

ENSIGN GLOBAL COLLEGE

KPONG, EASTERN REGION

**FOOD SYSTEMS MAPPING: A SCOPING REVIEW OF CHALLENGES AND
INNOVATIONS IN GHANA'S COASTAL AREAS**

BY

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SEPTEMBER, 2023

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INNOVATIONS IN GHANA'S COASTAL AREAS**

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**A THESIS SUBMITTED TO THE DEPARTMENT OF PUBLIC HEALTH IN
PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF
MASTERS' DEGREE IN PUBLIC HEALTH**

SEPTEMBER, 2023

DECLARATION

I hereby declare that this submission is my work for the master's degree in public health and that, to the best of my knowledge, it does not contain any material previously published by any person or material accepted for the granting of any other degree from the college, except where proper attribution has been indicated in the text.

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DEDICATION

With utmost sincerity, I dedicate this work to God Almighty for the insight and wisdom provided throughout the production of this thesis. Also, this work goes to my family for their constant support. Next, this thesis goes to my supervisor, Dr. Sandra Boatemaa Kushitor for her guidance and unflinching show of support.

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DEFINITION OF TERMS

FOOD SECURITY

Food security is defined as the physical and economic availability of all people to enough, safe, and nutritious food that meets their nutritional requirements and dietary preferences for a healthy and active life at all times.

FOOD SYSTEMS

Food systems are the interactions that take place between and within the biogeophysical and human environments, and they include a variety of activities such food production, processing, packaging, distribution, retail, consumption, and waste management.

SEEDS

Food systems interventions designed to address food insecurity are termed “seeds” in the Seeds of Good Anthropocene project.

FOOD SAFETY

Food safety refers to the precautions to guarantee that contaminants that might cause foodborne diseases do not enter the food throughout its handling, preparation, and delivery.

CLIMATE CHANGE

A shift in global or regional climate trends, most notably from the mid to late twentieth century, that is primarily attributed to increased levels of atmospheric carbon dioxide generated by the combustion of fossil fuels.

LIST OF ACRONYMS

COVID-19	Coronavirus Disease
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
IFAD	International Fund for Agricultural Development
NGO	Non-Governmental Organization
OHA	One Health Approach
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analysis
SDG	Sustainable Development Goal
SOGA	Seeds of Good Anthropocene
UNICEF	United Nations Children Fund
USD	United State Dollars

ABSTRACT

Background: Food systems are sophisticated human-made structures that have evolved through social, cultural, economic, and technological changes. Food systems on the African continent are diversified. However, this diversity is quickly disappearing, primarily because of agriculture and urbanization. This study seeks to map out all the challenges our food systems currently face through an overview of available evidence and the interventions designed to address them. This study seeks to identify and map out challenges within Ghana's coastal food systems and bottom-up interventions designed by citizens to address them.

Methodology: This study employed a qualitative research approach and a desk review of sixteen published literature on challenges in the food system space in Ghana, reviewing the evidence available from 2000 – 2022. Data was accessed from field notes and the Seeds of Good Anthropocene Project database, documenting interventions designed to address challenges faced in the food systems. A thematic approach was employed in analyzing the data.

Results/ Findings: The food system challenges identified from studies were categorized into seven main sub-themes: food value chain challenges, marine system challenges, lack of resources, COVID-19, Climate Change, Urban Development and policies, and Economic Challenges. Eighty seeds were identified from the seeds database that addressed challenges across the food system. Findings show that measures were put in place to address coastal food system challenges, but some of them were not sustainable.

Conclusion: This study underscores the complexity of challenges within coastal food systems, highlights the promising interventions designed to address these challenges, and emphasizes the need for comprehensive, inclusive, and strategic approaches. By acknowledging the gaps

in existing interventions and forging a collaborative path forward, stakeholders can work towards a more resilient, sustainable, and equitable coastal food system landscape in Ghana.

Keywords: Food Systems, Agriculture, Food Security, Malnutrition, Food System Interventions

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CHAPTER 1

1.0 INTRODUCTION

1.1 Background Information

Food systems are interactions between and within the biogeophysical and human environments, where diverse activities such as food production, processing, packaging, distribution, retail, consumption, and waste management occur (Hannah *et al.*, 2022). It is a complex structure co-produced with ecosystems that have evolved through many centuries of social, cultural, economic, and technical development. This structure is nonetheless diversified and incredibly diverse in a world where globalization has been gradually accelerating and still has elements representing its regional history (Savary *et al.*, 2020). In 2020, approximately 720 million to 811 million individuals faced hunger worldwide. The predicted range's mean (768 million) shows that 118 million people were hungry in 2020 than in 2019, with predictions ranging from 70 to 161 million (FAO, IFAD, UNICEF, 2021).

Food is at the crux of many of the issues humanity encounters. It can alter relationships with one another, economies, and societies (Gordon *et al.*, 2017; Pereira, 2018). Food is the principal source of sustenance for humanity on Earth, and producing food is the fundamental human activity that has altered the planet (Ellis *et al.*, 2021). Food ties people and places together locally between urban and rural areas and internationally through commerce in foods, animal feed, and fertilizer (Ericksen, 2008). The leading cause of decreasing life expectancy worldwide is currently poor diets, which include undernutrition, obesity, and micronutrient deficiencies. At the same time, over-nourishment and obesity are quickly emerging as global issues (Thompson and Scoones, 2009; Willett *et al.*, 2019). The current global food system is generally identified to be unsustainable. Nearly 800 million people are undernourished, and over one billion are overweight or obese (Meybeck and Gitz, 2017).

Establishing sustainable, robust food systems in Africa is incredibly difficult because of environmental crises, climate change, emergencies, and conflicts. For Africa to attain food security and pull people out of poverty, food systems must be climate change adapted. Two hundred and seventy-seven million, representing 22% of Africans, are undernourished. If appropriate adaptation measures are not implemented, this figure might rise to 350 million by 2050 (Braimoh, 2020). The food systems on the African continent are diversified and rich in indigenous and local knowledge, producing a wide range of ecosystem services. However, this diversity is quickly disappearing, primarily due to the effects of agriculture and urbanization (Bongaarts, 2019; Ellis *et al.*, 2021). The vulnerability of African food systems was highlighted during COVID-19, particularly in countries with limited social safety nets (Moseley and Battersby, 2020). Food systems form the foundation for the health of the world's population, but health policies nominally take these systems into account, especially in Africa (Patterson *et al.*, 2020).

Currently, more than 50% of Ghanaians live in urban areas due to migration to the city areas (Akparibo *et al.*, 2021). In Ghana, rural areas are more likely to experience food insecurity than urban ones. However, it is becoming more and more evident that city dwellers, particularly the most economically vulnerable population groups (including those residing in slums), face particular difficulties with regard to food access, quality, and safety, making them more susceptible to food insecurity and, ultimately, malnutrition (Akparibo *et al.*, 2021). Some drivers of food insecurity in Ghana are reduced agricultural output due to pests, illnesses, climate changes, low income and education levels that impede access to food and nutrition, and urbanization. Productive spaces are critical for improving food production in developing countries. However, in Ghana's existing land use planning system, uncontrolled fast urbanization and unsustainable land use practices jeopardize local efforts to boost food production (Kuusaana and Eledi, 2015). Climate change and other global changes would

diminish sustainability opportunities, particularly in low-income nations like Ghana's coastal towns (Day, Gunn and Burger, 2021).

Food systems interventions designed to address food insecurity are termed “seeds” in the Seeds of Good Anthropocene project. Seeds have been identified as innovative ideas or initiatives implemented by stakeholders across all levels, including government, businesses, individuals, and NGOs. They are mainly bottom-up interventions that can completely revolutionize food systems toward more sustainable systems (Bennett *et al.*, 2016). However, few are seen being implemented due to challenges such as a lack of support or funds. These initiatives can transform the food system's vulnerability, and their absence poses a significant risk. Political action plans and programs hardly address interdependencies along the food chain and the complexity of current global food systems, aside from the issues of food security and agricultural productivity. One reason there has not been much movement in food consumption patterns toward sustainability may be the lack of focus on broader systemic issues and, consequently, the lack of political will for improvements (Reisch, Eberle and Lorek, 2013).

Food security, nutrition, and safety are all closely intertwined. Food safety refers to the precautions to guarantee that contaminants that might cause foodborne diseases do not enter the food throughout its handling, preparation, and delivery. One of the most severe issues with food safety is a lack of cross-sectoral collaboration within the food production chain. Future achievements in food safety, public health, and welfare will be substantially determined by how well national agencies, enterprises, and other stakeholders can collaborate within the One Health framework (Boqvist, Söderqvist and Vågsholm, 2018). The One Health (OH) method to research makes sure that problems about the health of people, animals, and the environment are assessed holistically and integrated to offer a more thorough comprehension of the issue and possible solutions that would be feasible with siloed approaches (Lebov *et al.*, 2017). One Health is centered on food safety. The absence of coordination between the human health, food

safety, and animal health sectors substantially impacts significant food safety incidents (Gordon *et al.*, 2017). This study will therefore assess primary research on food systems that is currently accessible, including challenges, interventions, and ways to strengthen food systems and assure food security in Ghana using the One Health Approach.

1.2 Problem Statement

Nearly 1 billion people worldwide are hungry or malnourished, with an additional 1.5 billion overweight or obese (FAO, IFAD, UNICEF, 2021). The COVID-19 pandemic will cause 83 to 132 million people in poor nations to be undernourished. This is because of slow economic growth in 2020 and uncertain growth prospects in 2021. In 2018, 676.1 million Africans experienced moderate to severe food insecurity. This unusually high prevalence is expected to rise further as Africa experiences conflict, climate change, and economic decline (Trudell *et al.*, 2021). Even in the absence of discernible detrimental impacts on nutritional status, food insecurity can have a variety of negative implications on gender since women experience food insecurity more often than men, health and well-being, with possible repercussions for mental, social, and physical well-being (Grimaccia and Naccarato, 2022).

The food system in coastal cities in Ghana faces sustainability challenges. Climate change and other global change forcings (global temperature and heatwave increases) reduce city sustainability opportunities, particularly in low-income coastal areas (Day, Gunn and Burger, 2021). Sea-level rise, an increase in the frequency of the strongest tropical storms, a fluctuation in freshwater intake to coastal areas, sea pollution, and an increase in the severity of extreme precipitation events, including droughts, heat waves, freshwater shortages, and wildfires, are just a few of the factors contributing to this. Current climatic changes are profoundly impacting natural and human systems (Day, Gunn and Burger, 2021).

There is cause for concern as food insecurity among Ghanaians grows in tandem with urbanization and urban population growth (Kuusaana and Eledi, 2015). The peri-urban expansion has created competition for limited land resources due to the increased human population. Urbanization has quickly transferred prime agricultural lands in peri-urban regions to urban land use (Appiah, Asante and Nketiah, 2019). Changing land use patterns are a significant issue associated with rapid urban growth (Mohammed Bakoji *et al.*, 2020). Climate change and other global change forces will reduce sustainability opportunities, particularly in coastal areas in low-income countries like Ghana (Day, Gunn and Burger, 2021).

The world is at a crossroads, not only because we must overcome more challenging barriers to ending hunger, food insecurity, and all types of malnutrition but also because the vulnerability of our food systems has been exposed, allowing us to move forward more effectively and get on track toward achieving SDG 2 (FAO, IFAD, UNICEF, 2021). This study will therefore assess all primary research on food systems that is currently accessible, including challenges, bottom-up interventions, and ways to strengthen the food system and assure food security in Ghana using the One Health Approach.

1.3 Rationale of the Study

Food systems must offer food security and nutrition while supporting millions of people's livelihoods and being ecologically sustainable. These difficulties' basic dimensions are evident, and data on how improved policies might enhance food system performance is accessible in many situations (Deconinck *et al.*, 2021). However, there are considerable data and evidence gaps. This study presents an overview of evidence gaps and challenges facing food systems, proposing that more significant evidence is necessary for better policy. This can help them address new challenges posed by farmers, processors, retailers, and customers (Andam *et al.*,

2018). This study seeks to map out all our food systems' challenges through an overview of available evidence. This study will add up to the existing literature on food systems and hence, help fill the gaps in the literature using a comprehensive overview of the processes, challenges, and concepts in the food system space.

