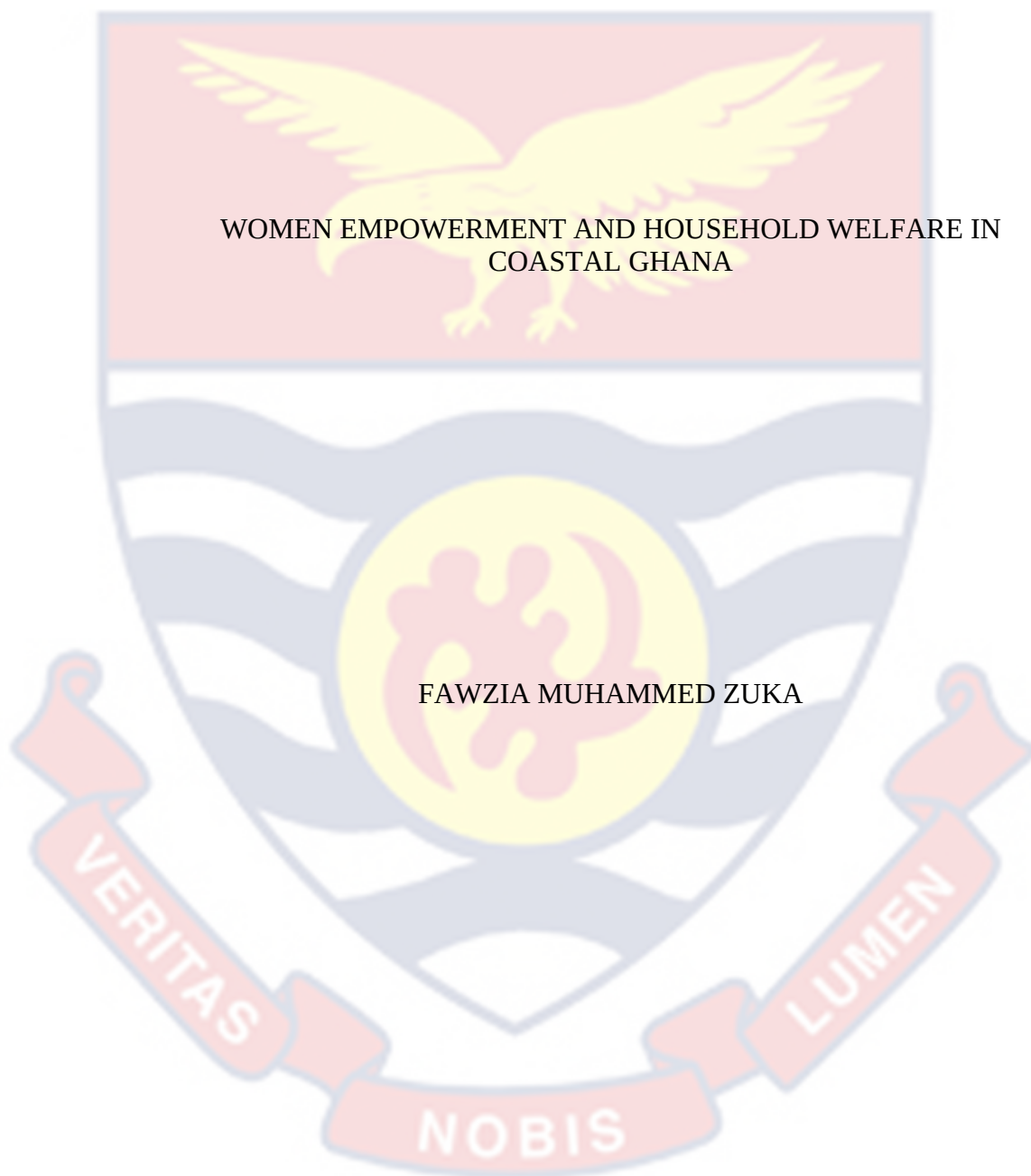


UNIVERSITY OF CAPE COAST

WOMEN EMPOWERMENT AND HOUSEHOLD WELFARE IN
COASTAL GHANA

FAWZIA MUHAMMED ZUKA



2024



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WOMEN EMPOWERMENT AND HOUSEHOLD WELFARE IN
COASTAL GHANA

BY

FAWZIA MUHAMMED ZUKA

Thesis submitted to the Department of Fisheries and Aquatic Sciences of the
School of Biological Sciences, College of Agriculture and Natural Sciences,
University of Cape Coast, in partial fulfillment of the requirement for the
award of a Doctor of Philosophy Degree in Integrated Coastal Zone
Management.

