arboreal animals compared to mixed terrestrial and arboreal animals. This means that consumers perceive health risk to be high decreases the likelihood of preferring mixed terrestrial, aerial and arboreal animals by 0.053 compared to the base outcome.

Also, the price of bushmeat had a positive marginal effect (0.037) and significant at 5%. This means that consumers perceiving price of bushmeat to be high increases the likelihood of preferring mixed terrestrial, aerial and arboreal animals by 0.037 compared to the base outcome, mixed terrestrial and arboreal animals. In contrast, a study, conducted in Gabon found that as the price of wildlife increased, the consumption of bushmeat declined, while the consumption of fish rose, indicating a substitution effect (Wilkie *et al.*, 2005). Similarly, a study in the Tarangire-Manyara ecosystem in Northern Tanzania revealed that the relatively low price of bushmeat compared to domestic meat drove widespread consumption, with little influence from alternative protein sources or relative wealth (Kiffner *et al.*, 2015). These pre-pandemic patterns contrast with our finding of a positive association between price and the preference for a mixed variety of bushmeat. One possible explanation is that in the post COVID-19 period, only more affluent or determined consumers (who are less price-sensitive) continued to purchase a wide range of bushmeat despite rising prices, thereby showing a positive correlation in that category. For most other consumers, higher bushmeat costs likely still act as a deterrent, indeed, our model's price coefficients for the "terrestrial only" and "terrestrial + aerial" groups were negative (though not significant), indicating a tendency toward reduced consumption, consistent with earlier studies. In essence, while raising bushmeat prices tends to suppress overall demand (Ziegler *et al.*, 2010)

The results also open discussions about the sustainability of current bushmeat consumption patterns. For instance, consumers with higher income levels may have increased access to a wider variety of bushmeat species, some of which may be more ecologically vulnerable. While this study did not directly assess species-specific conservation status, future research could benefit from incorporating biodiversity monitoring tools or collaborating with ecological experts to map consumer preferences onto conservation priorities. Furthermore, although health risk perceptions

were explored as predictors, this study did not measure actual knowledge accuracy or risk awareness depth. Future work could investigate the gap between perceived and actual zoonotic risk knowledge, especially in the post-COVID-19 landscape. Such data could inform more targeted public health campaigns.

#### **4.5 Exploratory factor analysis of the pillars of food security**

The findings of specific factors under the major constructs and some socioeconomic variables on food security using the SEM are presented in Table 4.3. However, the discussion was based on Table 4.4.

The control factors used in the model are region, ethnic group and gender. For the availability pillar the factors used were bushmeat availability, variety and its quantity. For accessibility pillar high price of bushmeat and income constraints were used. For the utilization pillar, the factors used were health and safety complaint and tasty and nutritious were used. Choice empowerment and community advocacy were used for the agency pillar. For the Stability pillar, the factors were impact of illegal hunting and economic instability. Lastly, the sustainability pillar, bushmeat taste distortion and increase in public health concerns and risks.

##### **4.5.1 Control variables**

The analysis of regional differences in bushmeat food security, as shown in Table 4.4, reveals significant variations across the Greater Accra, Bono, and Ashanti regions. In the Greater Accra Region, the coefficient of 0.113 at a 1% significance level indicates a positive and significant relationship between bushmeat consumption and food security compared to the Ashanti Region.

This suggests that in Greater Accra, the consumption of bushmeat contribute more positively to food security than in Ashanti. The region's urban setting may provide better access to bushmeat

markets, ensuring a steady supply and variety of bushmeat, which supports dietary diversity and nutritional intake.

**Table 4.3 Factor analysis results**

<b>Statements</b>	<b>Mean</b>	<b>Factor loadings</b>	<b>Alpha</b>
<b>Availability</b>			0.6946
Bushmeat quantity	3.96	0.7164	
Bushmeat variety	3.83	0.6800	
<b>Utilization</b>			0.9421
Tasty	3.41	0.6221	
Health issues	3.71	0.6745	
<b>Accessibility</b>			0.9755
High price of bushmeat	2.81	0.9409	
Income	2.82	0.9362	
<b>Agency</b>			0.9976
Access to information	3.23	0.9698	
Community advocacy	3.24	0.9713	
<b>Stability</b>			0.7922
Economic Instability	2.90	0.6293	
Effect of hunting	2.94	0.7309	
<b>Sustainability</b>			0.6860
Bushmeat taste distortion	2.89	0.6556	
Increase in public concerns health risks	3.03	0.6294	
<hr/>			
Bartlett test of sphericity			
Chi-square =	7207.073		
Degrees of freedom =	406		
p-value =	0.000		
H0: variables are not intercorrelated			

*Kaiser-Meyer-Olkin Test for sampling adequacy = 0.650*

Conversely, in the Bono-East Region, the coefficient of -0.074 at a 1% significance level indicates a negative and significant relationship between bushmeat consumption and food security compared to the Ashanti Region. This suggests that in Bono-East, bushmeat consumption contributes

negatively to food security. One reason for this could be the prevalence of traditional farming practices in the region, leading to less reliance on bushmeat as a staple food.

**Table 4.4. The Structural equation model results.**

<b>Constructs and indicators</b>	<b>Coefficient</b>	<b>P values</b>
<b>Socioeconomic Characteristics- Control Factors</b>		
Region		
Ashanti Region	0.113***	0.000
Bono-East	-0.074***	0.000
Gender	-0.008	0.472
<b>Availability</b>		
Bushmeat quantity	0.137***	0.001
Bushmeat variety	0.138***	0.001
<b>Utilization</b>		
Taste	0.158***	0.000
Nutrition	0.108***	0.001
<b>Accessibility</b>		
High price of bushmeat	-0.068***	0.009
Income	-0.067**	0.012
<b>Agency</b>		
Access to information	-0.047*	0.080
Community advocacy	-0.049*	0.070
<b>Stability</b>		
Effect of illegal hunting	-0.113***	0.002
Economic instability	-0.189***	0.000
<b>Sustainability</b>		
Bushmeat taste distortion	-0.159***	0.000
Increase in public health concerns and risks	-0.191***	0.000

\*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; \*  $p < 0.1$

Additionally, the Bono-East region may face issues such as deforestation and habitat loss, reducing the availability of wildlife and thus bushmeat. Moreover, the economic conditions in Bono-East may result in lower average incomes among consumers. This lower income may have limited their ability to afford bushmeat, leading to reduced consumption. The high price of bushmeat relative to other protein sources may further exacerbate this issue, making it less accessible to the local population.

#### **4.5.2 Availability**

From Table 4.4, the positive coefficient (0.137) for bushmeat quantity suggests a significant positive influence on food security, statistically significant at the 1% level. This indicates that easy access to bushmeat plays an important role in ensuring that households can consistently obtain a vital source of protein. In the aftermath of COVID-19, many supply chains were disrupted, affecting the availability of various food items. During this period, the quantity of bushmeat available has been particularly beneficial.

It has helped families maintain their nutritional standards by providing a reliable source of protein. This is especially important in times of uncertainty, where traditional food supply chains may be less dependable. The consistent availability of bushmeat ensures that households have access to necessary nutrients, which supports overall health and well-being. These results corroborate the findings of Fa *et al.* (2019), who reported that bushmeat is readily available for consumption in Central African cities, with approximately 22% of markets and 24% of restaurants selling it. Similarly, our findings are consistent with those of Kiffner *et al.* (2015), who observed that bushmeat is readily available in the Tarangire-Manyara ecosystem in Tanzania, where its widespread consumption is driven by its low cost and availability. This finding underscores the

importance of bushmeat as a component of food security, particularly in regions where other sources of protein may be less accessible or more expensive.

The data in Table 4.4 indicates a positive (0.138) and significant (1%) relationship between the variety of bushmeat and food security. This highlights the importance of diversity in enhancing the availability aspect of food security. Different types of bushmeat bring a range of nutrients and flavors to the table, which can make diets more balanced and enjoyable. This diversity helps households meet their nutritional needs more effectively, ensuring that they get a mix of essential vitamins and minerals. The perception of bushmeat variety among consumers has a profound impact on food security, as it influences their ability to access a diverse range of protein sources. A diverse diet is essential for ensuring proper nutrition, as different species and cuts of meat provide a broad range of essential nutrients. By having access to various bushmeat species, consumers can enjoy a balanced diet, reducing their reliance on a single food source. This diversification of protein sources reduces the risk of nutrient deficiencies, improving overall health and well-being. This finding aligns with the work of Van Vliet *et al.* (2012), who noted that the variety of bushmeat, including rodents, ungulates, and monkeys, provides diverse protein sources. This contributes significantly to food security for urban populations unable to afford alternative proteins. Moreover, opting for bushmeat variety reduces pressure on individual species, promoting conservation. By having a variety of options, consumers reduce their reliance on specific species, alleviating pressure on those populations. This reduced pressure allows species to replenish and maintain healthy populations, ensuring their long-term survival. Dindé *et al.* (2017) indicated that in Cote d'Ivoire, the variety of bushmeat contributes to food security in rural areas, but the Ebola-related ban led to reduced consumption, with fish and edible mushrooms filling the protein gap.

This consistent availability of variety of bushmeat ensures alternative sources of stable source of nutrition, thereby making a positive contribution to food security.

#### 4.5.3 Utilization

The results show that the taste of bushmeat has a very strong positive effect on the utilization of food security at 1% significant level (Table 4.4). If bushmeat is tasty, people are more likely to eat it regularly, which helps them get the nutrition they need. The natural foraging habits of wild animals enhance the meat's flavor, as they consume a diverse range of plants and fruits (Trefon, 2023). Also, the grasscutter (*Thryonomys swinderianus*) is noted for its high protein content and favorable organoleptic properties, particularly when processed through methods like oven drying (Adebowale *et al.*, 2024). This result is consistent with a previous study by Barrett & Lentz (2015), who found that despite bushmeat being illegal in Cameroon and expensive, bushmeat, including sought-after species like pangolins, remains popular due to its great taste and health associations. Similarly, research in the city of Lubumbashi in the Democratic Republic of Congo highlighted that 86.6% of the population consumed bushmeat monthly, with taste being a significant motivator for consumption (Tshikung *et al.*, 2019).