Understanding the vulnerabilities of African agricultural systems, food security, and nutrition would benefit policymakers (Moseley and Battersby, 2020). To fill these gaps, this study will add to the existing literature by mapping out the nature of food systems in coastal areas in Ghana to help in policy decisions and academia as well. Findings from this study will inform the policy decision-making process, using this study as a baseline for the policymaking process for food systems, and more innovative ideas can be implemented to tackle the vulnerability of the food systems.

Adapting Africa's food system to climate change will be vital if food security and poverty reduction are to be accomplished. Malnutrition affects around 277 million Africans (22%), which is expected to climb to 350 million by 2050 if suitable adaptation measures are not adopted (Braithwaite, 2020). For Africa to be ready for this troubling and uncertain future, resilience must be built into its food systems (Braithwaite, 2020). Food policies focusing on sustainability and health can significantly improve human and biosphere sustainability (Gordon *et al.*, 2017).

1.4 Conceptual Framework

The interconnected spheres of people, animals, and the ecosystems that make up their surroundings frequently give rise to problems that demand integrated approaches to health, such as the One Health (OH) concept. Initiatives tackling these wicked challenges frequently include complex structures and dynamics. One Health can be a comprehensive and organized

method of addressing these issues. Both the public and decision-makers need to be educated and reached out to in order to achieve this One Health goal. One Health curriculum in agriculture and food systems education programs can be a means to get the next generation interested in farming and agriculture and enhance public health by ensuring the safety and security of their food. Thanks to the One Health approach, they will learn the knowledge and gain the cooperation, teamwork, and communication skills essential to meet these problems.

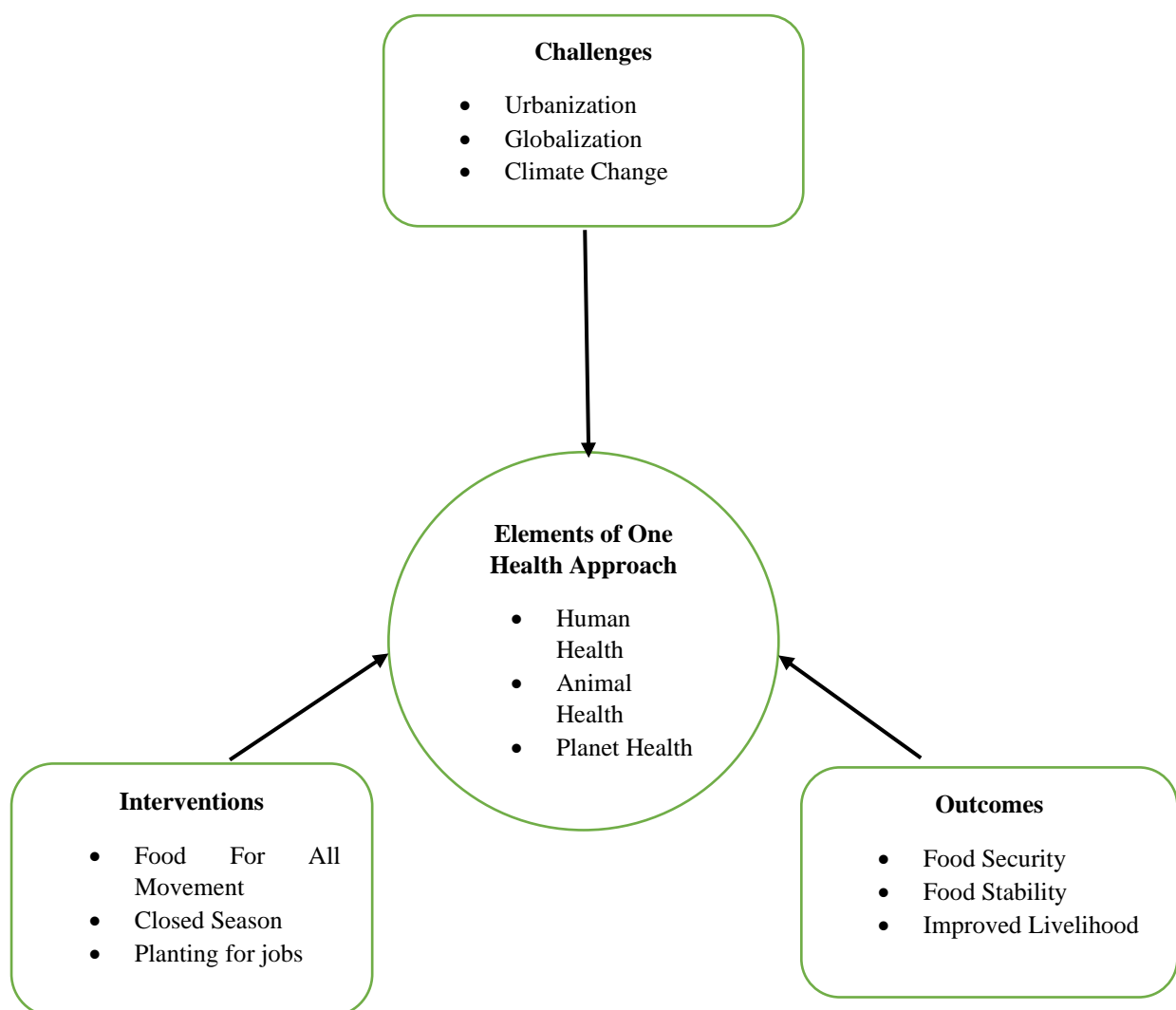


Figure 1.1: Framework of One Health Theory
Source: Adapted based on the One Health Framework

The framework shown in Figure 1.1 above explains how aspects of the one health approach are connected to problems in the food system. It discusses if these issues have any consequences for the health of people, animals, or the environment. It also focuses on how the components of the One Health Approach should be connected with the solutions created to address some of these problems. The framework will also act as a guide for determining whether the results of these challenges consider the health of people, animals, and the environment.

1.5 Research Questions

1. What challenges are within Ghana's food system (terrestrial and marine) space?
2. What bottom-up seed interventions have been designed to address these challenges?
3. Which of the challenges identified have been left out?

1.6 General Objective

This study seeks to identify and map out challenges within the food systems in Ghana and bottom-up interventions designed to address them.

1.7 Specific Objectives

1. To identify challenges within the food system space (terrestrial and marine) in Ghana using the one health approach
2. To examine bottom-up interventions (seeds) designed to address these challenges
3. To identify which challenges have been left out and how the outcomes of these interventions are linked with the One Health Approach

1.8 Profile of Study Area

Ghana is a West African country formally known as the Republic of Ghana. It is bounded on the west by the Ivory Coast, on the north by Burkina Faso, on the east by Togo, and on the south by the Gulf of Guinea and the Atlantic Ocean. Ghana's overall land area is 238,535 km² (92,099 sq mi), with a variety of biomes ranging from coastal savannas to tropical rainforests. With about 31 million inhabitants (as of the 2021 census), Ghana is the second-most populous country in West Africa, after only Nigeria. Accra is the capital and largest city; other notable cities include Kumasi, Tamale, and Sekondi-Takoradi. Ghana is a lower-middle-income country with an estimated population of more than 32 million people in 2022 and a GDP per capita of USD 2,445 in 2021. Despite national gains in lowering acute malnutrition and stunting, the Northern Savannah Ecological Zone continues to have high rates of poverty and stunting, at 21 and 28 percent, respectively (World Food Programme, 2022).

The Ukraine crisis, as well as debt and liquidity issues, have all had a severe influence on the economy. Global oil price increases and the devaluation of the Ghana Cedi versus major currencies are causing fast price increases, which may impact individuals' food security and nutrition. According to World Bank data, Ghana had the most significant food price inflation (122 percent) in Sub-Saharan Africa in 2022. Despite the tranquil atmosphere and economic possibilities that coastal areas provide the Ghanaian government and people, inadequate political leadership and irresponsible human conduct, notably climate change, have conspired to expose these places to significant challenges (Ofori, 2021).

With a population of over 32 million in 2022 and a GDP per capita of USD 2,445 in 2021, Ghana is a lower-middle-income country with high rates of poverty and stunting despite national advances in eliminating acute malnutrition (Ofori, 2021). Even while there have been improvements across the board, there are still significant differences between rural and urban regions as well as the north and south of the country. In most rural and peri-urban regions in

Ghana and the north, hunger and malnutrition are still widespread problems. It is, therefore, necessary to find out from the literature what problems persist that lead to food system challenges. This study also included interventions or studies that are 250km away from coastal areas.

1.9 Scope of Study

This study is part of the Seeds of Good Anthropocene (SOGA). The SEEDs project aims to advance the frontier of research and practice in the IDRC-funded Seeds of Good Anthropocene (SoGA) initiative by better understanding how to identify seed initiatives that have the potential to contribute to transformative change and how the emergence, development, and scaling of such initiatives through various amplification processes can be better supported. To help better direct future investments and response options aimed at promoting transformative change in African food systems, in-depth information on the goals, strategies, and contexts of individual food-related seeds in the coastal urban regions of Ghana was gathered. The Seeds of Good Anthropocene: Fostering food transformation in Africa project aims to improve our understanding of sustainable food initiatives.

The scope of this study encompasses a comprehensive examination of food systems within the coastal regions of Ghana, with a specific focus on mapping out the challenges and innovative interventions that influence these systems. Through an extensive literature review and analysis, this research seeks to identify critical challenges these systems face and highlight novel approaches, innovations, and strategies adopted to address these challenges. The ultimate goal of this scoping review is to contribute to a comprehensive knowledge base that can inform policies, interventions, and future research efforts to enhance the sustainability, resilience, and effectiveness of food systems in Ghana's coastal regions.

1.10 Organization of Report

This thesis consists of six main chapters. Chapter One introduces the topic under study. It outlines the background information, problem statement, study rationale, conceptual framework, general objective, research questions, specific objectives, the study area profile, and the study's scope. Chapter Two deals with the literature review related to the topic under study. Chapter Three details the methodology used in carrying out the study. This includes the study design, site, inclusion/exclusion criteria, study variables, data analysis, assumptions, and study limitations. Chapter Four covers data analysis, findings, and presentations of the challenges in the food system space and what has been done to address them. Chapter five (5) presents discussions and implications of the study findings. Chapter six (6) entails the summary, conclusion, and recommendations for further research.

CHAPTER 2

2.0 Literature Review

2.1 Introduction

Food systems are complex and multifaceted, encompassing various players, processes, and interactions influencing food production, distribution, and consumption. Food system sustainability has become a crucial concern in recent years as the global population grows and food demand rises. This literature review aims to provide an overview of the current understanding of food systems, explicitly emphasizing sustainability. This study reviews a range of literature, including academic articles and reports, to analyze the main issues in the food system. This chapter will review existing literature on food systems, challenges affecting the food systems, climate change in coastal regions, the One Health Approach, and food safety

2.2 Description of Food Systems

Food systems, by nature, are complex. They comprise a diverse spectrum of actors, processes, value chains, and interactions. In opposing ways, their results impact a broad spectrum of stakeholders and industries. Food systems must achieve their goals despite several unanticipated change drivers in the face of such complexity and unpredictability (Tendall *et al.*, 2015). Food systems are the networks of market and non-market actors and activities that link food production, aggregation, transportation, storage, processing and catering, distribution, preparation, consumption, waste management, and resource management. They also include agro-input suppliers (seed, fertilizer, packaging, and other suppliers) and the related regulatory organizations and activities (Dury *et al.*, 2023). Food systems have evolved tremendously since the birth of civilization. Food production, processing, and consumption are primarily domestic activities organized inside the household. Even cooking has become a

specialized business activity (Dury *et al.*, 2023). Academics and policymakers worldwide have recently been more interested in food systems (Béné *et al.*, 2019). Changes in preferences, technology, urbanization, and climate change all have an influence on how national governments see the food system. The food system impacts nutrition and health, livelihoods and jobs, and the sustainability of the planet (Tefft *et al.*, 2020). Lawrence *et al.*, (2019) assert that policies from areas like agriculture, food, health, finance, trade, and environment influence food systems because they are multifaceted socio-ecological systems involving many people with different interests and worldviews.

The future of the world is in doubt. Despite committing to eradicate food insecurity, hunger and all types of malnutrition by 2030, six years ago, it has not been able to achieve that (FAO, IFAD, UNICEF, 2021). Many of the drivers impacting food systems now were not present six years ago. Many factors threaten the security of food supplies in our world of increasing complexity and uncertainty. These include multiple global change processes (for example, climate change, urbanization, and aging population), unexpected shocks, for example, unforeseen responses of food systems to natural catastrophes, and financial and political crises (Tendall *et al.*, 2015).