SEPTEMBER 2024

DECLARATION

Candidate's Declaration

I certify that except for references made to the works of others, which have been duly acknowledged, this thesis is entirely my work, and neither part nor whole has been submitted to this university or anywhere.

Candidate's Declaration:..... Date:

Name: Fawzia Muhammed Zuka

Supervisors' Declaration

We hereby declare that the preparation and presentation of this thesis were supervised by the guidelines on supervision of thesis as laid down by the University of Cape Coast.

Principal Supervisor's Signature..... Date:

Name: Dr. Samuel K. M. Agblorti

Co-supervisor's Signature:..... Date:

Name: Prof. Wisdom Akpalu

ABSTRACT

Meeting the sustainable development goals and improving household welfare when women are empowered. Empowering women has also been cited as critical to achieving sustainable livelihoods in the fisheries sector. However, there is rarely a measuring tool that specifically assesses women's empowerment in fisheries activities. In this regard, this study extends the Women's Empowerment in Agriculture Index (WEAI) which is biased towards farming households and fails to account for the unique characteristics of fishing households to measure empowerment across six dimensions (production, resources, income, leadership, institution, time use) mapped to 12 indicators. This research also explored how women's empowerment can impact welfare indicators such as food insecurity and environmental poverty at the household level. Using micro-level data from five fishing communities in Ghana, the study employed the Alkire-Foster methodology to develop an empowerment index and the Probit and Fractional regression models to empirically show how empowering women correlates with food insecurity and environmental poverty, respectively. It was observed from the study that 41% of women are disempowered in fishing households. The results from intra-household empowerment showed that 72.6 % of men are disempowered. This implies that the males are less empowered than the females in the same household. Again, it was revealed that empowering women decreases the likelihood of being food insecure and environmentally poor by 37% and 13.6%, respectively. Since empowering women is essential to improving food security and ensure environmental sustainability, the study recommends that government and donor agencies should promote initiatives that strengthen the ability of women to decide on socio-economic issues at the household level.

KEYWORDS

Environmental poverty

Fisheries

Food security

Sustainable development

Water Poverty



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DEDICATION

To my Family.



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LIST OF ABBREVIATION


EJF	Environmental Justice Foundation
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GoG	Government of Ghana
GSS	Ghana Statistical Service
HFIAS	The Household Food Insecurity Access Scale
IEA	International Energy Agency
IFPRI	International Food Policy Research Institute
INDDEX	International Dietary Data Expansion Project
IPCC	Intergovernmental Panel on Climate Change
MoFAD	Ministry of Fisheries and Aquaculture Development
MoFEP	Ministry of Finance and Economic Planning
NGOs	Non-Governmental Organizations
SDGs	Sustainable Development Goals
UNCCD	United Nations Convention to Combat Desertification
UNEP	United Nations Environmental Program
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations Children's fund
UN	United Nations
WHO	World Health organization

CHAPTER ONE

INTRODUCTION

There has been an attempt to define and measure actual welfare or well-being in emerging economic research (Blundell et al., 1994; Easterlin, 2001; Rasmussen, 2006; Kahneman & Deaton, 2010). Conventional economic indicators such as household income and Gross Domestic Product (GDP) have been used as welfare measures. However, Sen (1993) argued that these conventional welfare measures do not accurately represent the multifaceted nature of human well-being and freedom.

As a result, welfare evaluation must be expanded to include a person's experience of life satisfaction. This view is supported by Moratti and Natali (2012), who advanced the argument that comprehensive welfare measurement should include both food and non-food (education, health, utilities, rent, and environmental service) indicators. Hence, the study focuses on emerging measurements of welfare, such as food security and environmental poverty (Coates et al., 2007; Nawaz & Iqbal, 2021), which capture different dimensions of human well-being at the household level.