The coefficient for nutrition, which was 0.108 and significant at 1%, indicates a strong positive influence on food security for bushmeat. This suggests that consumers perceive bushmeat as a nutritious food source, which in turn positively influences food security. In line with previous studies, our findings suggest that the perceived nutritional value of bushmeat enhancing food security. For instance, Sarti *et al.* (2013), noted that consumers believe bushmeat is nutritious due to its significant contribution to essential nutrients such as protein, iron, and zinc, and are they are more likely to include it in their diet, thereby improving overall food security. Similarly, Fargeot *et al.* (2017) found that bushmeat remains a significant protein source, especially among poorer

households, despite the availability of alternative meats. Contrary to some earlier research, which may have downplayed the role of bushmeat nutrition in food security, such as Van Velden *et al.* (2020) who noted that consumers include bushmeat in their diet for taste and diet diversity, not primarily for nutrition. However, our results highlight its importance as a source of nutrition. This aligns with the growing body of literature emphasizing the multifaceted benefits of nutrition, not just for individual health but also for broader food security.

#### **4.5.4 Accessibility**

The results from Table 4.4 show that income constraints have a negative effect (-0.067) on the accessibility component of food security (coefficient -0.067,  $p < 0.05$ ). In other words, respondents who feel their income is low also feel that limits how much bushmeat they can access or consume. This significant effect of income constraint on bushmeat consumption highlights the importance of considering economic factors in understanding consumer behavior and decision-making related to bushmeat. In recent times, the income levels of African countries have been adversely affected following the COVID-19 pandemic. Declines have been noted due to lost productivity, reduced GDP levels, and other economic challenges (Moyo and Tashu, 2023). This economic hardship is reflected in the findings, underscoring the significant influence of income constraints on bushmeat consumption among consumers in Ghana. This finding is consistent with a previous study undertaken in rural Gabon, where household income was a significant factor influencing bushmeat consumption. Wealthier households consumed more bushmeat, highlighting income's influence on consumption patterns (Foerster *et al.*, 2012). Another study demonstrated that high income levels were associated with both frequent bushmeat consumption and support for biodiversity loss countermeasures among Vietnamese urban residents, indicating income's significant impact on bushmeat consumption behaviors (Nguyen and Jones, 2022). The findings also underscore the

need for further research into the complex relationships between income, food security, and conservation in the context of bushmeat consumption in Ghana.

The analysis revealed a negative coefficient of -0.068 ( $p < 0.01$ ) for the price of bushmeat, indicating that higher perceived prices significantly reduce its contribution to food security. If bushmeat becomes too expensive, consumers will buy and eat less of it, negatively affecting how it contributes to their diet. This aligns with basic economic theory and is supported by empirical studies. Rentsch and Damon (2013) showed that in Tanzania, increasing prices led to a notable drop in bushmeat consumption (people either ate less or switched to other meats), which mirrors our finding. Similarly, Sirén and Wilkie (2016) noted that consumers are price-sensitive with bushmeat: when it gets pricier, they cut back. During COVID-19, many countries experienced food price inflation, and Ghana was no exception – most people saw higher prices for all food groups during the pandemic (Ismail *et al.*, 2023; Kunyanga *et al.*, 2023). These disruptions led to reduced food diversity and altered consumption behaviors as households coped with price hikes. Price is a critical factor in food choice experiments (Köster, 2009) and our results confirm that for bushmeat, high prices are a barrier. In summary, if bushmeat is too costly, it becomes less accessible and thus contributes less to food security. This suggests that economic interventions (like controlling inflation or providing cheaper farmed bushmeat alternatives) could improve food security.

#### **4.5.5 Agency**

From Table 4.4, the negative coefficient (-0.047) for access to information suggests a negative influence on the agency component of food security and this influence is statistically significant at 10%. This indicates that consumers' ability to make informed decisions about bushmeat consumption is compromised by inaccurate or misleading information. Consequently, the

consumption of bushmeat, significantly influenced by the information available to local communities, can lead to negative outcomes for public health and wildlife conservation. In agreement with Dell *et al.* (2021), misidentification of bushmeat species in markets can expose consumers to zoonotic diseases, as they may unknowingly purchase high-risk species. While misinformation can negatively affect bushmeat consumption by misleading consumers, targeted education and awareness initiatives hold the potential to empower consumers, thereby enhancing their agency in making informed food choices.

As indicated in Table 4.4, community advocacy had a negative coefficient (-0.049) at a 10% significant level. This implies that advocacy that focuses sternly on conservation of game animals will lead to stricter regulations which will reduce hunting activities, influencing consumers food security for bushmeat negatively. Furthermore, health campaigns highlighting health risks might create fear and reduce reliance on bushmeat. Our results extend the conclusion of Kouassi *et al.*, (2017) where awareness campaigns have shown to effectively reduce bushmeat consumption; for instance, multimedia interventions led to a 62% decrease in consumption among rural households in Côte d'Ivoire. However, the effectiveness of such interventions can be limited by low audience engagement, as seen in a Tanzanian study where a radio show failed to significantly impact bushmeat demand due to poor listener penetration (Veríssimo *et al.*, 2018).

#### **4.5.6 Stability**

Stability refers to the consistency of food supply and access over time. The study found that economic instability has a significant negative influence on bushmeat food security (coefficient - 0.189,  $p < 0.01$ ). This indicates that fluctuations in the economy – such as job losses, inflation, or other shocks (like those experienced during and after COVID-19) – can severely undermine the ability of households to obtain bushmeat consistently throughout the year. During periods of

economic instability, household incomes fall and purchasing power is reduced, making it harder to afford items like bushmeat (which might be considered a non-essential or luxury protein when money is tight). Many households are still recovering from the economic shocks of the pandemic (Mahmud & Riley, 2023). For instance, research shows that households without pre-pandemic businesses have largely recovered incomes to pre-COVID levels, but those with businesses are still earning about one-third less (due to prolonged closures and slow recovery even after lockdowns ended). Such lingering effects mean that even post-pandemic, families may not have the disposable income for bushmeat purchases, jeopardizing the stability of including bushmeat in their diet. The coefficient of -0.113 ( $p < 0.01$ ) for the effect of illegal hunting suggests that increased illegal hunting and trade significantly reduces bushmeat food security. This may seem counterintuitive at first (since more hunting could mean more bushmeat in the short term), but the likely interpretation is that respondents perceive illegal hunting as threatening the long-term availability of bushmeat. If wildlife is being overhunted illegally, people might be noticing declines in certain species or erratic supply, which makes their bushmeat supply less stable over time. In our post-COVID-19 context, it was noted anecdotally that as formal markets were disrupted, some hunting and trading shifted to more clandestine, unregulated practices. These unsustainable practices can rapidly deplete local wildlife. Consumers in our study might be aware that such trends will lead to scarcity of bushmeat in the near future, thus negatively impacting food security stability. Illegal bushmeat trade is known to threaten biodiversity and future yields (Nielsen et al., 2016; Lee *et al.*, 2020). For example, Karesh *et al.* (2009) describe how unregulated hunting can crash wildlife populations, and Gonçalves *et al.* (2019) emphasize that poverty and unemployment can drive people into unlawful hunting, creating a vicious cycle. Our results reinforce that when

respondents consider the effect of illegal hunting, they foresee problems in maintaining a reliable bushmeat supply, hence the negative association with stability.

#### 4.5.7 Sustainability

Under the sustainability construct, the perception of bushmeat taste distortion had a significant negative effect on food security (coefficient -0.159,  $p < 0.01$ ). This refers to the concern that bushmeat obtained from non-wild sources or via certain hunting methods doesn't taste as good as traditional wild bushmeat. Many respondents noted that bushmeat from farmed or domesticated game animals, or animals killed with poison, has an odd or inferior taste. This perceived decline in quality can make people less inclined to consume bushmeat, thereby reducing its contribution to their diet. Domestication of popular game (like grasscutters) has been encouraged to conserve wildlife and ensure a steady supply, but complaints about taste suggest a barrier to fully adopting farmed bushmeat. The difference in diet and activity between wild and farm-raised animals likely affects meat flavor and texture. The COVID-19 pandemic has added another dimension: it disrupted traditional hunting practices and supply chains, possibly increasing reliance on farmed game. However, if farmed bushmeat is seen as less palatable, consumers might not embrace it, threatening both sustainability and food security. Research in southern Benin highlighted poor hygiene in bushmeat production (Ahouanse et al., 2024), which can also affect taste and safety. In Tanzania, Schilling et al. (2020) found significant misidentification of bushmeat species by sellers, which could lead to consumers getting a different meat than expected – potentially influencing satisfaction and perceived taste. These issues align with our findings: when consumers perceive that bushmeat doesn't taste “right” (perhaps due to the use of poison or because it's farmed), they see it as a hit to their food security. Ensuring that farmed bushmeat closely matches the taste of wild game (as recommended by Bannor et al., 2023) will be important for sustainable transitions

These findings underscore the importance of addressing not only health and environmental dimensions but also sensory perceptions like taste when promoting sustainable bushmeat alternatives. However, the current study was limited in exploring which specific species or preparation methods are most vulnerable to taste changes. Future research could combine consumer surveys with product testing to evaluate the acceptability of sustainably farmed bushmeat or protein substitutes.

Additionally, while this study focused on three major regions of Ghana, its findings may not fully capture variations across all ethnic and ecological zones. Future research with broader regional coverage could reveal more diverse consumption drivers and conservation implications.