The global population is expected to exceed 10 billion by 2050, increasing food demand and putting additional strain on finite resources and a threat to public health. In addition, food insecurity rates are increasing globally due to COVID-19 and the Ukraine-Russia war. In light of a number of underlying vulnerabilities, rigidities and inefficiencies in global food systems, the impacts of the war on food security must be addressed with urgent and long-term reforms and policies in order to assist the transition to healthy, egalitarian, and ecologically sustainable food systems (Ben Hassen and El Bilali, 2022). Agricultural markets remain shaky as there is no resolution to the conflict and threats of additional escalation. The supply is limited. Globally, the estimated ending stocks for 2022–2023 are at their lowest point for wheat since 2007–2008

and maize and soybeans since 2012–2013. Due to fewer plantings in Ukraine, more grains and oilseeds must be produced globally to replenish stocks and control price levels (Glauber, 2023).

Food systems in Ghana's coastal areas are complex and multidimensional, with numerous players, processes, and interactions shaping food production, distribution, and consumption. Food system sustainability has become a crucial concern recently as the world's population expands and food consumption rises. Research by Atanga and Tankpa (2021) emphasized the link between climate change, flood occurrences, and food security in northern Ghana. Although there is research on these topics in Ghana's northern area, the literature so far suggests no distinct emphasis of research that focuses on the study site's nexus of climate change, flood disasters, and food security. This gap in the literature highlights the need for more research on the impact of climate change and flood disasters on food security in Ghana's coastal areas (Atanga and Tankpa, 2021).

A descriptive assessment of Ghana's food availability changes and safety information was undertaken between 2010 and 2020 (Boadi, 2022). Peer-reviewed studies published in Ghana between 2010 and 2020 were included in the review to document household-level food production, consumption, and safety problems. The authors discovered that Ghana's food availability and safety information have changed significantly over the last decade. However, there is still a need for more outstanding studies on these concerns in coastal regions (Boadi, 2022).

2.3 Challenges in Food Systems

Food systems are rapidly evolving. A review of theory and qualitative evidence shows how food systems rapidly change due to free trade, globalization, and increased urbanization (Gillespie and van den Bold, 2017). A study by Ericksen, (2008) concurs that global

environmental change and social, economic, and political developments may strain food security and agricultural systems unprecedentedly. The food systems challenges identified include climate challenges, food insecurity, food safety, agricultural challenges as well as land acquisition.

Food security may be put under unheard-of strain due to social, political, and economic developments as well as global environmental change. These have resulted in significant changes in the availability, price, and acceptability of many types of food, resulting in a nutrition transition in many developing nations (Gillespie and van den Bold, 2017). Rising mean temperatures, rising sea levels, and increased extreme climatic events such as droughts and heat waves are all predicted to influence global agricultural systems (Nelson *et al.*, 2016). Mabhaudhi *et al.* (2019) reported that while the development of the world's food system is attributed to increasing food production, accessibility, and availability, it is also blamed for introducing "new" issues, including famine, biodiversity loss, and environmental damage.

The COVID-19 pandemic has aggravated food system difficulties, such as supply chain interruptions, food insecurity, and increased food waste (Agyemang and Kwofie, 2021). The pandemic might have various effects on food security and food systems. The COVID-19 pandemic is already impacting the supply and demand sectors of the global food systems (Of, 2022). One year ago, the battle between Russian and Ukrainian forces seemed to threaten world food security. Global supplies of essential commodities were already scarce even before the conflict. The escalating war between two of the world's leading agricultural producers endangered more than a third of the worldwide wheat trade, more than 75% of the global sunflower oil commerce, and 17% of the global maize traffic. Wheat futures prices increased by about 60% within a week of the invasion, while soybean and corn prices increased by more than 15% (Glauber, 2023). Following the global economic disruptions caused by the pandemic, the world faced the possibility of another food price problem with potentially devastating

consequences. However, as the war stretched on until 2022, global markets shifted and developed. While high prices and other challenges continued, the direst circumstances for agricultural commerce and food security were generally avoided (Glauber, 2023).

Africa's food system is burdened by several problems, such as low agricultural production, restricted market access, and poor infrastructure (Mabhaudhi *et al.*, 2019). According to the research, including underutilized indigenous and traditional crops in food systems could boost Africa's food nutrition and security (Mabhaudhi *et al.*, 2019). Climate change threatens the sustainability of food systems in Africa and is predicted to considerably influence crop productivity and water availability. In 2020, food insecurity, poverty, and displacement increased in Africa, according to a recent multi-agency report coordinated by the World Meteorological Organization (2021), exacerbating the socioeconomic and health crisis caused by the COVID-19 pandemic. These factors were attributed to shifting precipitation patterns, increasing temperatures, and extreme weather.

Coastal areas face unique challenges in the food system space, including the impact of climate change and flood disasters on food security, water resources, and crop production, changes in food availability and safety, and spatial inequalities in delivery care. Food system performance now is more dependent on climate than 200 years ago; the potential consequences of climate change on food security have been seen as the most significant worry in areas where agriculture fueled by rainfall remains the principal source of food and income.

Nelson *et al.* (2016) conducted a study using 196 peer-reviewed papers on climate change and food systems to evaluate the current direction of research in this field. The authors highlight three significant topics in the literature: (1) climate change impact on food systems, (2) food systems' contribution to greenhouse gas emissions, and (3) food systems' capacity to ameliorate

climate change. The authors propose that more multidisciplinary research is needed to address the intricate linkages between food systems and climate change.

Ghana faces a range of challenges in the area of food systems, such as the effect of climate change and flood disasters on food security and changes in food availability and safety. Studies in Ghana have revealed that the country's issues with food insecurity are particularly severe in rural communities where livelihoods rely heavily on agriculture (Kolog, Asem and Mensah-Bonsu, 2023). Climate change and other global change forces will reduce sustainability opportunities, particularly in coastal areas in low-income countries like Ghana (Day, Gunn and Burger, 2021).

2.4 One Health Approach and Food Safety

The One Health approach is a multidisciplinary approach that recognizes the interconnectedness of human, animal, and environmental health. The food system is a critical component of the One Health approach, as it involves the production, processing, distribution, and consumption of food, which can impact human, animal, and environmental health. This literature review aims to provide an overview of the state of knowledge of the One Health approach and its application to food systems and food safety. Food safety may be improved by using the One Health strategy to predict, prevent, diagnose, and manage illnesses that transmit across animals, people, and the environment (Lavilla *et al.*, 2023). The One Health strategy can encourage intersectoral action and coordination among stakeholders, essential for solving complex problems with food safety (Abukhattab *et al.*, 2022).

One of the most significant challenges with food safety is a lack of cross-sectoral coordination across the food manufacturing chain. Future successes in food safety, public health, and welfare will significantly influence how well national organizations, businesses, and other stakeholders

can work together under the One Health framework (Boqvist, Söderqvist, and Vgsholm, 2018). More research and understanding of the significance of food systems in the greater framework of One Health may provide more entry points for sustainable, culturally acceptable, and economically feasible solutions via the food system (Fresco, 2023).

2.5 Conclusion

This literature review has provided an overview of knowledge on challenges in the food systems space in general and challenges in the food system space in coastal areas, in the worldwide context, Africa, and Ghana. The review has highlighted food systems' complexity and multifaceted nature and the need for interdisciplinary research and stakeholder engagement to develop sustainable food systems. The review has also identified key themes and debates in the field, including the climate change impact on food security, changes in food availability and safety, one health approach and food safety, and sustainable agricultural practices. Overall, the review underscores the urgent need for action to develop sustainable food systems capable of meeting the needs of a growing global population while simultaneously conserving and protecting the environment and promoting human health in coastal areas and beyond.

CHAPTER 3

3.0 METHODOLOGY

3.1 Introduction

This chapter explains how the research topic was explored and why specific designs and procedures were employed. The chapter also discusses the context in which the study was conducted, the sampling technique, the data collecting instrument, the data collection protocol, the analysis, the validity, and ethical considerations in the study.

3.2 Study Design

A scoping review of the literature related to challenges in the food systems space in Ghana was conducted. A scoping review is a “type of research synthesis that aims to map the literature on a particular topic or research area, and provide an opportunity to identify key concepts; gaps in the research; and types and sources of evidence to inform practice, policymaking, and research” (Daudt, Van Mossel and Scott, 2013). This scoping review explored the challenges and significant areas of consensus in the food system space. The interventions designed to address those challenges were mapped to the challenges from the Seeds of Good Anthropocene Project database.

3.3 Source of data

3.3.1 Scoping review

The study used published papers (including quantitative and qualitative research and mixed methods) on food systems in Ghana’s coastal areas. Data was derived from databases such as BMC Journal, Science Direct, Research for Life, and Google Scholar. The phrase search approach used Boolean operators, combinations of synonyms, key names, truncations and non-

truncations, and database-specific wildcards. Phrases such as [“food systems” and Ghana’s coastal cities], [“Challenges” OR “Issues” in the food systems].

Following the searches done across all sources, 110,108 citations were obtained. In total, 35 duplicate citations were eliminated, 110,013 records were designated as ineligible, and five were removed because complete texts could not be found, leaving 55 publications to be examined. Following title and abstract screening, 55 citations were chosen for screening. To determine their relevance, the potentially eligible full texts (n = 55) were downloaded and read in their entirety. Following this level of screening, 38 citations were eliminated, leaving a final batch of 17 citations to be reviewed. The PRISMA flow chart (Figure 3.2) describes the screening process.

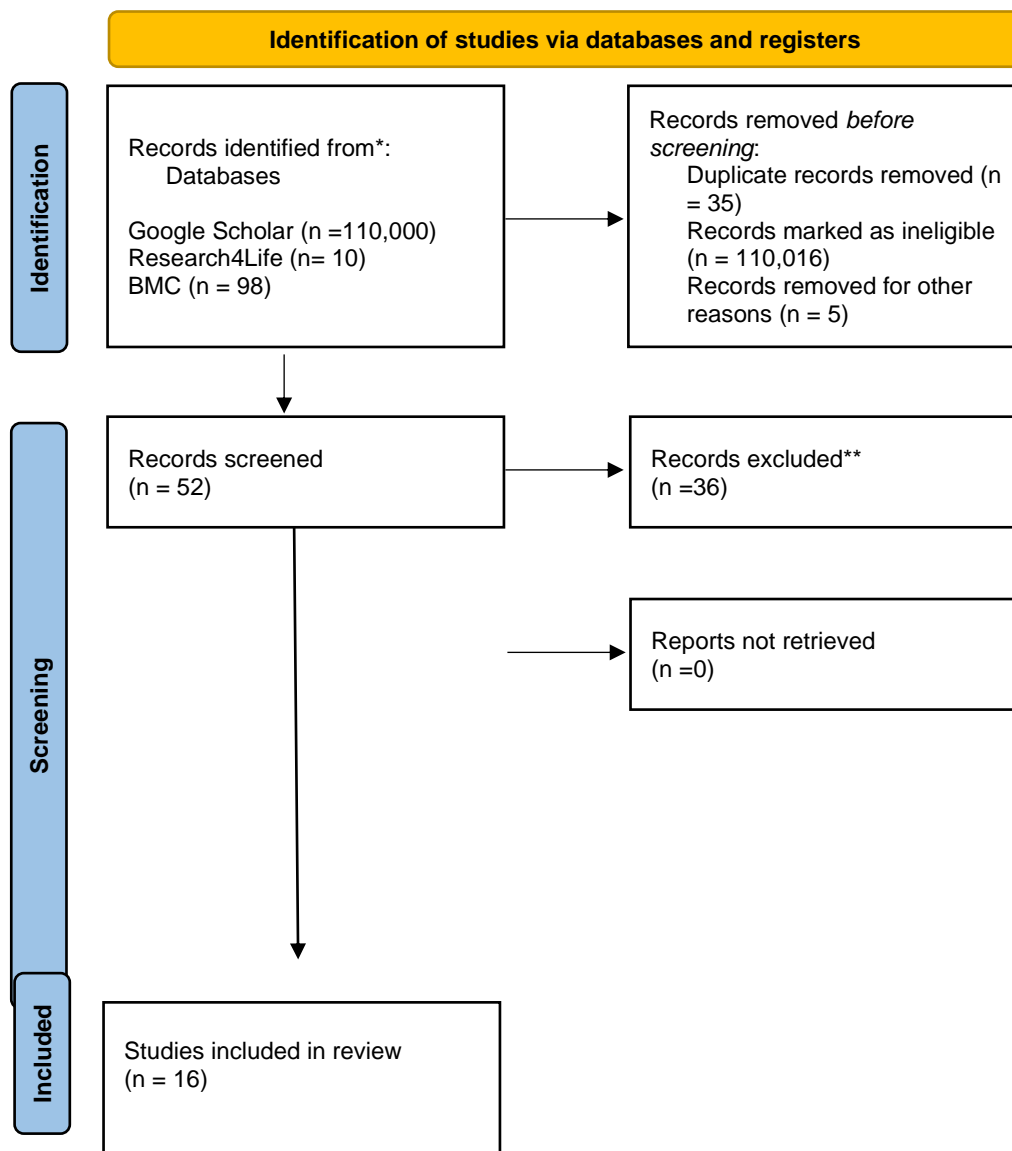


Figure 3.2: PRISMA flow chart describing the study selection process.