Women's empowerment has been a central topic in contemporary discourse on societal development due to pervasive gender imbalances that continuously impact women and girls in many socioeconomic sectors (Adjei, 2015). Governments and Non-Governmental Organizations (NGOs) have recognized women as vital in reinforcing sustainable food systems, achieving sustainable development goals (SDGs), and household welfare (UN Women et al., 2012; UN Women, 2014; Galiè et al., 2019). This is true because of women's significant contributions to food production, natural resource management,

environmental preservation, and income generation (Malapit & Quisumbing, 2015; UN Women, 2014; Essilfie et al., 2021).

While eliminating discrimination and socio-cultural prejudices against women and girls have been shown to drive economic growth and development, there is still a gender gap in economic opportunity and resource allocation (UN, 2016; Essilfie et al., 2021). Thus, implementing effective and inclusive policies to advance women's economic opportunities is essential for achieving the SDGs (Adjei, 2015; UN Women et al., 2012).

Although some studies have shown that empowering women can positively influence the environment and food security, there is still much ground to cover, particularly in fishing communities. With the livelihoods of nearly two million Ghanaians dependent on this sector (Akpalu, 2015), which also guarantees their access to food and income, a deeper analysis of this relationship is essential. Thus, the study aims to present empirical evidence that investigates how empowering women can influence household environmental poverty and food security in fishing regions in Ghana and highlight the interaction between disempowerment and other household deprivations, such as water and energy poverty, on food security. Such research highlights the interplay between gender, food security, and environmental sustainability and informs policies that promote economic development and well-being.

Background to the Study

It is essential to practice environmentally responsible resource management to protect the natural world and the well-being of humans (Coria & Sterner, 2011; Mozumber et al., 2018). The overexploitation and depletion of resources may endanger the environment and those relying on them for

economic security and well-being (Holland, 1996; Mozumber et al., 2018). These effects are often disproportionately experienced by disadvantaged populations and people who have restricted access to the decision-making processes (Berkes & Folke, 1998; Mozumber et al., 2018). The ripple effects that may result from ineffective management of natural resources can have far-reaching and lasting repercussions. For instance, nearly one-third of the world's fisheries are exploited beyond sustainable levels (FAO, 2016a; Finkbeiner et al., 2017). The effects of this overexploitation are not limited to monetary losses for people who make their livelihood from fishing; instead, it hurts the well-being of these individuals and their families on both a global and local scale (FAO, 2016a; Finkbeiner, 2015). This is especially important in emerging nations and resource-dependent places (Mozumber et al., 2018). It is, therefore, imperative to analyze the connection between the empowerment of coastal communities, particularly women, the state of the environment, and food consumption.

Most fishers make their homes along the coasts, where an estimated 60% of the global fish catch is harvested (FAO, 2016a). The fisheries sector has seen growing participation across all stages of production and distribution over the last three decades (Coulthard et al., 2011). According to recent estimates, more than 60 million people work directly in fisheries, and an additional 420 million individuals source their livelihood from fish processing and other value-chain activities (FAO, 2016a). Most people are small-scale fishers in developing nations (FAO, 2018). According to Akpalu (2015), small-scale fishing provides coastal communities with food and income to ensure their continued existence. Even though it is difficult to quantify the industry's contribution to food security and livelihoods due to lack of data, it is widely acknowledged that a substantial

number of coastal dwellers primarily derive their income from fishing, and a considerable fraction of the population relies on fisheries for food security (Allison et al., 2009).

Fish and fish products have much value, not only because they are a source of nutrition but also because they are a significant factor in ensuring enough food for everyone worldwide (FAO, 2018). Furthermore, the fishing industry supplies an estimated 37.5 % of all people on earth, with an average of 20% of animal protein consumed per capita (FAO, 2016a). According to Sumaila (2022), its function as a supply of micronutrients should not be undervalued.