The increase in public health concerns and perceived risks also showed a negative and significant effect on food security (coefficient -0.191,  $p < 0.01$ ). This suggests that as people become more concerned about the health risks of bushmeat (for example, due to COVID-19 raising awareness of zoonotic diseases), they may reduce their bushmeat consumption, which in turn diminishes bushmeat's role in their food security. Over the next five years and beyond, if health fears remain high, bushmeat could play a smaller part in diets. This is a double-edged sword: on one hand, reduced bushmeat consumption for health reasons can lower exposure to zoonoses; on the other, it removes a protein source that some families rely on. Our findings are consistent with Richards (2015), who found toxic compounds (from poisons) in the oral cavity of poisoned wildlife – meaning consumers of such meat are at risk, and it is often hard to detect poison post-mortem. In other words, if an animal was killed with poison, there may be no obvious sign of it once the meat is dressed; only specific post-mortem tests can reveal these toxins (Richards *et al.*, 2015), making it difficult for consumers to know when meat has been contaminated. A more recent study by Essuman and Duah (2020) found that the use of a poison (carbofuran) to hunt grasscutters can kill

the animal in under 10 hours, which means the carcass could enter the food chain while laced with poison, posing grave health dangers. Such findings have understandably made the public more wary. Therefore, in this post COVID-19 era, there is a crucial need to address health risks associated with bushmeat through sustainable wildlife management practices and improved surveillance to prevent zoonotic spillover events – both to protect public health and to ensure bushmeat can be relied upon as a safe protein source.

#### **4.6 Constraints faced by bushmeat consumers**

Five major constraints faced by respondents in the bushmeat market were identified during the questionnaire pre-testing phase of the study. Respondents ranked the constraints on a scale of 1-5 by assigning 1 to the most severe and 5 to the least severe. The results in Table 4.5 indicate that the three prevailing constraints among the respondents in the Accra, Ashanti and Bono regions are high price of bushmeat, income and health concerns related to zoonotic diseases, distance to bushmeat sales outlet and environmental concerns. Kendall's W is 0.58 (Table 4.5), indicating that there is a 58% level of agreement among the rankers. The model summary showed that the result was significant at 1% with a chi-square value of 693.12.

High price of bushmeat was the most pressing constraints of respondents as shown by the mean rank (1.41) in Table 4.5. The study revealed that market price for bushmeat were dictated by hunters, traders, market demand and supply dynamics and seasonal variations. In this post COVID-19 era, although restrictions have eased, the supply chain has not necessarily returned to pre-pandemic normalcy. Some hunters and traders may have shifted to other livelihoods, during the pandemic and not resumed bushmeat trading, potentially reducing the overall supply of bushmeat. Combined with general inflationary trends after the pandemic, this has kept bushmeat prices elevated.

**Table 4.5 Ranking of constraints faced by bushmeat consumers**

Constraints	Mean Rank	Rank
High price of bushmeat	1.41	1 <sup>st</sup>
Low income	2.24	2 <sup>nd</sup>
Health concerns related to zoonotic diseases	3.35	3 <sup>rd</sup>
Distance from buyer	3.49	4 <sup>th</sup>
Environmental concerns	3.68	5 <sup>th</sup>
N	300	
Kendall's W	0.578	
Chi-Square	693.119	
Df	4	
Asymp. Sig.	0.000***	

In a previous study conducted in Cameroon, the illegality and high cost of bushmeat were major barriers to consumption in urban Cameroon, where many consumers perceive it as a luxury item (Nguyen *et al.*, 2021). Also, in Nigeria, while taste and cultural customs drive demand, a significant portion of consumers would opt for cheaper protein alternatives if bushmeat prices rise (Iwajomo & Ogunsola, 2024).

Income constraints was ranked second with a mean rank of 2.24. The study revealed that consumers in the study area had issues with not earning enough or the cost of living has become quite unbearable as general prices have increased. The pandemic led to a widespread economic disruption, including job losses and reduced incomes. Many consumers interviewed in this study claim they have experienced a decline in their purchasing power making it difficult to afford some necessities. Those who work in the informal sector, such as the traders, were particularly hit hard, exacerbating the financial strain on families. The economic downturn caused by the pandemic has made it increasingly difficult for consumers to purchase bushmeat. Reduced incomes mean that households must prioritize their spending, often opting for cheaper, less nutritious food options.

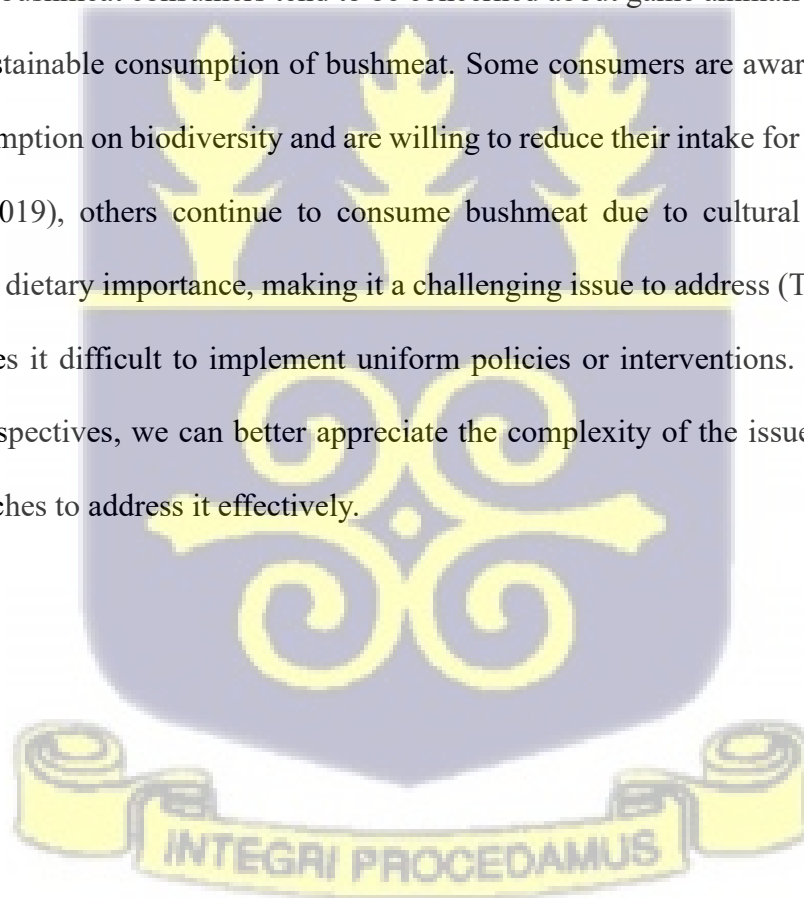
This shift not only affects dietary diversity but also has implications for food security and nutrition. According to Boadi *et al.* (2024), the impact of income loss due to COVID-19 exacerbates food insecurity among informal urban settlers in Ghana, affecting bushmeat consumers post-pandemic due to financial constraints. Similarly, a previous study revealed that, the COVID-19 crisis has disrupted food systems in Ghana, causing socio-economic impacts that are more devastating than the virus itself, affecting livelihoods and food systems in the country (Hodey *et al.*, 2021).

Health risk towards zoonotic diseases in the study area plays a critical role shaping the consumption dynamics of bushmeat, ranking third with a mean rank of 3.35 (Table 4.5). The health risks associated with bushmeat consumption have long been recognized and were further amplified by the Ebola outbreak, which significantly reduced the preference for game meat. This shift in consumer preference led to a decline in game meat consumption, compelling traders to seek alternative livelihoods and thereby impacting the entire supply chain (Falola *et al.*, 2015; NwaJesus *et al.*, 2020). Handling and butchering of wild animals can lead to direct transmission of pathogens. For instance, a study in Nigeria found that butchers had a HEV IgG seroprevalence of 31.1%, indicating a strong link between butchering activities and HEV infection (Oluremi *et al.*, 2023). Eating undercooked or improperly prepared bushmeat can result in the ingestion of harmful pathogens. This is particularly concerning for diseases like Ebola which can be transmitted through the consumption of infected animal meat (NwaJesus *et al.*, 2020). The consumption of wild animals has been linked to zoonotic outbreaks such as COVID-19, and Ebola, emphasizing the social and cultural dynamics connecting people, wildlife, and disease (Trefon, 2023).

The distance to bushmeat sales outlet within the study area was ranked fourth with a mean rank of 3.49 (Table 4.5). From the study, respondents consider the distance they have to travel to purchase bushmeat from the market as a constraint. Despite the availability of bushmeat, consumers must

travel to the large markets to obtain bushmeat. Long distances limit the number of potential buyers, making it harder for the bushmeat traders to find readily available markets for their bushmeat. Conversely, a study conducted in Yaoundé, Cameroon, revealed that bushmeat is supplied from extensive areas, with over 70% of sales points receiving bushmeat via trains and minibuses from distant regions, indicating a broad catchment area for supply (Edderai, 2006). This necessitates the need for Ghana to adopt new methods of marketing to enhance a broad catchment area for supply.

Environmental concerns were ranked as the least significant constraint when it comes to bushmeat consumption with a mean rank of 3.68 as shown in Table 4.5. Consumers, especially the highly educated bushmeat consumers tend to be concerned about game animals' conservation and thus practice sustainable consumption of bushmeat. Some consumers are aware of the impact of bushmeat consumption on biodiversity and are willing to reduce their intake for reasons (Sanchez-Sabate *et al.*, 2019), others continue to consume bushmeat due to cultural attachment, taste preferences, and dietary importance, making it a challenging issue to address (Trefon, 2023). This dichotomy makes it difficult to implement uniform policies or interventions. By understanding these varied perspectives, we can better appreciate the complexity of the issue and the need for nuanced approaches to address it effectively.