3.3.2 Seeds project: Data on food system innovations in Ghana

This study also used data from the Seeds project. Data was also accessed from field notes and the database of the Seeds project documenting interventions designed to address challenges faced in the coastal food systems space. Data was collected through observations and an online search and filled into a database through Google forms. Several trainings were held by the SEEDs team on what was considered a seed. A food system seed was defined by the project as

innovative ideas or initiatives implemented by stakeholders that are mainly bottom-up interventions that can completely revolutionize food systems toward more sustainable systems.

The SEEDs team designed a Google form to collect details on seeds in Ghana, Kenya and South Africa. The form was designed to collect information on the goals, objectives, strategies, and context of the seeds. Information on leverage points (Abson *et al.*, 2017), amplification evidence based on Lam *et al.* (2020), and transformation spheres (O'Brien and Sygna, 2013) were also collected (Kraaz *et al.*, 2022).

The transformation sphere looks at what sphere the seed is trying to change (practical, political and personal spheres). The practical sphere represents both climate change behaviors and technical solutions. Behavioral shifts, social and technical advancements, and institutional and management reforms are examples of these. The social and ecological processes and structures that generate the conditions for transitions in the practical realm are included in the political sphere. Individual and communal ideas, values, and worldviews determine how systems and institutions (i.e., the political sphere) are seen and influence what sorts of solutions (e.g., the practical sphere) are thought "possible".

The leverage points were based on two main categories (shallow: parameters, feedbacks, deep: design and intent). Shallow point is when the seed tries to adjust some parameters within the system and deep point is when the seed is trying to change the underlying rules and values of the system.

The evidence for amplification was based on whether the seeds were amplifying inside, amplifying out (dependent and independent), or amplifying beyond. Amplifying out refers to whether the seed has done anything to increase its lifespan or has accelerated the rate at which it exerts impact. Amplifying out (dependent) assesses if the seed's influence has spread to other locations, whereas amplifying out (independent) determines whether the seed has inspired

comparable efforts in other locations. Amplifying beyond investigates if the seed affects norms, regulations, or basic ideals that encourage individuals to live differently.

Data collection began in July 2022 and ended in July 2023. The seeds were identified through an online search, community visits and snowballing. Specific keywords and phrases aid in the online search on Google, Facebook, Twitter and Instagram. Social media analysis was conducted in search of seeds to identify initiatives that have the potential to transform the food system. Online newspaper sites were also searched through to look for publications concerning seeds.

Using the keywords from production through to processing, distribution, and consumption along with innovation/sustainability (for example, sustainable ways of processing fish in Ghana, innovative ways of fish distribution)

- Especially with Google and Twitter, measures were employed to filter most irrelevant information: using quotes to search for exact word phrases (e.g., innovative fisheries), or using asterisks, searching for multiple words at once (sustainable and innovative ways of fish processing), using much more specific words among others

Community visits were conducted in James Town, Ussher Town, Tema Harbor and Dansoman. The community visit included participant observations and informal conversations about activities of seed actors. Snowballing sampling approach was used where we gathered information about other seeds from the seeds that were identified.



Figure 3.3: Picture from field visit to Jamestown

3.4 Data analysis

The dataset had both open ended and closed ended responses. The open-ended data in the seeds were coded at a project meeting with a team of five members. The data was then exported into STATA and statistically analyzed and mapped to the challenges to present findings.

For the scoping review, a review was conducted based on food system challenges. Through a thorough search on databases, sixteen papers were included for this study related to challenges in the food system value chain. Data was extracted from these documents as texts in various thematic areas. The thematic areas were Food Value Chain challenges, Marine System challenges, Lack of resources, COVID-19, Climate Change, Urban Development and Policies, and Economic challenges. The search method was carried out by the four phases of the

PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) for scoping reviews protocol and have been described below. The extracted data in the form of text was analyzed qualitatively. The extracted data was organized into themes. Thematic analysis was applied in analyzing the extracted text(data). An exclusive coding scheme was created in Microsoft Excel to collect information from and evaluate the selected papers critically considering the objectives of this review. The pre-test of this coding scheme was modified, refined, and simplified to address possible difficulties. The scheme was examined by cross-checking to further ensure the methodological approach's quality and consistency. The research team agreed regarding the coding of the articles. Sixteen papers were used for this study and content analysis was done. Codes from these were categorized into themes (Food Value chain challenges, Marine System challenges, Lack of resources, COVID-19, Climate Change, Urban Development and Policies, and Economic Challenges)

3.4.1 Framework for Scoping Review

Arksey and O'Malley's (2005) framework, expanded by Colquhoun et al. (2010), and further explained in the Joanna Briggs Institute Reviewers Manual: This scoping review was conducted using Scoping Reviews to address the lack of uniformity in reporting. The framework provides five important processes in performing a scoping review: (i) determining the research topic, (ii) locating relevant studies, (iii) study selection, (iv) charting the data, and (v) compiling, summarizing, and reporting results. The following is a full description of how the framework was used:

Stage 1: Identifying the Research Question

The primary research question was what challenges currently exist in the food system space in coastal areas in Ghana? This review sought to understand the literature related to challenges in

the food systems space in Ghana's coastal Areas. Thus, this review addressed the critical question of "What studies currently exist about food system challenges in Ghana?"

Stage 2: Identifying Relevant Studies

A comprehensive literature search was conducted using online databases such as BMC Journal, Science Direct, Research for Life, and Google Scholar, as well as other relevant sources such as thesis, dissertations, and grey literature. The phrase search approach used Boolean operators, combinations of synonyms, key names, truncations and non-truncations, and database-specific wildcards. Phrases such as ["food systems" and Ghana's coastal cities], ["Challenges" OR "Issues" in the food systems]. The search only included English language sources. The search was limited to studies published between 2000 and 2022.

Stage 3: Study Selection & Eligibility

Based on the inclusion/exclusion criteria, the search results of peer-reviewed articles were screened for relevant studies. Meetings were held by the study team to discuss and ensure uniform interpretation and application of inclusion/exclusion criteria. The appropriate studies were examined for duplication, and those found were eliminated. To reduce selection bias, a pair of researchers screened the study titles and abstracts from the selected papers. Reviewer disagreements about the title and abstract were resolved through conversations until a consensus was reached. Two reviewers evaluated full-text papers for eligibility. A third reviewer settled disagreements between reviewers during the entire paper stage.

Inclusion & Exclusion Criteria

Inclusion Criteria

All published literature, reviews, and reports on food systems available from the year 2000 from several databases were used. Papers were selected from the year 2000 because those were the times when human activities contributed to climate change and urbanization that affected

the food systems. Qualitative studies, quantitative studies, mixed method, and academic/technical reports published in English and Ghana that presented findings in the food systems space and were available in full-text options online were used for this study.

Exclusion Criteria

The study did not include all published literature that was not in English or within the stipulated year range. Studies that did not meet the inclusion criteria were also not used.

Stage 4: Charting/extracting the data

Data was extracted on publication characteristics of the included studies using a standardized data extraction form (attached in appendix). A data charting form was created on Microsoft Excel, where all the necessary extracted data from the included sources of evidence were populated. This includes authors, date, country, the aim of the study, study design, key findings, and conclusion. The data extraction was conducted by two investigators independently. The data in Microsoft Excel was coded, and a narrative synthesis was conducted. The evidence was then mapped against the strategies meant to address these issues in each research. The findings are reported and presented in accordance with the issues explored in the critical food system challenge. This review does not assess the methodological quality of the included studies because that was not the study's goal.

Stage 5: Collating, summarizing, and reporting results

The Seeds database was statistically analyzed. A narrative explanation of the findings from the various sources of evidence was also given and connected to the findings from the seeds database. To extract the topics critically analyzed concerning the study purpose, thematic content analysis was used. To describe the retrieved data, a narrative report, tables, and charts were created.

3.5 Ethical Consideration

Ethical Approval for the SEEDs Project was sought from Stellenbosch University and Ensign Global College (Project ID: 24527). Approval for this study was sought from the ethics committee of Ensign Global College (ENSIGN/IRB/EL/SN-234). This study does not involve human subjects, so informed consent was not used, and there were no risks.

3.6 Assumptions

Complex interactions between diverse components such as production, distribution, consumption, and waste management characterize food systems in Ghana's coastal areas. These food systems are thought to be impacted by various problems and possibilities, ranging from environmental elements and socioeconomic situations to cultural behaviors and legislative frameworks. Furthermore, it is expected that a range of interventions exists within these coastal food systems that have the potential to solve existing difficulties while also contributing to the overall sustainability and resilience of the food supply chain. The study will summarize all the challenges from available primary research related to food systems. This will enlighten stakeholders on the difficulties facing the food system and promote the development of measures to establish resilient food systems.

3.7 Limitations

The main limitation is that some of the seeds have ended. They were project based and only lasted for a few months or years. Some of the seeds were also not available online. The scope of literature was a limitation in this study. The findings of the study relied heavily on the available literature. A limited number of studies relating to challenges in the food system in Ghana's coastal areas affected the study's comprehensiveness. Also, the quality and reliability of data in the literature may lack rigor which can affect the findings of this study.

CHAPTER FOUR

4.0 RESULTS

4.1 Introduction

The result of this study was presented based on the following objectives of the study: (i) To identify challenges within the food system space (terrestrial and marine) in Ghana using the One Health Approach (ii) To examine bottom-up interventions (seeds) designed to address these challenges. (iii) To identify which challenges have been left out and how the outcomes of these interventions are linked with the One Health Approach. The study findings are presented in two main parent themes: terrestrial food system challenges and marine food system challenges. These were further broken down into seven main sub-themes, Food Value chain challenges, Marine System challenges, Lack of resources, COVID-19, Climate Change, Urban Development and Policies, and Economic Challenges with 47 codes. The following sections present the key results according to the themes of food system challenges, mapped to the interventions designed to address these challenges, as well as a summary of the evidence of the challenges that could be useful to Ghanaian policymakers.

4.2 Characteristics of Studies Included

The features of the included studies are summarized in Table 4.1. The review comprised 16 papers in total. The year of publication varied between 2011 and 2022. The research was carried out in Ghana's urban or peri-urban areas. The included research covers the terrestrial and marine food systems in Ghana. Findings show that measures were put in place to address coastal food system challenges, but some of them were not sustainable enough so there is the need to encourage and strengthen more bottom-up interventions to curb this menace.