The viability of marine fisheries is in jeopardy, despite its essential role in developing economies, primarily as a result of increased fishing efforts and the destruction of habitat, but also as a direct result of increased subsidies coupled with lax enforcement and unregulated fisheries management (Tobey et al., 2016; Sumaila, 2022). The near collapse of the fisheries and natural resource degradation widen the fish consumption deficit (FAO, 2016a). This situation undermines health, food, and water security for most people in coastal developing countries (Barange et al., 2018). Climate change and pollution from land-based sources are further amplifying the risks to marine biodiversity and hindering the ability of coastal inhabitants to withstand those risks (Sumaila, 2022; Lam et al., 2020).

Food security is becoming a global concern due to the increasing population worldwide (Rabitt et al., 2019). It is expected that fishing communities, particularly those with little agricultural land, maybe the most affected by a lack of nutrition due to the changes projected to occur in fish

populations (Rabitt et al., 2019). Due to the reduction in fish populations, recent research indicates that about 11% of the global population is vulnerable to inadequate essential micronutrients (Rabitt et al., 2019). Furthermore, the research suggests that approximately 19% of the population may face deficiencies in micronutrients such as omega-3 fatty acids and vitamin B12 (Golden et al., 2016). The situation is alarming: one in three fisheries faces overfishing, and the majority of remaining fisheries are operating at their maximum sustainable capacity (FAO, 2016a). Food security in growing coastal areas is a significant concern, and it is anticipated that by the year 2030, these nations may not be able to satisfy their domestic demand, which might result in food insecurity for a significant number of people (FAO, 2016a; Golden et al., 2016; Rabitt et al., 2019). In guaranteeing food security for future generations, it is imperative to implement sustainable management of the world's fisheries resources (FAO, 2016a; Rabitt et al., 2019).

Prosocial behavior, characterized by voluntary actions intended to benefit others, has emerged as a potential mediator in the relationship between women's empowerment and household food security. Recent studies have begun to explore how women's empowerment can foster prosocial behavior, which in turn contributes to improved food security outcomes at the household level. A study showed that empowered women in Bangladesh's rural areas participated more in community activities and support networks, resulting in better food security for their families (Aker et al., 2017). Similarly, Malapit et al. (2019) observed that empowered women in agricultural households in Ghana were more inclined to participate in collective action groups, resulting in improved knowledge sharing about nutrition and food production techniques. These

prosocial behaviors, facilitated by women's empowerment, can create social capital that serves as a buffer against food insecurity during times of scarcity (Lamidi, 2019).

Research consistently shows how women's empowerment fosters prosocial behavior that enhances community food security. In Zambian fishing communities, empowered women were more likely to form cooperative fish processing and marketing groups, which improved both their economic status and household food stability (Petesch et al., 2018). Similarly, in Bangladesh, empowered women often shared food with neighbors during shortages, creating reciprocal support networks that strengthened community-wide food security (Sraboni et al., 2014). These informal safety nets, emerging from women's empowerment, help buffer against food insecurity risks (Quisumbing et al., 2021). Beyond direct food sharing, empowered women in India showed higher participation in community-based natural resource management, contributing to sustainable food systems and long-term security (Meinzen-Dick et al., 2019).

In addition, fishing communities, known for being among the most vulnerable, poor, and marginalized populations in developing nations, are afflicted by the deprivation of environmental quality (Nursiah et al., 2016). This is the case, despite the critical role fishing communities play in the economy and the sustenance of food security. These communities frequently face environmental challenges intertwined with poverty, such as lacking access to sanitary facilities and heightened exposure to pollution and other environmental hazards (Nursiah et al., 2016). The implications of these environmental problems transcend beyond the realm of the economy and have the potential to have knock-on effects not just on human health but also on the environment's

capacity to remain habitable (Muyodi et al., 2011). According to the findings of several studies, efforts to successfully manage coastal environmental crises will help not only the expansion of the economy but also the protection of health as well as the natural environment (Bartram & Cairncross, 2010; Muyodi et al., 2011; Feris, 2015; Andersson, 2016).