## CHAPTER FIVE

### SUMMARY, CONCLUSION AND RECOMMENDATIONS

#### 5.1 Introduction

This chapter brings together the key insights from the study on bushmeat consumption in the aftermath of COVID-19 and its implications for food security in Ghana. Section 5.2 outlines a summary of the study's key findings, followed by the overall conclusion in Section 5.3. Lastly, Section 5.4 offers practical recommendations drawn from the research.

#### 5.2 Summary and major findings

The study examined the bushmeat consumption after the COVID-19 and its implication on food security in Ghana. This was achieved by describing the diversity of bushmeat consumed. The study analyzed the factors influencing consumer preference for different types of bushmeat after the COVID-19 pandemic. It also study examined the implications of consumer perceptions of bushmeat on food security after the COVID-19. Constraints faced by consumer post COVID were identified and ranked accordingly.

Data was collected from 300 bushmeat consumers across six districts in the Greater Accra, Ashanti, and Bono regions of Ghana. Fifty (50) consumers were selected from each of the following districts: Accra Metropolitan District, Korley Klottey Municipal Assembly, Kumasi Metropolitan District, Kwadaso Municipal District, Nkoranza South Municipal District, and Techiman Municipal District. The socio-economic and institutional characteristics of the respondents were estimated using STATA 17.

The socio-economic analysis revealed that female consumers is made up of 57% of the respondents, as women are primarily responsible for preparing meals and ensuring food security for their families. Additionally, 94.33% of bushmeat consumers had some level of formal

education. The study found that 46% of the respondents were married. Akans represented 76% of the respondents, highlighting the strong association between bushmeat consumption and the Akan ethnic group in Ghana. Furthermore, 38% of the respondents earned between GHS 801-1500, indicating a lower middle-income bracket.

The study revealed that grasscutter is the most consumed bushmeat, with a total of two hundred and fifty-eight (258) respondents consuming grasscutter across the three regions of study. Comparatively, between the three regions, Ashanti region had the highest grasscutter consumers with 96 consumers. The second most consumed bushmeat was rat, with a total of hundred and sixty-seven (167) consumers across the three regions. The most consumed rat consumption region is identified to be Bono-East region, with a total of sixty-five (65) consumers. Also, under the categorization, hundred and seventy (170) consumers consumed terrestrial animals, (thirty-seven) 37 consumed a mix of terrestrial, aerial, and arboreal animals, (thirty-nine) 39 consumed a mix of terrestrial and aerial animals, and fifty-four (54) consumed a mix of terrestrial and arboreal animals, making a total of 300 consumers.

For the multinomial logistic analysis, the study revealed that consumers earning between GHS 801-1500 and GHS 1501-3000 showed positive marginal effects of 0.108 and 0.095, respectively. These effects were significant at the 5% level, indicating a significant influence on the preference for mixed terrestrial, aerial, and arboreal animals compared to the base outcome of mixed terrestrial and arboreal animals.

The study found that consumers residing in the Ashanti region had a positive marginal effect of 0.234 at 1% significance level for the preference of terrestrial animals compared to a mix of terrestrial and arboreal animals. However, these consumers residing in the Ashanti region exhibited a negative marginal effect of -0.145 at 1% significant level for the preference of mixed terrestrial

and aerial animals compared to a mix of terrestrial and arboreal animals. Additionally, the study showed that consumers in the Bono-East region had a negative influence on the preference of terrestrial animals compared to mixed terrestrial and arboreal animals. Conversely, there was a positive marginal effect of 0.175 at a significant level of 1% for the preference of mixed terrestrial, aerial, and arboreal animals compared to a mix of terrestrial and arboreal animals. Furthermore, the study indicated a positive marginal effect of 0.083 at 10% significant level for the preference of mixed terrestrial and aerial animals compared to mixed terrestrial and arboreal animals.

The study also revealed that gender had a significant negative effect of -0.122 on the preference of terrestrial animals only compared to a mixed terrestrial and arboreal animal. Conversely, gender had a positive marginal effect of 0.068 at 10% significant level for the preference of mixed terrestrial, aerial, and arboreal animals compared to a mix of terrestrial and arboreal animals. Health risk showed a positive marginal effect of 0.086, significant at 5%, for the preference of terrestrial animals only compared to a mix of terrestrial and arboreal animals. However, health risk had a negative marginal effect of -0.053, significant at 5%, for the preference of mixed terrestrial, aerial, and arboreal animals compared to a mix of terrestrial and arboreal animals. Lastly, the price of bushmeat had a positive marginal effect of 0.037, significant at 5%, for the preference of mixed terrestrial, aerial, and arboreal animals compared to a mix of terrestrial and arboreal animals.

The analysis of consumer perception regarding bushmeat on food security in the post-COVID-19 era revealed several significant findings. Under the control variable Region, the Ashanti region showed a coefficient of 0.113 and the Bono East region showed a coefficient of -0.074, both significant at the 1% level. For the availability construct, bushmeat availability had a coefficient of 0.137 and bushmeat variety had a coefficient of 0.138, both significant at the 1% level. Under the utilization pillar, taste had a coefficient of 0.158 and nutrition had a coefficient of 0.108,

both significant at the 1% level. For accessibility, the high price of bushmeat had a coefficient of -0.068 and income had a coefficient of -0.067, both significant at the 1% level. In the agency construct, access to information had a coefficient of -0.047 and community advocacy had a coefficient of -0.049, both significant at the 10% level. Regarding stability, the effects of illegal hunting had a coefficient of -0.113 and economic instability had a coefficient of -0.189, both significant at 1%. Lastly, for sustainability, bushmeat taste distortion had a coefficient of -0.159 and the increase in public health concerns and risks had a coefficient of -0.191, both significant at 1%.

The findings showed that high price for the bushmeat, income constraints, health risk of zoonotic diseases and distance of bushmeat sales outlet are the most prevailing constraints among respondents in the study areas.

### **5.3 Conclusions**

The findings reveal that grasscutter, rat, and antelope were the most consumed types of bushmeat across the three studied regions in Ghana. Consumers showed a clear preference pattern, predominantly favoring terrestrial animals, followed by notable preferences for combinations of terrestrial and arboreal animals. Preferences for combinations including aerial animals were less common, with the least preference shown for mixes of all three categories—terrestrial, aerial, and arboreal animals.

The study's multinomial logistic regression analysis provided a nuanced understanding of the factors shaping consumer preferences. These preferences were significantly influenced by income levels, regional location, gender, perceived health risks, and price sensitivity. For instance, middle-income earners (GHS 801–3000) showed a stronger inclination toward consuming diverse bushmeat types, including aerial and arboreal animals. Regionally, consumers in the Ashanti region

preferred terrestrial animals, while those in Bono East showed more diverse preferences but less inclination toward terrestrial-only options.

Gender differences were also evident. Men were more likely to consume a diverse mix of animals, while women tended to prefer terrestrial bushmeat—a trend that aligns with their domestic and market-facing roles in food preparation and sales. Furthermore, perceptions of health risk influenced preference patterns: consumers who were more cautious about zoonotic diseases opted for terrestrial animals, while those less concerned chose a broader mix. Bushmeat price also shaped consumption: higher prices pushed some consumers toward more diverse combinations, likely due to cost-per-unit trade-offs and availability dynamics.

In line with the study's third objective, consumer perceptions were assessed using the six FAO food security pillars: availability, utilization, accessibility, agency, stability, and sustainability. While this study does not measure the direct impact of bushmeat consumption on food security, the findings reveal important perceived implications. For instance, availability—reflected in the variety and quantity of bushmeat—was seen as enhancing food security. Utilization attributes such as nutrition and taste also positively contributed. However, accessibility was negatively impacted by high bushmeat prices and limited incomes. Likewise, agency and stability were undermined by factors like poor access to information, weak advocacy, economic instability, and illegal hunting. Sustainability concerns, including distorted bushmeat taste (possibly due to chemical use or preservation) and growing health risks, emerged as key long-term issues.

With respect to the final objective, the study identified multiple constraints faced by bushmeat consumers. These include the high cost of bushmeat, limited incomes, health concerns related to zoonoses, distant market outlets, and growing environmental concerns. These constraints

collectively shape bushmeat consumption choices and pose challenges for market access and sustainable demand.

#### **5.4 Recommendations**

Based on the study's findings, the following recommendations are made for policy action to help improve the food security status of bushmeat consumers.

As grasscutter is deemed a very important micro-livestock or bushmeat and is in high demand across the three regions, research institutions such as the Livestock and Poultry Research Center and the Animal Research Institute under the Council for Scientific and Industrial Research (CSIR) must take it upon themselves to organize quarterly intensive training programs on best practices of grasscutter farming. Ensuring the taste of grasscutter is maintained is very important for market acceptance and customer satisfaction. These initiatives can help increase the supply of farmed grasscutter, reducing the pressure on wild populations.

Bushmeat suppliers should consider selling their products in smaller, more affordable portions. This could make bushmeat accessible to a broader range of consumers, including those with lower incomes. By offering various portion sizes, suppliers could cater to diverse consumer preferences and budgets, potentially increasing their customer base and sales.

To improve accessibility, introducing sliding scale pricing in local markets can make bushmeat more affordable for lower-income consumers. A sliding scale pricing model refers to a flexible pricing system where the cost of a product or service is adjusted based on the consumer's ability to pay. In practice, this could involve setting price tiers such as standard, reduced, or subsidized rates based on income brackets or community-verified need. Local governments can develop policy incentives or tax relief for market sellers who comply with affordability schemes. For example, sellers could be reimbursed partially by municipal authorities or supported through NGO-

facilitated food access funds, helping balance profit motives with social goals. Though the feasibility may vary by region, similar models have been piloted in community-supported agriculture (CSA) schemes in other contexts, where local governments subsidize food costs for low-income households through market partnerships. Such mechanisms, if carefully piloted and evaluated in the Ghanaian context, could increase access without undermining seller revenue.