Table 4.1: Characteristics of Studies Included

Citation	Year	Title	Purpose/Rationale	Major Findings
Boadi P, Gyimah FT, and R Aryeetey	2022	Descriptive Analysis of Changes In Ghana's Food Availability And Food Safety Information Between 2010 And 2020	As part of formulating food-based dietary guidelines for the country, this study assessed the information on the existing status and trends linked to food production, commerce, safety, and consumption in Ghana.	From 2010-2018, per capita food production and consumption were higher in all categories except vegetables and fish.
Joseph A. Yaro, Department of Geography and Resource Development, University of Ghana	2013	Building Resilience and Reducing Vulnerability to Climate Change: Implications for Food Security in Ghana	The main question addressed by this paper is 'Which aspects of food systems are most vulnerable to climate change, and how will/does this affect the food security of households?'	Climate change's food production losses in Ghana cause the rural poor to rely heavily on agricultural cultivation, causing insurmountable challenges in combating food insecurity. This leads to limited market access and limited access to alternative livelihoods.
Elizabeth Robinson, Shashidhara Kolavalli, and Xinshen Diao	2012	Food Processing and Agricultural Productivity Challenges: The Case of Tomatoes in Ghana	Ghana's agriculture sector appears to be losing out to imported processed food products and cannot compete because of low productivity.	Ghana has attempted and failed several times to revive successful largescale tomato processing.
Irene Susana Egyir, Kwadwo Ofori, Godfred Antwi & Yaa Ntiamoa-Baidu	2015	Adaptive Capacity and Coping Strategies in the Face of Climate Change: A Comparative Study of Communities around Two Protected Areas in the Coastal Savanna and Transitional Zones of Ghana	This research aims to make a case for communities around the forest and wetland-protected areas. There is no doubt about the capacity strengthening of all households vulnerable to changing climatic factors.	The study examines households' coping strategies in some areas of Ghana, considering changing climatic conditions and loss of wildlife access due to protected areas.

Isaac Koomson & Sefa Awaworyi Churchill	2021	Ethnic Diversity and Food Insecurity: Evidence from Ghana	Ghana serves as a case study due to its high food insecurity rate, with over 3 million people classified as highly vulnerable or food insecure. Additionally, a quarter of children under five are chronically malnourished. The country's ethnic diversity makes it crucial to analyze the link between ethnic diversity and food insecurity.	Ethnic diversity increases food insecurity, with trust, criminal violence threats, and war/conflict being key channels influencing this relationship.
Henry Anim-Somuah, Spencer Henson, John Humphrey, and Ewan Robinson	2013	Strengthening Agri-Food Value Chains for Nutrition: Mapping Value Chains for Nutrient Dense Foods in Ghana	The report briefly reviews the undernutrition situation in Ghana, focusing on the key. Micronutrient deficiencies that impact nutrition outcomes and the populations most affected by Undernutrition.	The report analyzes value chains for groundnut and complementary food products in Ghana to identify their potential for addressing undernutrition, challenges in promoting consumption, and options for overcoming these challenges.
Astrid Elise Hasselberga, Inger Aakrea , Joeri Scholtensb , Ragnhild Overåc , Jeppe Koldingd , Michael S. Banka , Amy Attere , Marian Kjellefolda	2020	Fish for food and nutrition security in Ghana: Challenges and opportunities	Ghana has undergone rapid economic expansion in recent decades. However, rising inequality, uncertainty in fish availability, and unsustainable fisheries management pose a threat to local food and nutrition security.	Our review emphasizes the necessity of sustaining the viability of small fish populations in order to improve micronutrient availability, address micronutrient deficiencies in Ghana, strengthen women's roles in decision-making, and promote female education. Furthermore, empowerment in the fisheries industry is a critical technique for improving FNS in the region.
Raphael Ane Atanga and Vitus Tankpa	2021	Climate Change, Flood Disaster Risk, and Food Security Nexus in Northern Ghana	This research seeks to review the nexus of climate change and flood disaster impacts on northern Ghana's food security and their implications on the region's food security.	The study reviewed the impacts of climate change, flood disasters, and food security in northern Ghana. Results showed a connection between extreme weather events like droughts, rainfall variability, and floods,

				which worsen food insecurity. Flood disasters impact food availability, access, utility, and stability, making food insecurity a common issue.
Callum Nolan	2019	Power and access issues in Ghana's coastal fisheries: A political ecology of a closing commodity frontier	Academics use commodity frontiers to understand capitalism's expansion and challenge existing hegemonies and control systems. This paper explores how capitalist expansion affects access to critical resources in Ghana's small-scale marine fishing community, focusing on power and access.	The paper reveals increasing difficulty accessing fish and resources, leading to unsustainable fishing methods. Overfishing by foreign trawlers disproportionately affects certain community members, compounding existing vulnerabilities due to gender and class.
Divine Odame Appiah, Felix Asante and Bernice Nketiah	2019	Perspectives on Agricultural Land Use Conversion and Food Security in Rural Ghana	Rapid peri-urbanization in Ghana's Asante-Akim South district leads to increased demand for peri-urban lands, affecting households' decisions to convert to residential and commercial land uses. This paper examines the trade-off in food production.	We report the increasing rate of agricultural land. Uses conversions were a result of increasing demand for residential and commercial land usage at The expense of agricultural land uses. Converting prime agricultural lands into other land uses was seen as profitable for agricultural expansion
Andrew Booth, Amy Barnes, Amos Laar, Robert Akparibo, Fiona Graham, Kristin Bash, Gershim Asiki, Michelle Holdsworth	2021	Policy Action Within Urban African Food Systems to Promote Healthy Food Consumption: A Realist Synthesis in Ghana and Kenya	Obesity and nutrition-related non-communicable diseases (NR-NCDs) in Africa increase due to urbanization and changing food environments; policy action is limited; socio-economic and political factors must be considered.	Five policies navigate complex pathways influenced by global, national, and local contexts, affecting food accessibility, affordability, availability, consumer relationships, and globalized trade. Coherent laws and government capacities are essential.

Samuel Nii Ardey Codjoe, George Owusu	2011	Climate change/variability and food systems: evidence from the Afram Plains, Ghana	While there are many studies on the impacts of climate change and variability on food production, few Studies are devoted to a comprehensive assessment of the impacts on food systems.	Understanding the local environment and household reactions is crucial for establishing successful solutions for mitigating the potentially negative effects of climate change on food security in rural Ghana.
Isaac Okyere, Ernest O. Chuku, Bernard Ekumah, Donatus B. Angnuureng, Justice K. Boakye-Appiah, David J. Mills, Raymond Babanawo, Noble K. Asare, Denise. Aheto & Brian Crawford	2020	Physical distancing and risk of COVID-19 in small-scale fisheries: a remote sensing assessment in coastal Ghana	This study aimed to provide sound scientific evidence as a basis for informed policy direction and intervention for the artisanal fishing sector in These are challenging times.	Crowding risk at landing beaches is independent of population, requiring equal attention and urgency for all coastal landing sites to prevent and mitigate disease spread.
Kwaw S. Andam, David Tschirley, Seth B. Asante, Ramatu M. Al-Hassan, and Xinshen Diao	2018	The transformation of urban food systems in Ghana: Findings from inventories of processed product	Urban food systems in Ghana are evolving due to rapid urbanization and household income growth. Due to urbanization, imports, and domestic processing and packaging, retail inventories reveal surprising outcomes.	Imports predominate, particularly for milled rice and tomato paste, with larger percentages in smaller cities than in Accra. Traditional retail establishments sell more imported goods than modern retail outlets.
Elias Danyi Kuusaana, Joyce Angnayeli Eledi	2015	Customary land allocation, urbanization and land use planning in Ghana: Implications for food systems in the Wa Municipality	Uncontrolled urbanization and non- compliant land use practices have exacerbated the potential for urban food production in metropolitan areas.	The study found customary stakeholders in Wa Municipality are converting agricultural land to urban uses, with land use plans rarely enforced. Priorities are shifted to residential and commercial land, affecting agricultural lands. Weak institutional linkages and reactive planning systems need improvement. Local governments should partner with landowners to reserve high- potential agricultural land for sustainable urban food production.

Francis Zana Naab, Romanus Dogkubong Dinye And Raphael Kasim Kasanga	2013	Urbanisation And Its Impact On Agricultural Lands In Growing Cities In Developing Countries: A Case Study Of Tamale In Ghana	This research uses empirical evidence from Tamale, Ghana, to analyze the impact of fast urbanization on agricultural areas in developing cities.	Urbanization negatively impacts poor farming communities in Tamale, requiring policy focus on protecting prime agricultural lands as livelihood sources. Urbanization is necessary but should not deprive rural communities of their primary source of income.
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4.3 Challenges within coastal food systems space in Ghana

The challenges identified from studies were categorized into seven main sub-themes, Food Value chain challenges, Marine System challenges, Lack of resources, COVID-19, Climate Change, Urban Development & Policies, and Economic Challenges.

4.3.1 Food Value Chain Challenges

Food systems are the interactions between and within the biogeophysical and human environments, where various activities range from food production to food consumption, including food processing, packaging, distribution, retail, and waste management. Given the complexity of today's food systems, it is crucial to recognize and remove challenges that prevent producers from reaching processing, value-adding, and end markets. Below are some codes that emerged from the value chain challenges.

Food Insecurity (n=2) was reported to persist in Ghana, focusing on children being malnourished. This is mainly because Ghana lacks a comprehensive method for monitoring food insecurity among vulnerable people. Also, Ghana's ethnic variety dynamics make it an ideal case study for examining the relationship between ethnic diversity and food insecurity. Food accessibility, use, and availability were further issues identified. Below are some quotes to support it:

“In 1996, the Rome Declaration on World Food Security highlighted food availability, accessibility, and utilisation as the three dimensions of food security. Food availability includes producing, distributing, and exchanging food, whilst food accessibility entails acquiring food. Food utilisation has a central element of food safety and includes consuming and deriving benefits from food. The stability of these three dimensions is central to attaining

food security. Moreover, failure to meet any of these three dimensions leads to food insecurity. Food insecurity and hunger are closely related and have simultaneously been monitored” (R16)

“In Ghana, the number of severely and moderately food insecure people rose from 13.6 million between 2014 and 2016 to 15.2 million between 2017 to 2019. It is not surprising that food insecurity is a national concern prioritized by sectors such as food and agriculture (R16)”

The food system also confronts problems with post-harvest food waste and inadequate storage space (n=2). Inadequate storage facilities cause the loss of food products, mainly fruits, throughout the harvesting and handling processes. Food and nutrition security in Ghana may be at risk as a result. Malnutrition/undernutrition (n=2) remains an issue in the food system because we fail to address the underlying circumstances required to increase consumption of nutrient-dense foods.

“the transportation system—especially feeder roads that link food production areas and major markets— is presently inadequate and is highly vulnerable to the intense climate extremes that are anticipated during the coming decades. Post-harvest storage losses of all cereals are estimated to be between about 8% (R4)”

Table 4.2: Coding frame for themes, sub-themes, and codes organization

Themes	Codes	Sample Quotes
Food Value Chain Challenges	<p>Food Insecurity Prevalence of Imported Foods Issue of Quality Packaging Food availability, access, and utilization Post-harvest food waste and inadequate storage capacity Undernutrition/Malnutrition Inadequate dietary diversity Consumption of foods rich in micronutrients Ethnic Diversity Use of agrochemicals Underutilized consumption of indigenous foods Seasonality of foods Food Safety health issues Food adulteration</p>	<p><i>“Nutrient-sensitive programmes aimed at agriculture and the food system are needed to increase the consumption of diverse food types, with special attention to affordability, since these populations are already vulnerable to caloric malnutrition”.</i></p>
Marine System Challenges	<p>Exploiting fish stock A global hotspot for illegal fishing Saiko fishing Changing dynamics of power and access in the coastal frontier</p>	<p><i>“As much as one third of fish caught in the region is thought to have been done so illegally, with vessels operating without licences, under false flags and entering inshore exclusion zones that are reserved for artisanal fishers”</i></p>
Lack of resources	<p>Land Acquisition Inadequate transportation system High food quality composition database Subsidies and incentives for Agriculture not encouraging Transportation Women in the fishing sector have restricted access to funding and training. Low level of social, financial, natural, and human capital Limited adoption of new technologies Lack of institutional support Marketing System Resource Availability</p>	<p><i>“Although their roles in the fisheries are considered essential, Ghanaian women have limited access to funding, education and institutional support compared with their male counterparts”</i></p>

COVID 19	Shifting consumer preferences Market Access Border Restrictions	<i>“Changing consumer demands, market access and border restrictions among others, are predicted to be the major drivers of the impact of COVID-19 on fisheries”</i>
Climate Change	Land Degradation Heat Waves Floods Food Unavailability	<i>“Climate change related events including prolonged droughts and floods affect food security in the site”</i>
Economic Challenges	Increased food pricing Economic Inequality Reduced Prices of food crops on the international Market	<i>“Prices of foodstuff have increased because the demand for food by the increasing population is high compared to the quantity of food supplied in the market”</i>
Urban Development and Policies	Rapid Urbanisation Urban development Agriculture Land Use Trade-off on Food Production Non-compliant land use systems Lease land for urban uses rather than agricultural purposes Land tenure systems Less Policy and program attention	<i>“Rapid peri-urbanization has resulted in increasing demand for and pressure on peri-urban lands at the expense of agricultural lands”</i>

Source: Review of Literature

Furthermore, underutilized consumption of indigenous foods and foods rich in micronutrients was prevalent. Deficiency in certain micronutrients essential for growth, especially in children, may lead to malnutrition and food security. The issues identified in the food value chain are deeply intertwined. The other challenges of interest were the seasonality of foods, food adulteration, issues of food safety, and quality packaging.