Despite global efforts to promote environmental sustainability, many developing countries still engage in harmful practices such as uncontrolled human waste disposal and reckless dumping of waste materials (Mensah & Enu-Kwesi, 2019). Unfortunately, these unsustainable practices negatively impact the water-based and fishery-based livelihoods of coastal populations who depend on these resources for sustenance (Mensah & Enu-Kwesi, 2019). Indeed, densely populated coastal regions' economic and social development heavily relies on these livelihoods (Lattermann, 2010; Dengerink, 2013). As Small and Nicholls (2003) have noted, the environmental concerns that threaten the livelihoods of coastal populations are of critical importance, given the vital role of these communities in development. Kruijssen and Asare's (2013) study confirms that many economically disadvantaged coastal residents depend on nature for sustenance, thus, highlighting the urgent need to prioritize environmental issues in coastal towns to benefit the local population and the broader economy is crucial.

Environmental poverty is characterized by the inadequate capacity of a community to secure and sustain a habitable and wholesome environment (Liu, 2012; Nawaz & Iqbal, 2021; Essel-Gaisey & Chiang, 2022). The determination of the suitability of an environment for human habitation and the progress of human civilization depends on a range of multifaceted factors, such as

demographic growth, cultural practices, and technological advancements (Masson-Delmotte et al., 2021). These factors impact the overall quality and accessibility of natural resources, which, in turn, influence society's economic development and general welfare (Nawaz & Iqbal, 2021). It is noteworthy that specific environments may be inherently unsuitable for human habitation, and the notion of environmental poverty centers on regions where human activities have caused deterioration, despite their initial suitability (Liu, 2012). It is imperative to emphasize that environmental deprivation is not a natural occurrence; instead, it stems from flawed human-environment interactions that lead to a decreased level of environmental health (Nawaz & Iqbal, 2021). Although individuals experiencing economic poverty may access financial assistance, sustenance, housing, and medical care provided by the government and other international organizations, individuals experiencing environmental poverty are often not targeted for poverty alleviation (Liu, 2012). However, it is essential to note that living in an unhealthy environment while surviving on minimal income may be worse than living in a fertile area without any income (Liu, 2012).

Access to essential environmental services is vital for the continued growth of a sustainable society and the health of humans (Nawaz & Iqbal, 2021; Stauber et al., 2018). According to the United Nations, approximately 5 billion individuals lack necessities such as proper sanitation, while 2 billion access water from unimproved sources (UN, 2019). Rising water bodies and excess rainfall cause water surpluses in riverine and coastal regions, affecting thousands of people (Nursiah et al., 2016; Young et al., 2021). However, there is an issue with the degradation of terrestrial regions, and a sizeable amount of

the land on earth is now being negatively impacted (UNCCD, 2022). Human and industrial activities, such as the release of carbon dioxide, worsen climate change's potential harm to the ecosystems (IEA, 2020).

Environmental utilities are scarce in most developing countries, worsening households' environmental deprivation (Nawaz & Iqbal, 2021). While access to sanitary facilities is a fundamental human right, a staggering 2.4 billion people lack this access. Around one billion individuals relieve themselves in the open air near coastal areas (UNICEF & WHO, 2020). The persistent release of untreated sewage into natural habitats harms marine biodiversity, which in turn affects the ability of fisherfolk in those areas to make a living and the availability of clean water for their homes (Andersson, 2016). The global use of unclean cooking fuels—wood, biomass, coal, charcoal, and agricultural waste—leads to 2.5 million premature deaths annually. This contributes to the broader toll of environmental risks, which are responsible for an estimated 13 million deaths each year (IEA, 2020). Additionally, it is believed that the deterioration of the environment brought on by humans has a detrimental influence on the well-being of 3.2 billion people and is responsible for a yearly loss of 10% in economic development (UNEP, 2021). In response to these critical issues, women's empowerment, environmental management, and the promotion of green practices are pivotal (Andersson, 2016).