In terms of stability, promoting local employment initiatives to reduce reliance on bushmeat is essential. Creating jobs in areas such as sustainable tourism, agroforestry, and farmed animal rearing can divert pressure from bushmeat consumption.

Additionally, law enforcement must work closely with communities to effectively enforce anti-poaching laws. While enforcement is often challenging, successful models exist such as community ranger programs in East Africa where co-management frameworks involve community members in surveillance and compliance. Ghana could explore similar models that leverage traditional authority structures to enhance community compliance.

For sustainability, it is important to educate communities about the benefits of farmed bushmeat and support the establishment of local farms to ensure both quality and taste. Public health campaigns should aim to promote safe handling and cooking practices to mitigate health risks.

To enhance feasibility, each initiative can be aligned with stakeholder roles. Governments should lead policy development, pricing regulation, and enforcement of anti-poaching laws. NGOs can coordinate public health messaging and conduct capacity-building for farmers. Community leaders and cooperatives can mobilize support for sustainable farming and income-generating projects that reduce dependence on bushmeat hunting.

Increasing the number of sales outlets or establishing mobile sales units can make bushmeat more accessible, while partnering with local markets and retailers can expand distribution networks. Promoting sustainable hunting practices and supporting conservation efforts can address environmental concerns. Educating consumers about the importance of sustainable consumption and the environmental impact of their choices can further support these efforts.

Together, these recommendations offer a practical and collaborative path to improving food security in the post-COVID-19 era, while acknowledging the socio-economic, environmental, and public health complexities associated with bushmeat consumption.



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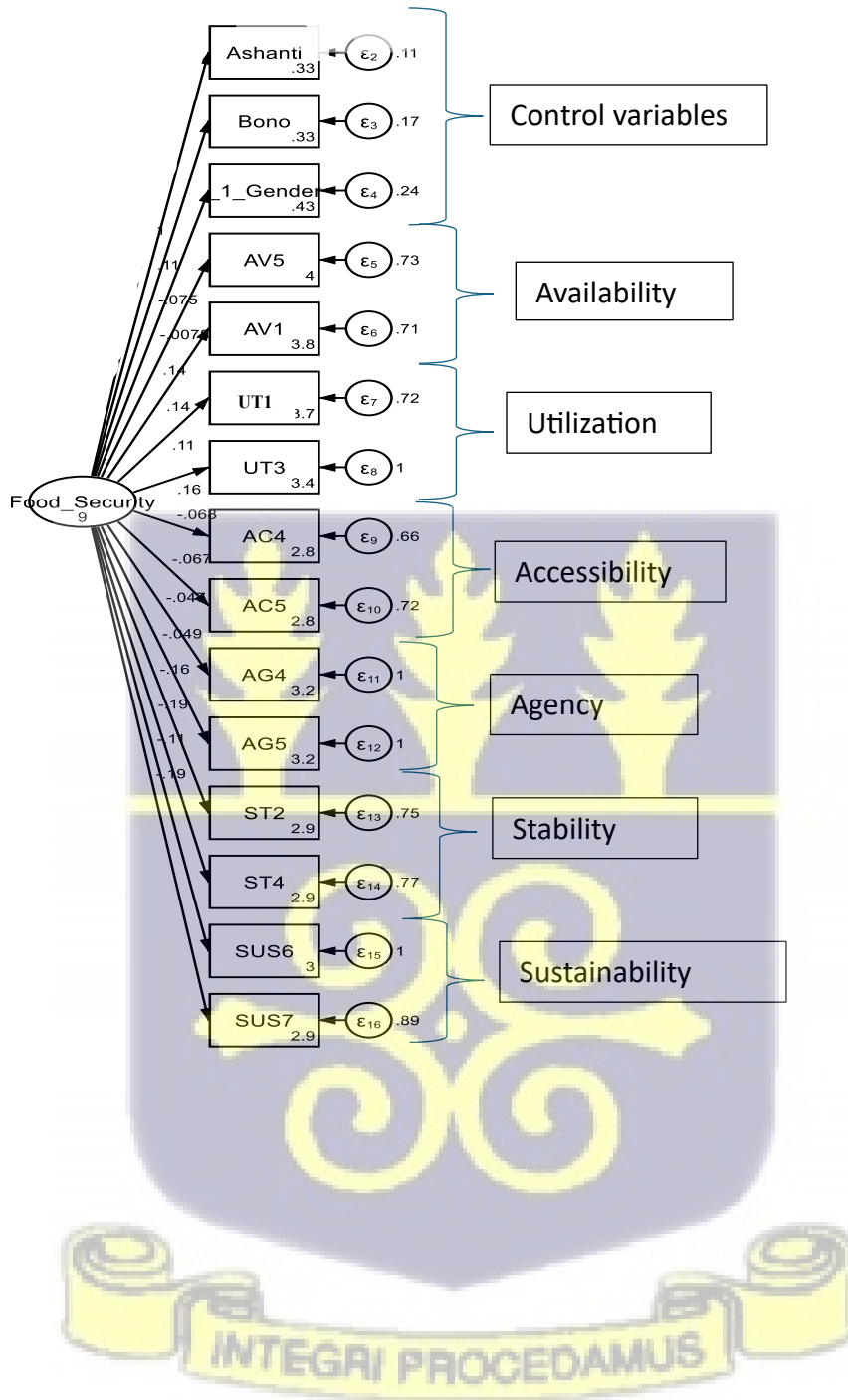
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APPENDIX

SEM Path analysis



**Multinomial logistic regression results**

Terrestrial animals

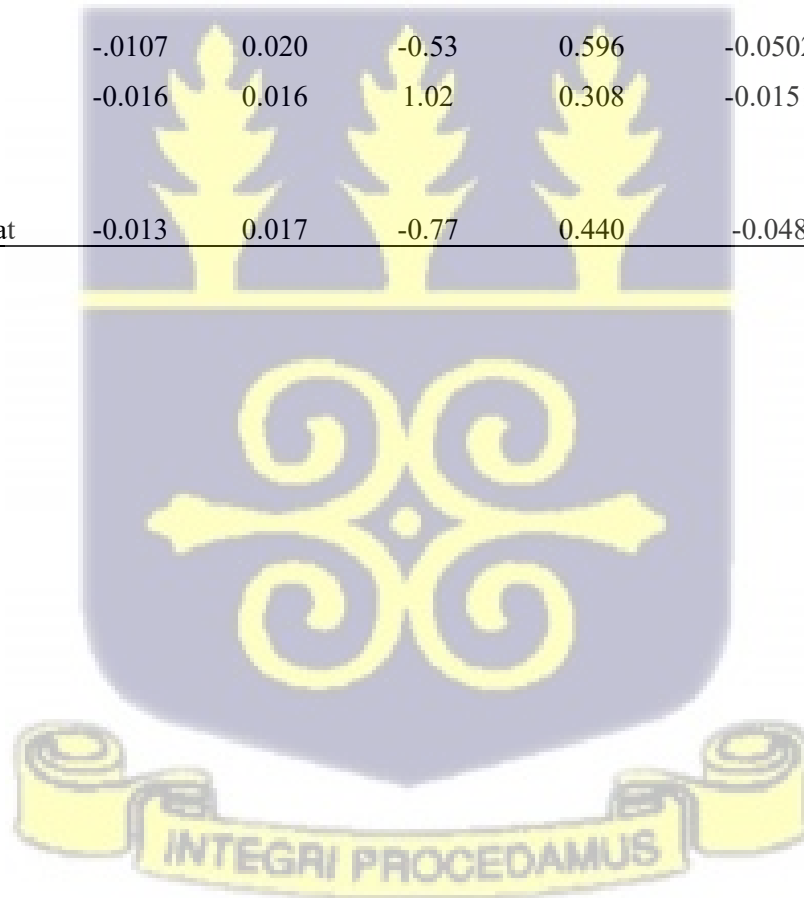
	<b>dy/dx</b>	<b>std. err.</b>	<b>z</b>	<b>P&gt; z </b>	<b>[95% conf. interval]</b>	
Age	-0.0005	0.00321	-0.17	0.864	-0.0068499	.0057472
Income						
<GHS 800	0.0364	0.1189	0.31	0.759	-0.196	0.269
GHS 801-1500	-0.0728	0.106	-0.68	0.495	-0.282	0.1365
GHS 1501-3000	-0.1418	0.100	-1.41	0.159	-0.339	0.055
Region						
Ashanti	0.234	0.079	2.95	0.003	0.078	0.390
Bono-East	-0.199	0.088	-2.27	0.024	-0.372	-0.026
Gender	-0.122	0.063	-1.93	0.053	-0.2449	0.0018
Formal education	0.008	0.00796	1.04	0.300	-0.007	0.0238
Size of household	-0.006	0.01299	-0.51	0.607	-0.0321	0.0187
Health risk	0.086	0.035	2.42	0.016	0.016	0.155
Pref. for altern. over bushmeat	0.010	0.026	0.40	0.689	-0.040	0.061
Price of bushmeat	-0.022	0.028	-0.76	0.448	-0.0783	0.034