4.3.2 Marine System Challenges

Some of the challenges identified in the marine food systems by the review are the over-exploitation of fish stock, Ghana's coastal areas as a global hotspot for illegal fishing, "saiko" fishing, and the changing dynamics of power and access in the coastal frontier. Saiko fishing is one-way international trawlers have deepened the coastal frontier. This includes selling frozen juvenile fish taken as bycatch by industrial trawlers to artisanal fishermen using specially modified canoes. Previously dumped at sea owing to being young or an undesired species, these fish are gradually becoming a traded item. This is a challenge because it directly competes with canoe fishermen and oversupplies local markets with cheap and low-quality fish.

The European Union gave Ghana the yellow card a few years ago to signal unlawful fisheries. A third of all fishing was done illegally due to unlicensed vessels, the use of chemicals for fishing, and light fishing, which may not be suitable for human consumption. This restricts access to safe, nutritious fish, which impacts human, animal, and environmental health. The changing dynamics of power and access at the coastal frontier affect access to fishing grounds, fish, capital, and fish for processors.

"Access is obtained through private agreements, bilateral agreements with the European Union and often illegal fishing, of which Western Africa is considered a global hotspot. As much as one third of fish caught in the region is thought to have been done so illegally, with vessels operating without licenses, under false flags and entering inshore exclusion zones that are reserved for artisanal fishers (R7)"

4.3.3 Lack of resources for production

Resource availability plays a vital role in the success of any endeavor. On the agricultural frontier, land acquisition (n=2) poses a significant challenge to the food system space. This is due to increased demand for land due to more people relocating to urban areas. People in peri-urban regions increasingly purchase land for residential or commercial reasons other than agriculture. Some chiefs and landowners have political authority over the lands, making distributing areas for agricultural use difficult.

“Many people acquire land for agricultural, residential and commercial purposes. Just a few (3.2%) people now acquire land for agricultural purposes whereas commercial and residential land acquisition accounted for 22.6% and 61.3% respectively (R8)”

Another main contributor to post-harvest losses in the food systems sector is inadequate transportation systems (n=2). Access to food depends on a transportation network similarly harmed by floods, reducing the capacity to transfer food to people in need. Food security is in danger as a result of the region's already inadequate food storage and processing facilities, physical destruction of the transportation network, and instability in the region's food supply.

“the transportation system—especially feeder roads that link food production areas and major markets— is presently inadequate and is highly vulnerable to the intense climate extremes that are anticipated during the coming decades. Post-harvest storage losses of all cereals are estimated to be between about 8%. Improvements in rural transportation will help enable farmers to market surplus production (R4)”

Moreover, low social, financial, natural, and human capital levels and the limited adoption of new technologies implicate food systems. These can be attributed to the unavailability of such resources that will produce better food outcomes. Modern technology may help agricultural systems enhance food production, distribution, livestock, and fisheries. There is also limited

funding and training for women in the fisheries sector to empower them to process safe, healthy, nutritious fish for consumption. Also, subsidies and incentives for agriculture are not encouraging, which propels people to engage in other commercial activities with more value.

Lack of institutional support, market systems, and high food quality composition databases were identified as some of the challenges related to resource unavailability that impact the food system in a negative sense. All these challenges can potentially affect environmental, human, and animal health using the one health framework.

4.3.4 Climate Change

Climate change (n=7) was a widely reported challenge faced by the food systems. Climate change is a long-term shift in weather data shown as a likely change in average or extreme weather conditions. Climate change exposes the vulnerability of food systems. It is characterized by a delay in the onset of rainy seasons, heavy or very little to no rainfall, heat waves, drought, and floods. These factors pose a threat to food production. Agriculture relies heavily on climate. Hence any change in the climate impacts the output of plants and animals. Thus, both directly and indirectly, climate change can impact the food supply through flooding. It affects food availability, access, utility, transportation systems, and mixed opportunities in terms of processing and storage of food. Floods destroy farms, livestock, and crops, leading to a decline in food productivity. Rainfall variability due to climate also affects food processing and storage. Land degradation occurs due to changing climates which inadeptly affects food production. The fishing industry is not excluded from its vulnerability to the changing climate: coastal erosion, frequent storms, and strong waves. Here are some quotes below to support the theme:

“According to the respondents climate change provides mixed opportunities in terms of processing and storage of food. This is because drying is a key component of most of the

storage techniques. Thus, extreme dryness will aid processing and storage, while flooding may hamper food storage (R4)”

“Climate change related events including prolonged droughts and floods affect food security in the site (R9)”

4.3.5 COVID-19

Coronavirus negatively impacted different sectors worldwide, and the food systems were not left out. Fishing communities were considered high-risk populations due to the movement of fishermen and the risk of contaminating the fish due to poor hygiene practices. Changing consumer expectations, market access, and border constraints, among other factors, were the primary drivers of COVID-19's influence on fisheries. The pandemic also threatened food security because more people were restrained and malnourished due to the inability to access good food. This is a quote to support the theme:

“Changing consumer demands, market access and border restrictions among others, are predicted to be the major drivers of the impact of COVID-19 on fisheries (R3)”

4.3.6 Economic Challenges

Economic challenges pose dire implications for food systems. Economic inequalities in the disparity of distribution of income to food system areas make food inaccessible. High food pricing (n=3) is one of the economic challenges associated with the food system. The increase in food prices is also a result of the high cost of factors involved in food production, including transportation and agricultural inputs. The contexts of availability, accessibility, and cost characterize food security. So, it becomes problematic and poses a significant threat to food security when food prices are high. Seasonality of foods/fish and low production due to other factors also account for the high food pricing. The high prevalence of imported foods due to

the demand for processed foods also affects food pricing due to low productivity. The high cost of fuel for the transportation of food crops could also influence the pricing.

“Prices of foodstuff have increased because the demand for food by the increasing population is high compared to the quantity of food supplied in the market (R6)”

On the contrary, reduced food crop prices on the international market, followed by additional subsidies in exporting nations, have mostly ruined the profitability of small-scale farming, even for those with commercial tree crops.

4.3.7 Urban Development and Policies

Policies regarding land acquisition and the rapid peri migration of more people into urban areas play a significant role in some of the challenges that affect the food systems in coastal areas. There is less policy and program attention regarding underutilized food crops that can contribute immensely to food security. Another challenge is the policy about land tenure systems. In Ghana, lands are still under customary tenure, where traditional leaders have undue power in planning. The subject of urbanization, land use, and food systems heavily relies on the land tenure structure. Land values for previously rural places rise along with urbanization.

“Rapid peri-urbanization has resulted in increasing demand for and pressure on peri-urban lands at the expense of agricultural lands(R6)”

As a region gets more urbanized, agricultural land use systems and practices face increasing threats from new urban residents and become increasingly insecure. Most families and stools find it more convenient to lease their lands for urban uses than to keep them for agricultural use due to the high land values and high demand in metropolitan and peri-urban zones. A trade-off between agricultural land utilization and food production also exists. There is no denying

that the worrisome increase in peri-urbanization and its associated activities has resulted in an increasing demand for agricultural lands for residential and commercial usage.

4.3.8 A food systems map of Ghana's coastal areas

Figure 4.1 uses a top-to-bottom layout; on the righthand side we can see the key categories of 'challenges', 'interventions', 'actors' and 'outcomes. Within each grouping there are boxes which refer to different types of things. These are connected by different types of arrows. The diagram begins with challenges identified in the fishing sector, the interventions that were enacted to solve these challenges, actors responsible and what outcomes or likely/outcomes the intervention was going to achieve. Some of the challenges identified in the sector were Illegal, Unreported and Unregulated fishing, Issuance of the Yellow Card by European Union, Plastic Waste, Unhealthy conditions surrounding fish processing and Respiratory Tract Interventions

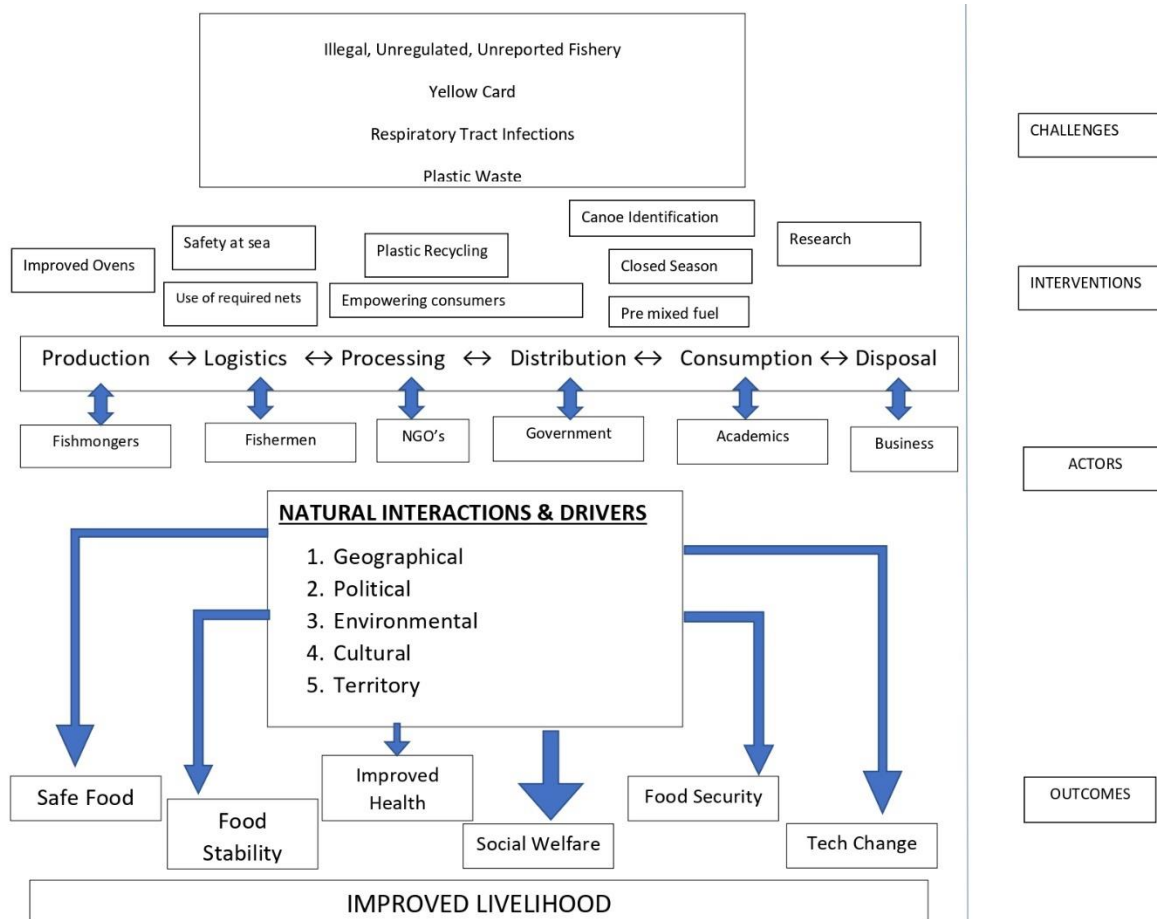


Figure 4.4: Food systems map (Marine)

All of these problems led to the emergence of several innovative initiatives, which we refer to as "seeds" from various actors. Government, NGOs, academics, businesses, fishmongers, and fishermen were all recognized as actors. The interventions listed in the diagram are indicated right on top of the actors that implemented them. Because the food chain system is interrelated, it emerged between the interventions and their actors. The actors who have been identified have a range of food chain experience, and the majority of these interventions also touch all aspects of the system, from production to processing to consumption.