Communities that engage in artisanal fishing have a demonstrated history of being responsive and adaptable in adverse environmental conditions (Nursiah et al., 2016). This capacity, profoundly embedded in their cultural and social norms, has proven to be very important to their continued existence over time (Mensah & Enu-Kwesi, 2019). However, since human activities are

causing the environment to change at an accelerating rate, these groups may find it challenging to adapt to their increased exposure to environmental stresses (Nursiah et al., 2016). Therefore, tackling problems of environmental poverty will result in better living conditions for coastal residents while simultaneously contributing to preserving the marine ecosystem (Halpern et al., 2008).

Regarding managing capture fisheries, sociocultural norms and power dynamics shape certain activities both males and females engage in (FAO, 2016b). Despite the prominent male representation within the fishing sector, as evidenced by the generic term "fisherman" and the gendered roles inherent in the industry, numerous studies have emphasized the crucial contributions made by women in this field (Bennett, 2005; Harper et al., 2013; FAO, 2016b; Ameyaw et al., 2020). In most underdeveloped countries, water, fuel procurement, and resource stewardship are the responsibilities of women (Kumar, 2012). Women constitute nearly half the fisheries labor force, although their responsibilities vary amongst coastal communities (Kelleher et al., 2012; Ameyaw et al., 2020). Primarily engaged in fish processing, women hold a unique position as fish traders while exercising control over substantial financial resources (Harper et al., 2013; FAO, 2016b). They also provide financial support to fishermen to procure fishing equipment, own fishing vessels, negotiate fish prices, and generate significant economic returns for households and communities (FAO, 2016b). Additionally, they undertake unpaid household duties, including the provision of childcare, nutritional support, and care for the elderly, while also transferring their knowledge of resource use and traditional management practices (Ameyaw et al., 2020).

However, despite their significant economic contributions, women's involvement in fishing activities needs to be more valued. They remain invisible in fisheries data and policy decision-making processes (Williams et al., 2005; Williams, 2008; FAO, 2016b). This is due to gender-based economic, social, and political restrictions that limit women's decision-making ability around productive resources compared to men (Harper et al., 2013; FAO, 2016b). Studies reveal that women's representation in fisheries and environmental management is underwhelming, and there is a general lack of empowerment for women in these domains, particularly in decision-making (Alonso-Población & Siar, 2018; Freeman & Svendsen, 2022). Smith (2003) posits that this situation arises from the inability of women to manage their income, decide on household and childcare responsibilities, and have access to healthcare, education, and adequate time allocation for activities. Therefore, to attain sustainable livelihoods, women must not be excluded from policies and initiatives addressing the use of marine resources (Ameyaw et al., 2020).

Nonetheless, women's traditionally undervalued roles in the fishing industry are significant in raising financial capital and promoting sustainable development (Gustavsson & Riley, 2018). Hence, empowering women as decision-makers at all levels of the value chain and in the household domain is an essential strategy for achieving sustainable development (Harper et al., 2013; Galiè et al., 2019). It has been argued that family well-being is not solely dependent on household income but also on the source of revenue. Gustavsson and Riley (2018) suggest that women's income from fish processing and trading helps the household more than men's earnings from fishing in times of need.

Therefore, women's economic empowerment could enhance community sustainability and household food security.

Rural women's role as ecosystem managers and protectors of water, seeds, forests, territories, and ecosystems is crucial to biodiversity conservation (UNEP, 2020). Women gather water and fuel and handle sanitation in most rural families; therefore, excluding them from management design is a primary cause of their failure (UNEP, 2020). Water and sanitation programs must reduce women's water collection time and energy and increase their involvement in environmental decision-making to enhance women's health and quality of life (Kumar, 2012). Thus, sustainable fishing, eradicating hunger, and environmental protection need women's empowerment and collaboration (de la Torre-Castro, 2019; UN Women, 2014).

Therefore, women's empowerment is a framework that enhances an individual's capacity to make significant independent decisions that would otherwise be inaccessible (Kabeer, 1999; Alkire et al., 2013). Again, the principle of empowerment covers all vulnerable individuals in society. Thus, endeavors to empower women must consider the broader consequences of paradigm shifts in policies and decisions in the household (Essilfie et al., 2021).