Mixed of terrestrial, aerial animals, arboreal animals

	<b>dy/dx</b>	<b>Std. err.</b>	<b>z</b>	<b>P&gt; z </b>	<b>[95% conf. interval]</b>	
Age	0.0028	0.0017	1.60	0.109	-0.0006	0.0063
Income						
<GHS 800	0.050	0.046	1.07	0.286	-0.041	0.142
GHS 801-1500	0.108	0.049	2.20	0.028	0.011	0.205
GHS 1501-3000	0.095	0.045	2.10	0.036	0.006	0.1856
Region						
Ashanti	0.035	0.0502	0.71	0.477	-0.0627	0.1342
Bono-East	0.1753	0.0518	3.38	0.001	0.0736	0.277
Gender	0.068	0.0362	1.90	0.057	-0.002	0.139
Formal education	-0.00048	0.0046	-0.10	0.917	-0.009	0.008
Size of household	-0.005	0.007	-0.67	0.504	-0.0205	0.0101
Health risk	-0.053	0.021	-2.50	0.012	-.0946	-.0115
Pref. for altern. over bushmeat	-0.021	0.0157	-1.34	0.179	-0.052	0.0097
Price of bushmeat	0.037	0.016	2.28	0.022	0.0053	0.0696

Mixed terrestrial and aerial animals

	<b>dy/dx</b>	<b>std. err.</b>	<b>z</b>	<b>P&gt; z </b>	<b>[95% conf. interval]</b>	
Age	0.0007	0.002	0.39	0.699	-0.003	0.004
Income						
<GHS 800	0.028	0.0682	0.42	0.676	-0.105	0.162
GHS 801-1500	0.030	0.0623	0.48	0.628	-0.0919	0.152
GHS 1501-3000	0.0017	0.0582	0.03	0.976	-0.112	0.115
Region						
Ashanti	-0.145	0.055	-2.61	0.009	-0.254	-0.036
Bono-East	0.083	0.045	1.84	0.065	-0.005	0.171
Gender	0.034	0.035	0.96	0.337	-0.035	0.104
Formal education	-0.0019	0.004	-0.42	0.674	-0.010	0.007
Size of household	-0.002	0.007	-0.32	0.748	-0.016	0.0119
Health risk	-0.0107	0.020	-0.53	0.596	-0.0502	0.028
Pref. for altern. over bushmeat	-0.016	0.016	1.02	0.308	-0.0151	0.047
Price of bushmeat	-0.013	0.017	-0.77	0.440	-0.048	0.021





**UNIVERSITY OF GHANA**

**DEPARTMENT OF AGRICULTURAL ECONOMICS AND AGRIBUSINESS**

**CONSUMER PERCEPTION AND PREFERENCE FOR BUSHMEAT AND ITS  
IMPLICATION ON FOOD SECURITY AFTER THE COVID-19 PANDEMIC IN GHANA**

**QUESTIONNAIRE**

*This is an academic research project that is being conducted to fulfill the requirements for a Master of Philosophy Degree in Agribusiness.*

*The following questions are posed for this research, and I would appreciate it if you could provide me with the necessary answers. Please note that the data collected will be used solely for academic purposes and will be kept confidential. Also, you may opt out of the interview at any point. Thank you for your cooperation.*



**Serial No:**

--	--	--

**Identification**

Name of Enumerator: .....

Date of Interview:

...../...../.....

Region: .....

Market name: .....

Name of Respondent: .....

Telephone number: .....

**SCREENING QUESTIONS**

- i) Do you consume bushmeat? 1=Yes [ ] 2=No [ ]  
If No, respondent cannot be interviewed  
If Yes, move to question (ii)
- ii) Have you consumed bushmeat after the COVID-19 pandemic? 1=Yes [ ] 2=No [ ]  
If No, do not proceed with respondent.  
If Yes, respondent can be interviewed

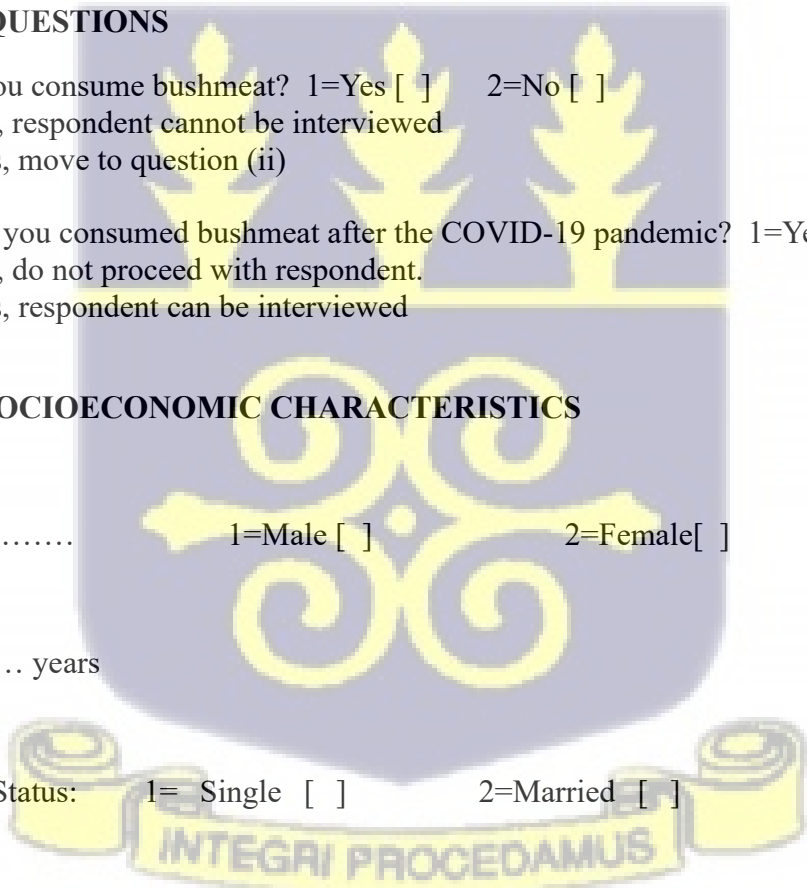
**SECTION A: SOCIOECONOMIC CHARACTERISTICS**

[Q1]. Gender: ..... 1=Male [ ] 2=Female [ ]

[Q2]. Age: ..... years

[Q3]. Marital Status: 1= Single [ ] 2=Married [ ] 3=Divorced [ ]  
4=Widowed [ ]

[Q4]. Religion: 1=Christianity [ ] 2=Muslim [ ] 3=Traditionalist [ ] 4=No Religion [ ]  
5=Other (please specify) .....



[Q5]. Ethnic background: 1=Ga-Dangme [ ] 2=Akan [ ] 3=Ewe [ ] 4=Mole-Dagbon [ ]  
5=Others (please specify).....

[Q6]. Occupation: 1=Agriculture/Farming [ ] 2=Government/Public Sector [ ] 3=Education  
[ ] 4=Transport/Logistics [ ] 5=Trader [ ] 6=Unemployed [ ] 7=Retired [ ]  
8= Student [ ] 9=Self-employed [ ] 10= Private Sector [ ] 11= Other (please specify):  
.....

[Q7]. Monthly Income:

1= < GHC 800 [ ] 2=GHC (801-1500) [ ] 3=GHC (1501-3000) [ ] 4=>GHC 3001 [ ]

[Q8]. Education:..... years

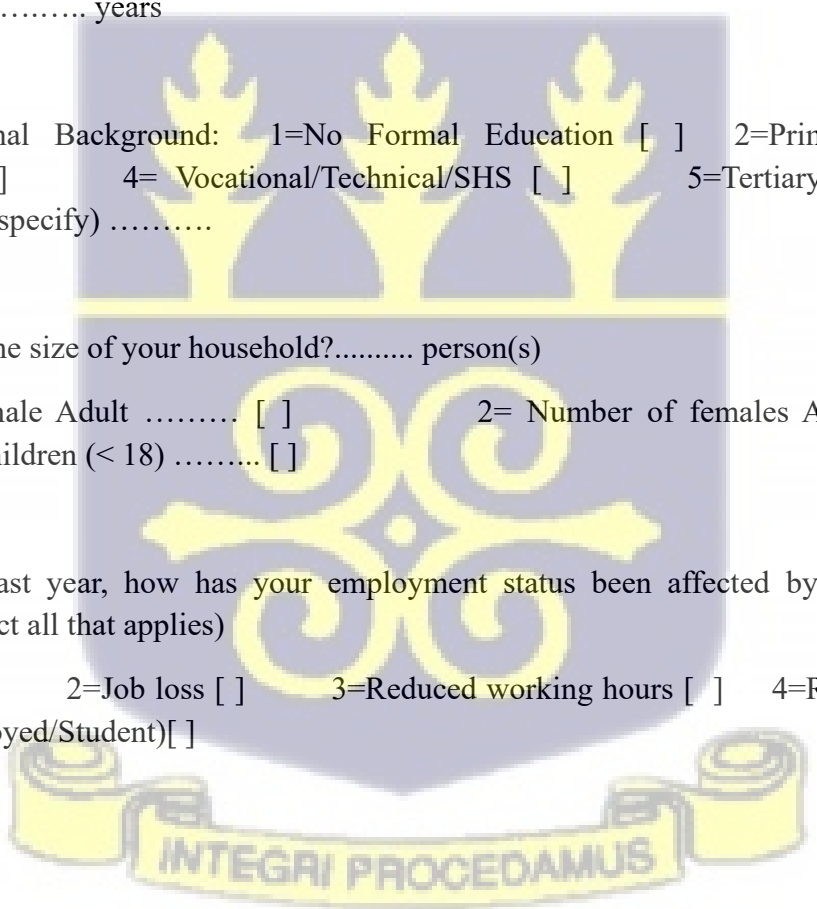
[Q9]. Educational Background: 1=No Formal Education [ ] 2=Primary School [ ]  
3=JHS/MSCL [ ] 4= Vocational/Technical/SHS [ ] 5=Tertiary Education [ ]  
6=Other (please specify) .....

[Q10]. What is the size of your household?..... person(s)

1=Number of male Adult ..... [ ] 2= Number of females Adult ..... [ ]  
3=Number of Children (< 18) ..... [ ]

[Q11]. In the past year, how has your employment status been affected by the COVID-19 pandemic? (Select all that applies)

1=Unaffected [ ] 2=Job loss [ ] 3=Reduced working hours [ ] 4=Remote work [ ]  
5=N/A(Unemployed/Student) [ ]



[Q12]. How has your household's financial situation changed after the COVID-19 pandemic?