Beneath the actors is a box which talks about external drivers and natural interactions that directly/indirectly affects the outcomes that these actors intended to achieve. This could be a negative/positive influencer. The long-term outcomes of the interventions were to achieve

improved livelihoods which will be achieved by the short-term outcomes which include: food stability and safe food, improved health, social welfare, food security and technological advances. The dotted line from the interventions also shows a linkage of the outcomes of the interventions.

4.4 Characteristics of SEEDs identified

4.4.1 Seed source

Seed source is the medium through which the information about the seed was obtained. The sources were social media, key informant, website and report (Table 4.3). Seeds identified from websites and reports constituted the majority (73.4%). There were also seeds that were sourced through key informants which represented 27.8% and 11 (13.9%) were sourced through social media. Some of the seeds were also identified as a combination of two or more sources.

Table 4.3: Seed Source

Seed Source	Frequency	Percentage (%)
Social media	11	13.9
Key Informant (i.e. word of mouth)	22	27.80
Website, report etc (written material publicly available)	58	73.40

Source: Database of SEED Project

4.4.2 Coastal seed type

The seed types were either marine, terrestrial or intertidal. Some seeds had both or more components. Terrestrial refers to a seed that only works in a terrestrial ecosystem (even if found in a coastal zone); marine refers to seeds operating in the marine environment and intertidal refers to seeds working at the interface (for example mangroves). Majority of the seed types

were terrestrial (64.9%) followed by marine seed types that represented 49.4%. Intertidal seed types were 4 in number representing 5.2%.

Table 4.4: Coastal Seed Type

Coastal Seed Type		
	Frequency	Percentage (%)
Terrestrial	50	64.90%
Marine	38	49.40%
Intertidal	4	5.20%

Source: Database of SEED Project

4.4.3 Seed aims to transform which part of the food system

This characteristic looks at what component of the food system the seed is trying to transform. Underlying ecosystem functioning (e.g., improve biodiversity, other ecosystem services necessary for food production), Food Production, Distribution (processing, logistics, shipping), Consumption (e.g., retail, demand and preferences), and broader institutional environment for food systems (policies, institutions, funding) were the components. Most of the seeds (n=34) were focused on food production which represented 42.5%. This was followed by seeds that were trying to transform underlying ecosystem functioning (30%) i.e., improve biodiversity and other eco system services necessary for food production. Distribution also constituted 25% with broader institutional environment for food systems and consumption at 23.4 and 21.3% respectively.

Table 4.5: Seed aims to transform which part of the ecosystem

Seed aims to transform which part of the ecosystem		
	Frequency	Percentage(n%)
Underlying ecosystem functioning	24	30
Food Production	34	42.5

Distribution	20	25
Consumption	17	21.3
Broader institutional environment for food systems	19	23.4

Source: Database of SEED Project

4.4.4 Type of seed actor

This refers to who does the project (runs things) not funders or partners that help with consultation (Table 4.6.). Civil Societies and NGOs (42.7%) were responsible for running most of the initiatives. Businesses (28.7%) also run these initiatives for profit. Grassroots (citizen groups, associations, more informal organizations) also represented 23.8% of who run the initiatives. Academics/Research, Government and Cooperative for Social enterprises represented 17.5%, 11.3% and 10% respectively. Some of the seeds also had a combination of these categorizations.

Table 4.6: Seed Type

Seed Type		
	Frequency	Percentage (%)
Government	9	11.3
Civil Societies, NGOs	34	42.7
Academic/Research	14	17.5
Business/For Profit	23	28.7
Cooperative for social enterprises	8	10
Grassroots (citizen groups, associations, more informal organizations)	19	23.8

Source: Database of SEED Project

4.4.5 Action arena

For what the seeds were working on, the options varied from advocacy/education, networking, Capacity-building (supports other projects through know-how; helps project development), funder, a project that has on ground project and new product/technology 41.3% of the seeds

(n=33), had on-ground projects that were currently running followed by (n=29) that worked on advocacy/education representing 36.3%. Twenty-seven (33.8%) of them were working on a new product/technology and the rest were either business, capacity building, supporting other projects and networking. Some of the seeds were also working on targeting two or more of the arenas.

Table 4.7: Action Arena

Action Arena		
	Frequency	Percentage (%)
Advocacy/Education	29	36.3
Networking	10	12.5
Capacity Building	25	31.3
Funder	3	3.8
Project based	33	41.3
New product/Technology	27	33.8
Business	2	2.6
Insurance Policy	1	1.3
Provide certification	1	1.3

Source: Database of SEED Project

4.4.6 Seed Has legal status

Legal status refers to being more "institutionalized" for example it's an official business or NGO. Non legal status means that they are usually at their inception, they are a group or collective but don't have official recognition from the state. Almost all the seeds (n=78) had a legal status which represented 97.5% out of the 80 seeds, leaving two (2.5%) which did not have legal status.

Table 4.8: Legal Status

Has Legal Status		
	Frequency	Percentage (%)
Yes (Formal)	78	97.5
No (Informal)	2	2.5

Source: Database of SEED Project

4.5 Food system challenges being addressed by the seeds

Food systems interventions designed to address food insecurity are termed “seeds” in the Seeds of Good Anthropocene project. Seeds have been identified as innovative ideas or initiatives implemented by stakeholders across all levels, including government, businesses, individuals, and NGOs. They are mainly bottom-up interventions that can completely revolutionize food systems toward more sustainable systems. Below are the focus areas the seeds are trying to address.

Table 4.9: Food system challenges being addressed by the seeds

Issue Seed is addressing	Frequencies(n=79)	Percentage (%)
Canoe registration	2	2.53
Child labor	1	1.27
Coastal waste management	2	2.53
Depletion of fish stock (pelagic fish.	2	2.53
Depletion of marine resources (pelagic.	4	5.06
Diabetes	1	1.27
Fish production	2	2.53
Food insecurity	5	6.33
Food waste	1	1.27
Gender inequity in the fish industry	4	5.06
Governance lack	1	1.27
Illegal, irregular, and unregulated fishing	4	5.06
Inaccessible healthy African foods	1	1.27
Inefficient smoking ovens	3	3.8
Instability in the Aquaculture supply chain	1	1.27
Lack of data systems on biodiversity	1	1.27
Lack of local cocoa processing	1	1.27
Lack of locally sourced food processing	1	1.27
Lack of marine management strategy	1	1.27
Lack of transparency	1	1.27
Limited access to indigenous processing.	1	1.27
Limited access to market	1	1.27
Limited capacity in coastal research	1	1.27
Limited natural fruits and vegetable	1	1.27
Loss of Indigenous knowledge	1	1.27
Low Ghanaian exports	1	1.27

Low capacity of female agriprenuers	1	1.27
Low capacity of poultry farmers	1	1.27
Low patronage of Ghana rice	1	1.27
Low-quality organic supplies	1	1.27
Marginalized small-scale fishers	1	1.27
Marine litter	1	1.27
Maritime sustainability challenges	1	1.27
Natural fruits and vegetable preservation	1	1.27
Plastic pollution	1	1.27
Poor fishing practices (overfishing)	3	3.8
Poor vaccination	1	1.27
Poor vaccination among women livestock	1	1.27
Post-harvest loss	1	1.27
Rural poverty	5	6.33
Smoke-related diseases	1	1.27
To improve fish processing	1	1.27
Unemployment	1	1.27
Unhealthy eating habits	1	1.27
Unhealthy food availability	1	1.27
Unhealthy food environments for NCDs	1	1.27
Unsustainable coastal management	1	1.27
Unsustainable farming systems	3	3.8
Urban Agriculture	1	1.27
Weak cooperation b/n member states	1	1.27
lack of coastal management database	1	1.27
Overfishing	1	1.27
Total	79	100

Source: Database of SEED Project

Some quotes to support some of the issues the seed is trying to address:

“Our fish farm case study in Ghana allowed me to look at the bigger picture —it is imperative for food security needs. It plays a significant role in mitigating widespread poverty among rural masses”

“Combatting waste and serving vegan meals”

“Highlighting the potential of Ghanaian food. We believe that Ghana’s food is of great cultural and social value, has (socio) economic potential and keep or make Ghanaians healthier. Right now the system is pushing in the wrong direction. We want to build a food system in Ghana that is fair and future proof for Ghanaians and our environment”

4.6 Challenges that have been left out

Although interventions have been designed to address food system challenges, there are still a few challenges that are yet to be addressed. There are still challenges about governmental interferences, economic challenges, policy development with regards to food systems and attention to programs. The figure below presents an overview of the challenges of food systems map based on the findings of this study and overlaid with interventions that have been designed to address them.

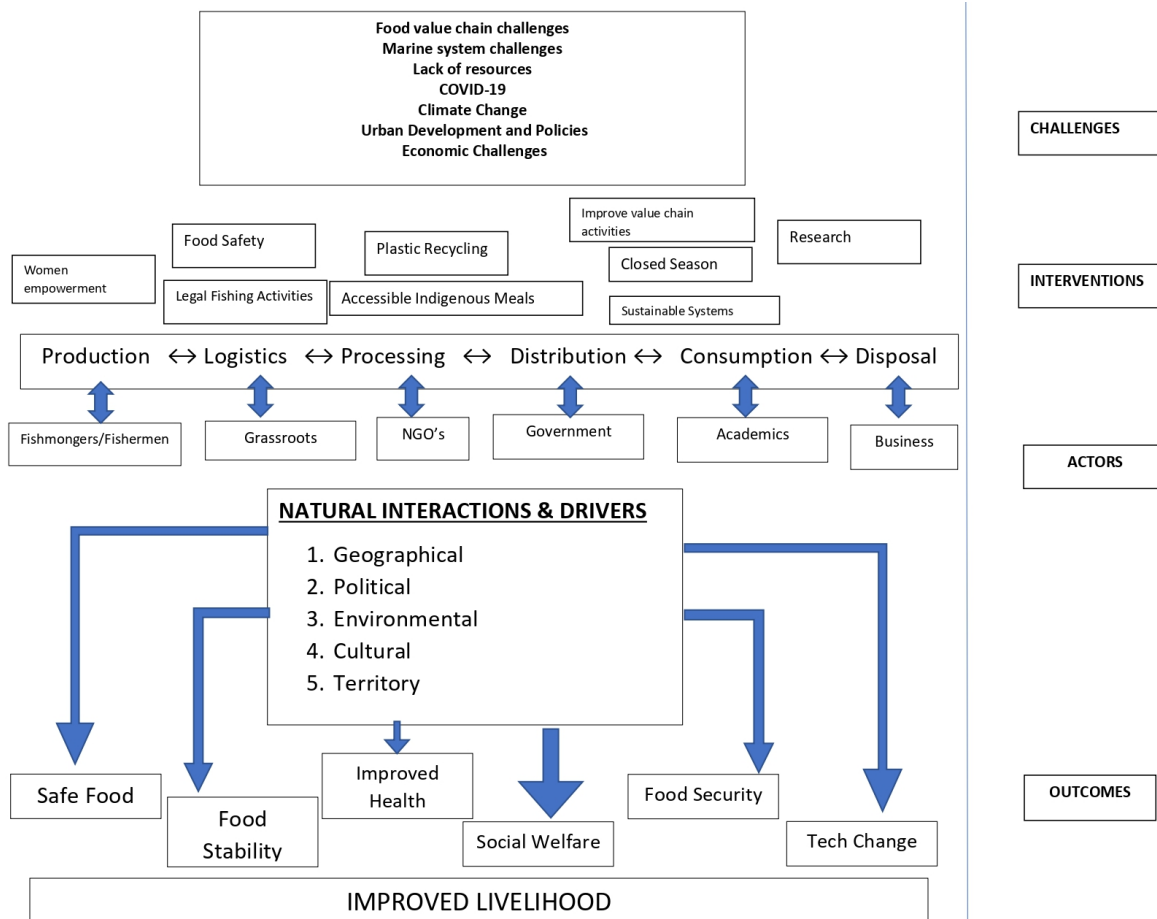


Figure 4.5: Food Systems Map

CHAPTER FIVE

5.0 DISCUSSION

5.1 Introduction

The research sought to explore coastal food system challenges and which interventions had been designed to address them and identifying which of these challenges have been left out. It provided evidence on food system challenges from literature, thus filling the gap in a comprehensive review of literature about food system challenges. The focus of the study was on food system challenges and the interventions designed to address them as well as determining the interventions that had been left out. Findings revealed that although there were challenges in the food system space, interventions or initiatives which we term as seeds have been designed to transform the food system space. There was a need to strengthen initiatives and identify strategies to support the emergence, development, and scaling of initiatives that have the potential to contribute to the transformation of the food system in Ghana. This study showed that while these initiatives have been designed to address the challenges, some of the challenges have been left out. Additionally, a better understanding of the fault lines and synergies that could affect the likelihood of collaboration between initiatives is a goal.