Statement of Problem

The role of women in sustainable development, particularly in coastal fishing communities, has gained increasing attention in recent years. Scholars and policymakers recognize that empowering women is crucial for achieving various developmental goals, including food security, poverty reduction, and environmental sustainability (Kabeer, 1999; UN Women, 2014; Narayanan et

al., 2019). However, a significant knowledge gap persists regarding the specific experiences and needs of women in the fisheries sector.

In coastal fishing communities, women play vital roles throughout the value chain, yet their contributions often go unrecognized or undervalued (Harper et al., 2013; Ameyaw et al., 2020; Freeman & Svendsen, 2022; Oloko et al., 2022). This lack of recognition not only perpetuates gender inequalities but also hinders overall sustainable development efforts in these areas. The unique socio-cultural context of fishing communities necessitates a tailored approach to understanding and measuring women's empowerment, as existing indices developed for agricultural or urban settings may not adequately capture the nuances of the fishing sector (Malapit et al., 2019; Galiè et al., 2019; Narayanan et al., 2019).

In the fishing industry, gender roles are typically well-defined: men primarily engage in fish capture, while women focus on processing and marketing activities (Danso-Wiredu, 2018; EJP & Hen Mpoano, 2019). This gendered division of labor creates unique challenges and opportunities for women's empowerment that current research has yet to fully explore. Additionally, coastal communities present complex interactions between women's empowerment, household food security, and environmental sustainability that remain inadequately studied.

Although some scholars have attempted to measure women's empowerment in fisheries contexts (Harper et al., 2013; Cole et al., 2020; Freeman & Svendsen, 2022), the field lacks thorough, multidimensional assessments that account for various empowerment factors—including decision-making authority, resource control, and mobility. This knowledge gap hampers our full

understanding of women's contributions to fisheries and the obstacles they encounter in achieving empowerment.

While the relationship between women's empowerment and food security has been extensively studied in agricultural settings (Sraboni et al., 2014; Galiè et al., 2019; Essilfie et al., 2021), its dynamics within fishing communities remain poorly understood. Evidence suggests that empowering women improves household nutrition and food security (Smith et al., 2003), but the specific pathways through which this occurs in coastal contexts need further exploration.

Recent studies have identified potential mediating factors between women's empowerment and food security, including social capital (Lamidi, 2019), water security (Young et al., 2021), and energy access (Sola et al., 2016). However, these transmission mechanisms require more thorough investigation within coastal fishing communities, where distinct environmental and socio-economic conditions may shape these relationships differently.

Additionally, the methods used to assess food security in these communities may not fully capture the complexity of the issue. While dietary diversity scores and consumption patterns are commonly used metrics (Meinzen-Dick & Quisumbing, 2001; Amugsi et al., 2016; Malapit & Quisumbing, 2015), they may not provide a complete picture of food insecurity's magnitude and severity in coastal areas.

Environmental degradation poses a significant threat to coastal communities, potentially impacting both food security and livelihoods (Nawaz & Iqbal, 2021). The burden of environmental challenges falls heavily on women, who are often primarily responsible for resource-dependent household activities.

Tasks such as collecting water and gathering cooking fuel become increasingly difficult as environmental conditions deteriorate, intensifying women's daily workload (Herrero, 2017). While empowering women has been suggested as a strategy to improve environmental management and reduce poverty (UNEP, 2020), the specific role of women's empowerment in addressing environmental issues in coastal communities remains largely unexplored (Stauber et al., 2018).

Through this multifaceted approach, the research seeks to enhance understanding of both the barriers to and opportunities for women's empowerment in fishing communities, while illuminating the broader implications for food security and environmental stewardship. Thus, this study aims to develop a context-specific empowerment index, conduct a comprehensive evaluation of women's roles and experiences in the fishing sector, and examine the complex interplay between empowerment, food security, and environmental sustainability. By investigating these interconnected issues, this research seeks to inform more effective, targeted policies and interventions that can enhance women's empowerment, improve household welfare, and promote sustainable development in coastal fishing communities.