1=Improved [ ] 2=Stayed the same [ ] 3=Slightly worse [ ] 4=Significantly worse [ ]

[Q13]. Do you perceive bushmeat as an affordable food option for your household after the COVID-19 pandemic?

1=Yes [ ]      2=No [ ]

[Q14]. Have you encountered any challenges related to the affordability of bushmeat after the COVID-19 pandemic?

1=Yes [ ]      2=No [ ]

[Q14b]. If yes, please briefly describe the challenges faced in affording bushmeat: .....

Goes 14[Q15]. Have you faced challenges in accessing basic resources like food and healthcare due to the COVID-19 pandemic?

1=Yes [ ]    2=No [ ]

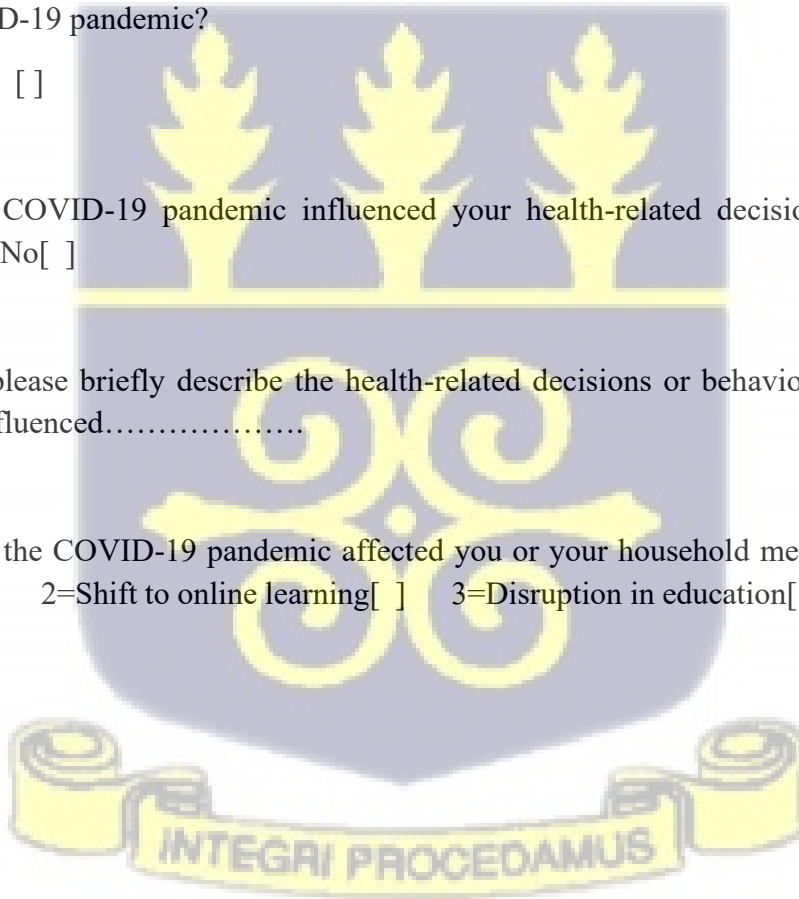
[Q16]. Has the COVID-19 pandemic influenced your health-related decisions or behaviors?

1=Yes [ ]    3=No [ ]

[Q16a]. If yes, please briefly describe the health-related decisions or behaviors the COVID-19 Pandemic has influenced.....

[Q17]. How has the COVID-19 pandemic affected you or your household members' education?

1=No impact [ ]    2=Shift to online learning [ ]    3=Disruption in education [ ]    4=Other please specify [ ]



**SECTION B: DIVERSITY OF BUSHMEAT CONSUMED AFTER THE COVID-19 PANDEMIC**

[Q18]. Which type of bushmeat have you consumed after the COVID-19 pandemic? (Select all that applies)

- 1= Grasscutter [ ]      2=Maxwell duiker [ ]      3=Antelope [ ]      4=Bushbuck [ ]  
5=Bush-tailed porcupine [ ]      6=Rat [ ]      7=Squirrel [ ]      8=Black duiker [ ]  
9=Ahanta Francolin [ ]      10=Bat [ ]      11=Others (specify) .....

[Q19]. Out of your selection in [18] which one do you consume most? please select **one** type of bushmeat from the types of bushmeat below or specify if other:

- 1= Grasscutter [ ]      2=Maxwell duiker [ ]      3=Antelope [ ]      4=Bushbuck [ ]  
5=Bush-tailed porcupine [ ]      6=Rat [ ]      7= Squirrel [ ]      8=Black duiker [ ]  
9=Ahanta Francolin [ ]      10=Bat [ ]      11=Others (specify) .....

[Q.20] How often do you consume bushmeat after the COVID-19 pandemic?

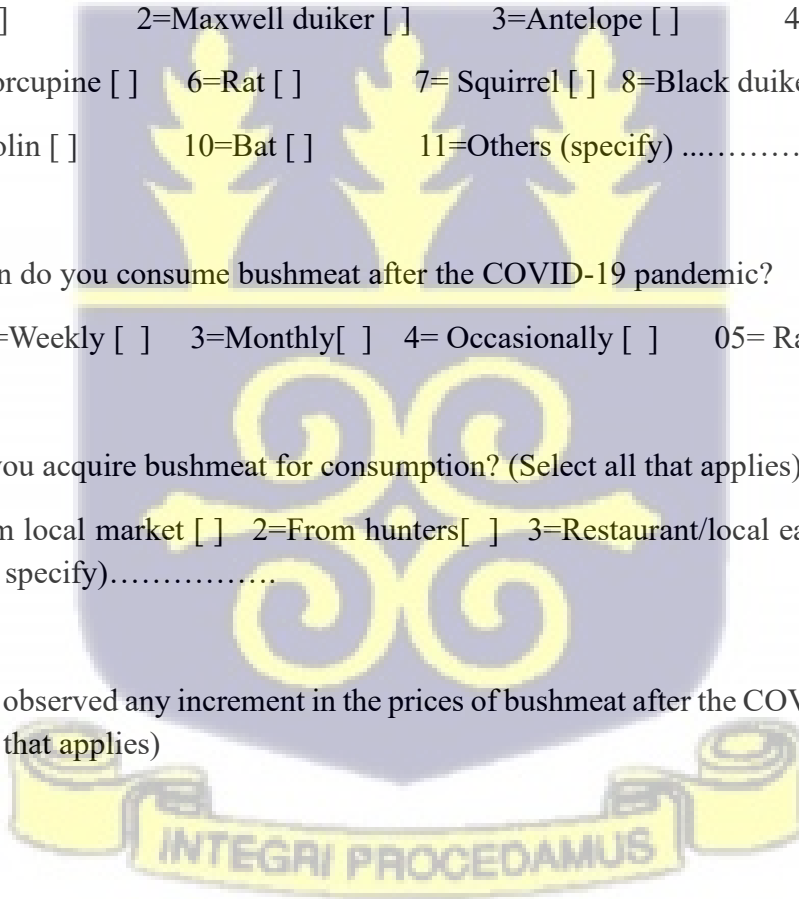
- 1=Daily [ ]    2=Weekly [ ]    3=Monthly[ ]    4= Occasionally [ ]    5= Rarely [ ]

[Q22]. How do you acquire bushmeat for consumption? (Select all that applies)

- 1= Purchase from local market [ ]    2=From hunters[ ]    3=Restaurant/local eatery (chop bar)[ ]  
4= Other (please specify).....

[Q23]. Have you observed any increment in the prices of bushmeat after the COVID-19 pandemic? (please select all that applies)

- 1=Yes  
2=No



[24]. Has your consumption of bushmeat reduced due to the price increment after the COVID-19 ?

1=Yes, [ ]                    2=No [ ]

[25]. Do you think there are health risks associated with consuming bushmeat, especially after the COVID-19 pandemic?

1=Yes [ ]      2=No [ ]

[25b]. If yes, what are some health risks associated with bushmeat consumption.....

[26]. Are you satisfied with the variety of bushmeat options available to you post COVID-19?

1=Yes [ ]      2=No [ ]

[27]. Are you satisfied with the taste and quality of bushmeat options available to you post COVID-19?

1=Yes [ ]      2=No [ ]

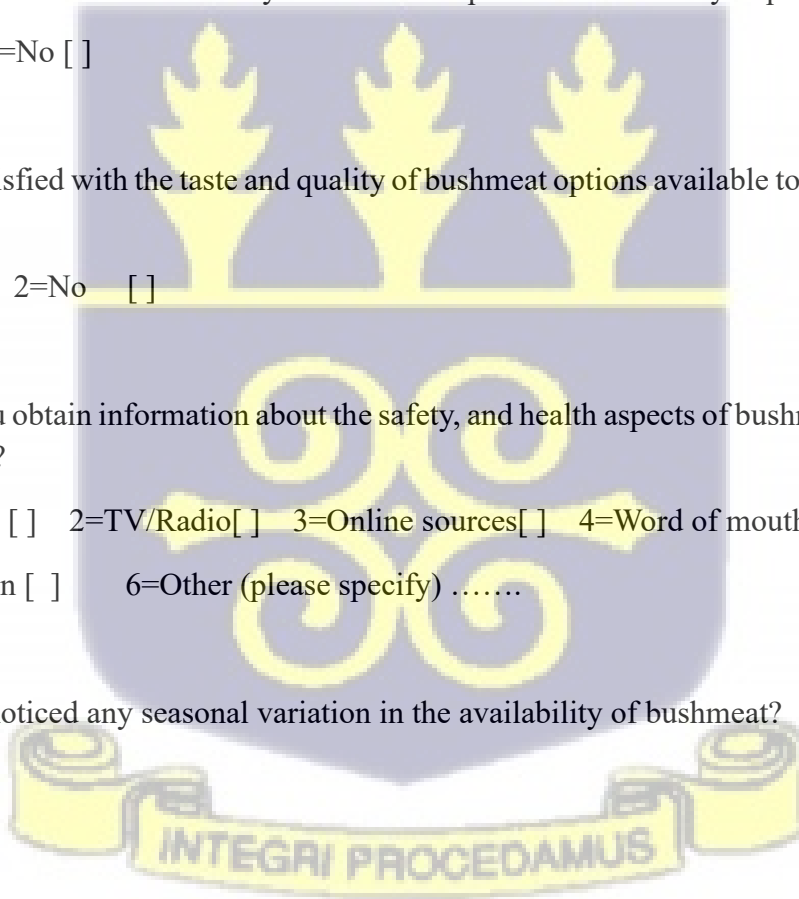
[28]. How do you obtain information about the safety, and health aspects of bushmeat you consume post-COVID-19?