5.2 Challenges in Food Systems

Findings from this study show food systems are evolving due to increased urbanization and urban development. This consistent with the review of theory and qualitative evidence that shows how food systems rapidly change due to free trade, globalization, and increased urbanization (Gillespie and van den Bold, 2017).

Evidence from the study suggests that as a region gets more urbanized, agricultural land use systems and practices face increasing threats from new urban residents and become

increasingly insecure. There is no dispute that there is a rising demand for agricultural lands for residential and commercial use due to the alarming growth in peri-urbanization and its accompanying activities

A study by Ericksen, (2008) concurs that global environmental change and social, economic, and political developments may strain food security and agricultural systems unprecedentedly. The food systems challenges identified include climate challenges, food insecurity, food safety, agricultural challenges as well as land acquisition. Our findings cut across these challenges identified by existing literature. Food insecurity in Ghana has emerged as a major concern, particularly among vulnerable groups such as children, with far-reaching repercussions for public health and community well-being. The findings of this study, which highlight the ongoing nature of food insecurity and its link to child malnutrition, highlight important inadequacies in the country's ability to effectively address this issue. The confluence of elements, such as the lack of a thorough monitoring technique and the complicated interplay between ethnic diversity and food insecurity, creates a complex environment that requires comprehensive attention and deliberate responses. Global environmental change, along with social, political, and economic developments, may place unprecedented strains on agricultural systems and food security. These have resulted in significant changes in the availability, price, and acceptability of many types of food, resulting in a nutrition transition in many developing nations (Gillespie and van den Bold, 2017).

Beyond the immediate difficulties encountered by fishing villages, COVID-19 caused a cascade of disturbances within the fisheries industry. Changes in customer expectations and demand patterns were among the main causes of these disruptions. Restaurants and the foodservice sector witnessed closures or reduced operations as lockdowns and social distancing measures were put in place. Due to this sudden shift in demand dynamics, seafood producers and distributors had to be flexible and adaptable in order to move their products from

commercial to retail markets. The COVID-19 pandemic has aggravated food system difficulties, such as supply chain interruptions, food insecurity, and increased food waste (Agyemang and Kwofie, 2021). The pandemic might have various effects on food security and food systems. Our findings also indicated that market access had become a crucial problem. The timely delivery of commodities to markets was hampered by border restrictions, lockdowns, and transportation interruptions, which impeded the free movement of seafood products. Due to the disruption of supply networks, this not only had negative economic effects on fishermen and fishing communities, but also presented a risk to food security. Both farmers' livelihoods and customers' access to wholesome food sources were impacted by the consequent shortage and variable costs of marine goods.

Climate change threatens the sustainability of food systems in Africa and is predicted to considerably influence crop productivity and water availability. Coastal areas face unique challenges in the food system space, including the impact of climate change and flood disasters on food security, water resources, and crop production, changes in food availability and safety, and spatial inequalities in delivery care. Food system performance now is more dependent on climate than 200 years ago; the potential consequences of climate change on food security have been seen as the most significant worry in areas where agriculture fueled by rainfall remains the principal source of food and income. Climate change and other global change forcings (global temperature and heatwave increases) reduce city sustainability opportunities, particularly in low-income coastal areas (Day, Gunn and Burger, 2021). The effects of climate change are exacerbated by the agriculture sector's reliance on good climatic conditions. Temperature and precipitation variations can directly harm animal health and agricultural growth, resulting in lower yields and decreased food production. From farm to table, the food supply chain is affected in a cascading manner. Extreme weather events affect food accessibility and availability by destroying infrastructure, destroying crops, and upsetting

transportation networks. This may result in both short-term shortages and long-term declines in the ability to produce food, undermining food security and driving up food costs.

Nelson *et al.* (2016) conducted a study using 196 peer-reviewed papers on climate change and food systems to evaluate the current direction of research in this field. The authors highlight three significant topics in the literature: (1) climate change impact on food systems, (2) food systems' contribution to greenhouse gas emissions, and (3) food systems' capacity to ameliorate climate change. The authors propose that more multidisciplinary research is needed to address the intricate linkages between food systems and climate change.

This discussion delves into the multifarious impacts of climate change on food systems, spanning its effects on agricultural productivity, food availability, access, utility, transportation, and processing. Ghana faces a range of challenges in the area of food systems, such as the effect of climate change and flood disasters on food security and changes in food availability and safety. Climate change and other global change forces will reduce sustainability opportunities, particularly in coastal areas in low-income countries like Ghana (Day, Gunn and Burger, 2021).

5.3 Interventions designed to address them

Importantly, the analysis discovered a number of initiatives, or "seeds," that have been created to spur transformational change within coastal food systems. These interventions cover a wide range of strategies, such as value chain improvement, community-based fisheries management, aquaculture projects, and policy lobbying. These initiatives, which together reflect proactive efforts toward sustainable development, highlight the possibility of positive change in the landscape of the coastal food system.

From the study, 69.4% of the seeds were terrestrial, or had both marine and terrestrial components. 42.5 % of the seeds were aiming to transform the food production part of the food value chain. This is because how food is produced is one of the main drivers of health and wellbeing. The majority of the seeds too were project based (41.3%) and one disadvantage of that was that they were time sensitive. Lack of resources and funding to promote the sustainability of the project were often the major barriers to continuity. Almost all the seeds (97.5%) had legal statuses.

The "seeds" conceptualization within the Seeds of Good Anthropocene project introduces a paradigm shift in the way we approach food security and sustainability. These bottom-up interventions represent a collective endeavor to address the multifaceted challenges of food systems. By acknowledging the interconnectedness of food security, poverty alleviation, environmental preservation, and cultural heritage, these seeds have the potential to blossom into a more equitable, resilient, and sustainable food future.

The influence of these seeds is demonstrated through a case study of a fish farm in Ghana, which emphasizes the interdependence of food security, poverty reduction, and sustainable development. As a focused solution, fish farming not only helps local food security by providing a constant supply of protein, but it also improves rural communities by producing revenue and alleviating poverty. This shows how such measures can have broader socioeconomic advantages while also improving food security.

Another aspect of the seeds is their emphasis on waste reduction and vegan meals. These solutions are consistent with the need to lessen the environmental impact of food systems while simultaneously addressing nutritional and ethical concerns. Reducing food waste and supporting plant-based diets not only save resources, but also help to create better food systems that prioritizes health and wellbeing.

The areas of concentration for the seeds highlight the necessity of a thorough strategy for changing food systems. They cover a wide range of themes, including nutritional options, cultural preservation, and economic empowerment. Although a few of the challenges are yet to be tackled, these solutions seek to develop a food system that is not only robust but also egalitarian, culturally appropriate, and ecologically sustainable by addressing these problems holistically

There are difficulties in putting these seeds into practice. Systemic impediments must be overcome, multiple stakeholders must collaborate, and effective initiatives must be scaled up. The seeds present a persuasive picture of a food system of the future, one that is radically different from the present and supports economies, societies, and the environment.

5.4 Public Health Significance of findings

The findings discussed in the previous sections collectively hold significant implications for public health on both local and global scales. The multifaceted challenges identified, the interventions explored, and the interactions between various factors all underscore the critical importance of public health considerations in shaping the future of food systems. One Health is centered on food safety. The absence of coordination between the human health, food safety, and animal health sectors substantially impacts significant food safety incidents (Gordon et al., 2017).

The persistence of food insecurity, as illuminated through various studies, directly impacts public health. Insufficient access to nutritious and safe food can lead to malnutrition, stunted growth, and compromised immune systems, especially among vulnerable populations such as children and pregnant women. The interventions aimed at addressing food security, including "seeds" and adaptive strategies, can significantly contribute to improving the nutritional status and health outcomes of communities.

The findings described in relation to diverse contexts and treatments highlight the extensive and complex relationship between food systems and public health. The difficulties and possibilities highlighted highlight the requirement for comprehensive, team-based, and sustainable methods that give priority to the health and wellbeing of people, communities, and the environment. Stakeholders may strive toward a more resilient, egalitarian, and health-promoting food system that benefits both the present and future generations by including public health concerns into the design and implementation of interventions.

5.5 Conclusion

In conclusion, this study not only contributes to the body of knowledge concerning coastal food systems and their challenges but also underscores the importance of a holistic approach to intervention design and implementation. By acknowledging the limitations of current strategies, harnessing potential synergies, and addressing overlooked challenges, stakeholders can lay the groundwork for a more resilient and sustainable coastal food system in Ghana. As the global community grapples with mounting food security concerns and environmental pressures, the lessons gleaned from this research can offer valuable insights for shaping a more resilient future.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter provides brief overview of study findings, conclusions as well as recommendations for future research. The findings are provided based on the theory on which the study was premised and literature that was reviewed earlier.

6.2 Conclusions

Findings show that measures were put in place to address coastal food system challenges, but some of them were not sustainable enough so there is the need to encourage and strengthen more bottom-up interventions to curb this menace. There exist numerous challenges in the food systems space from production through till consumption. Coastal areas face far more unique challenges and the vulnerability of the food system is exposed due to certain difficulties identified in the study.

Seeds have been identified as innovative activities or initiatives to help curb some of these challenges in the food systems space. They are thriving and innovative but there are still certain challenges that have been left out

This study underscores the complexity of challenges within coastal food systems, highlights the promising interventions designed to address these challenges, and emphasizes the need for comprehensive, inclusive, and strategic approaches. By acknowledging the gaps in existing interventions and forging a collaborative path forward, stakeholders can work towards a more resilient, sustainable, and equitable coastal food system landscape in Ghana.

6.3 Recommendations

Based on the findings of this study, the following recommendations are suggested:

- i. Collaborations between seeds is very necessary as it would help them leverage their skills and expertise, share knowledge and ideas and support each other grow to curb the challenges in the food system space.
- ii. Considering the potential contribution of food systems to food security and good health, there is a need for the relevant sector ministries such as the Ministry of Food and Agriculture, Ministry of Fisheries and Aquaculture and the Ministry of Health to enact a national policy and political action plans and programs that will address interdependencies along the food chain and the complexity of current food systems.
- iii. While it is nearly difficult to change Ghana's customary tenure systems, the Ministry of Lands and Natural Resources can help in the planning and acquisition of lands for agricultural purposes in the face of growing urbanization.
- iv. All relevant stakeholders including government, citizens, civil societies and NGOs should offer support for the emergence of new initiatives that have the potential to transform the food system in Ghana to strengthen and scale them up.

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APPENDIX

Appendix I: Ethical Clearance



OUR REF: ENSIGN/IRB/EL/SN-234
YOUR REF:

April 19, 2023.

INSTITUTIONAL REVIEW BOARD SECRETARIAT

Helen Bour
Ensign Global College
Kpong

Dear Helen,

ETHICAL CLEARANCE TO UNDERTAKE POSTGRADUATE RESEARCH

At the General Research Proposals Review Meeting of the *INSTITUTIONAL REVIEW BOARD (IRB)* of Ensign Global College held on Wednesday, April 19, 2023, your research proposal entitled "**Food Systems Mapping: An Analysis of Changes and Innovations in Ghana's Coastal Cities**" was considered.

You have been granted Ethical Clearance to collect data for the said research under academic supervision within the IRB's specified frameworks and guidelines.

We wish you all the best.

Sincerely

A handwritten signature in black ink, appearing to read "Rebecca Acquah-Arhin", with a stylized flourish at the end.

Dr. (Mrs.) Rebecca Acquah-Arhin
IRB Chairperson

Appendix II: PRISMA Checklist

Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
TITLE			
Title	1	Identify the report as a scoping review.	i
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	viii
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	7
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	10
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	29
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	27
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	22, 32
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	22
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	27
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	28
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	22
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	22

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	29
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	22
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	32
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	22
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	32
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	37
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	57
Limitations	20	Discuss the limitations of the scoping review process.	Click here to enter text.
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	64
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	v

JB I = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).

‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JB I guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med.* 2018;169:467–473. doi: [10.7326/M18-0850](https://doi.org/10.7326/M18-0850).

Appendix III: Plagiarism Report