1=Local markets [ ]    2=TV/Radio [ ]    3=Online sources [ ]    4=Word of mouth [ ]

5=No information [ ]    6=Other (please specify) .....

[29]. Have you noticed any seasonal variation in the availability of bushmeat?

1=Yes    2=No



**SECTION C: CONSUMER PERCEPTION FOR BUSHMEAT ON FOOD SECURITY AFTER THE COVID-19 PANDEMIC**

*Use the numbers to rate each perception where; 1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree*

<i>Availability</i>	<b>Strongly Disagree (1)</b>	<b>Disagree (2)</b>	<b>Neutral (3)</b>	<b>Agree (4)</b>	<b>Strongly Agree (5)</b>
[30]. Bushmeat is readily available in the market known for bushmeat sales after the COVID-19 pandemic (Bushmeat is readily available in the market)					
[31]. The variety of bushmeat available meets my preference in this post-COVID period					
[32]. In this post COVID-19 period, the availability of bushmeat varies seasonally, affecting my ability to include it in my meals consistently					
[33]. I always get the quantity of bushmeat I demand at the market after the COVID-19 pandemic period.					
[34]. I often turn to other alternatives of protein due to the unavailability of bushmeat in this post-COVID-19 period.					
<i>Accessibility</i>					
[35]. Accessing bushmeat market is convenient and easy in my local area after the COVID-19 pandemic.					
[36]. In this post-COVID-19 period, bushmeat is affordable and that makes it my preferred source of protein over goat, sheep, beef, chicken.					
[37]. I prefer alternative protein sources once the price of bushmeat increases in this post-COVID-19 period.					

[38]. The price of bushmeat is very high and thus impacts my ability to purchase bushmeat					
[39]. My income constraints affect my ability to purchase bushmeat					
<b>Utilization</b>					
40]. The quality of bushmeat meets health and safety standards after the COVID-19 pandemic.					
[41]. In this post-COVID-19 period, zoonotic diseases such as Ebola and Covid-19 has affected the perceived quality of bushmeat. Risk of contracting zoonotic disease					
[42]. I consider bushmeat to be tasty, and an essential component of my diet post-COVID-19 period.					
[43]. In this post-COVID-19 period, I am aware of the potential health risks associated with the consumption of bushmeat when improperly cooked.					
[44]. Preference of bushmeat over alternatives protein					
[45]. In this post-COVID-19 period, bushmeat holds cultural significance in my community and is a common ingredient in traditional meals. Cultural significance					
<b>Agency</b>					
[46]. In this post-COVID-19 period, local communities have the authority and capacity to manage the hunting and trade of bushmeat sustainably.					
[47]. In this post-COVID-19 period, I feel empowered to make decisions about what variety of bushmeat to consume.					
[48]. In this post-COVID-19 period, I have the capability to influence how bushmeat is hunted and distributed in my community.					
[49]. In this post-COVID-19 period, I am cautious about the information I receive regarding bushmeat consumption, ensuring it is accurate and reliable to make informed decisions					
[50]. In this post-COVID-19 period, I am mindful of community advocacy efforts to ensure conservation of wildlife					
<b>Stability</b>					
[51]. In this postCOIVD-19 era, I foresee my economic instability situation to affect my ability to include bushmeat in my diet within the year					

[52]. In this post-COVID 19 period, I perceive the good taste and quality of bushmeat to be distorted within the year.					
[53]. In this post-COVID 19 period, I foresee illegal hunting to have a significant negative impact on bushmeat trade in a years..					
[54]. Bushmeat prices will fluctuate within the year which will make it expensive thereby inaccessible in this post-COVID-19 period.					
[55]. In this post-COVID-19 period, the potential health risks associated with the consumption of bushmeat will increase within the year.					
[56]. In this post-COVID-19 period, the cultural significance of bushmeat in my community will be strongly maintained within the year.					
<b>Sustainability</b>					
[57]. Illegal hunting is likely to have a significant negative impact on bushmeat trade in 5 years and beyond.					
[58]. In this post-COVID-19 period, I perceive the good taste and quality of bushmeat to be maintained in the next 5 years and beyond.					
[59]. In this post COVID-19, concerns about the rise in health risk related to bushmeat will rise in 5 years and beyond					
[60]. In this post-COVID-19 period, the quantity of bushmeat available in the markets may be reduced in the next 5 years and beyond.					
[61]. In this post-COVID-19 era, harmful methods of hunting may be developed and employed by hunters which will affect biodiversity negatively in the next 5 years and beyond					
[62]. In this post-COVID-19 era, the potential health risks associated with the consumption of bushmeat may increase and be very evident in the next 5 years and beyond					



**SECTION E: FACTORS INFLUENCING BUSHMEAT CONSUMPTION AFTER THE COVID-19 PANDEMIC**

[63]. Which alternative protein sources do you prefer most?

1=Beef [ ]      2=Chicken [ ]      3=Goat [ ]      4=Sheep [ ]  
5= Others (Please specify) [ ].....

[64]. When purchasing bushmeat, do you take into consideration the prices of other protein alternatives?

1= Yes [ ] 2=No[ ]

[65]. If yes, if you are faced with this situation: 1 kg of bushmeat = 40 cedis & 1 kg other meats (goat, sheep, beef) = GHS 25. Which one will you purchase?

1=Bushmeat [ ]      2= Other meat [ ]

[66]. How has your consumption pattern of bushmeat changed since the onset of the COVID-19 pandemic?

1=Increased consumption [ ]  
2=Decreased consumption [ ]  
3=No change in consumption [ ]

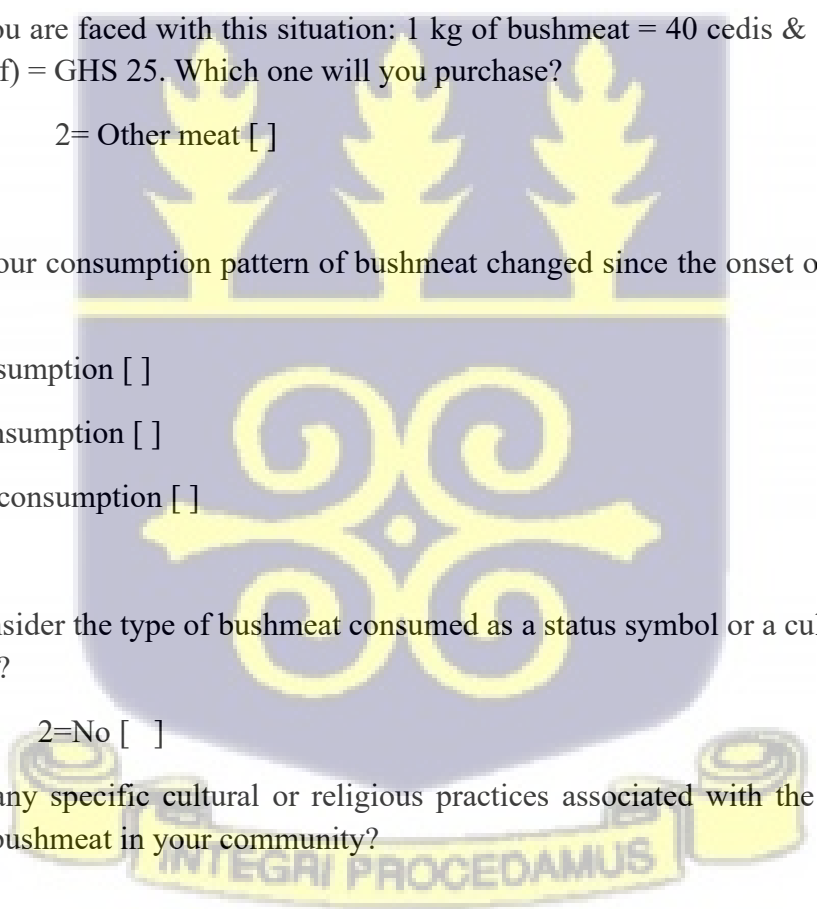
[67]. Do you consider the type of bushmeat consumed as a status symbol or a cultural tradition in your community?

1=Yes [ ]      2=No [ ]

[68]. Are there any specific cultural or religious practices associated with the consumption of certain types of bushmeat in your community?

1=Yes 2=No

[68b]. If yes, please specify.....



**SECTION F: CONSTRAINTS FACED BY CONSUMERS AFTER THE COVID-19 PANDEMIC**

[69]. Rank the following challenges faced by bushmeat consumers in the study area according to their severity, with 1 being the most severe and 5 being the least severe:

<b>Challenges</b>	<b>Rank</b>
a. Low-income level	
b. High price	
c. Environmental concerns.	
d. Distance from sales outlet	
e. Health risk related to diseases	