Research Objectives

This research aims to analyze how women's empowerment can affect food insecurity and environmental poverty and ascertain the direction of impact. Also, the study seeks to pursue the following specific objectives:

1. Construct an index that quantifies the degree of women's empowerment within fishing households.

2. Investigate how food insecurity is impacted by empowering women and also examine the role prosocial behavior plays in mediating this relationship.
3. Explore the overlapping impact of empowerment, water, and energy poverty on household food insecurity.
4. Estimate environmental poverty and explore women's empowerment correlation with it.

Study Hypotheses

The research centers around the hypotheses below:

- i. Women's empowerment will influence food insecurity.
- ii. Prosocial behavior will mediate the impact women's empowerment will have on food insecurity.
- iii. The combined effect of empowerment, water, and energy poverty will impact food security.
- iv. Women's empowerment will impact environmental poverty.

The Research Purpose

The thesis aims to contribute to the existing knowledge base concerning how women's empowerment and decision-making capacity engender food security and sustainable environments in fishing communities. The study will also furnish policy recommendations geared towards augmenting household resilience to hunger and advancing environmental well-being. The significance of this inquiry is underscored by the pressing challenges of food insecurity and environmental degradation that confront coastal communities in Ghana, especially women and children. Thus, this study is designed to offer insights into the significant contributions women's empowerment presents in addressing these issues and guiding policy decisions in this regard.

Significance of the Study

The pivotal role of women in enhancing sustainable livelihoods and bolstering developmental initiatives across all economic sectors, including coastal communities, is incontrovertible. Governmental bodies and donor agencies have attempted to prioritize women in their actions to promote sustainable food production, eradicate hunger, and foster healthy environments. The present research stresses the importance of comprehending women's efforts as primary stakeholders to ensure equitable access to improved opportunities and pathways to engender prosperity. By revealing the extent to which women are empowered in the fisheries sector, the criticality of achieving Sustainable Development Goal 5 will be emphasized, thereby safeguarding women's human rights, and advancing the pro-poor growth agenda within coastal communities. Furthermore, enhancing women's empowerment within fishing communities holds significant potential for ameliorating poverty, hunger, and malnutrition, promoting sustainable fisheries, and ultimately realizing gender equality.

This study developed an empowerment index based on the Alkire-Foster methodology to quantitatively assess disempowerment in Ghana's fishing industry. The index helps policymakers identify: which individuals face disempowerment, the number and types of deprivations they experience and the specific dimensions and indicators where multidimensional poverty occurs. This represents one of the first quantitative measurements of women's empowerment in Ghana's fishing sector, where women are integral participants throughout the value chain. The findings would also show specific dimensions of empowerment women are disempowered in. This allows policymakers, analysts, and donor agencies to track and target specific dimensions that need attention for women

to be out of their deprived state. They could also utilize the research outcome to generate relevant and appropriate strategies to raise the status of women within the fishing industry to meet the SDGs.

Research consistently demonstrates that women's empowerment is essential for reducing household vulnerability to food insecurity and environmental stresses. These concerns are intimately linked and profoundly impact communities' well-being and sustainable development. As primary caregivers and food providers, women often encounter impediments in accessing resources and decision-making power, leading to food insecurity and poverty. Simultaneously, environmental degradation exacerbates poverty and undermines the capacity of communities to produce food sustainably. In-depth research examining these relationships can inform comprehensive strategies that tackle the systemic barriers to both women's empowerment and sustainable food systems. This entails comprehending the socio-economic and political barriers to women's empowerment and the effects of environmental degradation on their welfare and ability to provide for their families. Formulating gender-responsive policies and programs supports improving food security, mitigating environmental poverty, and fostering sustainable development in Ghana. This study has the potential to provide guidance and insights for policymakers, practitioners, and communities as they seek to enhance the quality of life for women and their families in Ghana, particularly within coastal communities.

Delimitation of the Study

Conducted within the context of Ghanaian communities, the research focuses on rural coastal communities where a substantial proportion of women reside and engage in livelihood activities. The study's methodology relies

exclusively on surveys, using econometric tools to analyze and interpret the data. This approach is chosen for its ability to provide a quantitative comprehension of the link between empowering women and household welfare indicators such as environmental poverty and food security. The survey data is obtained from a representative sample of fishing households comprising men and women that provides a robust and nuanced depiction of these concerns. Given the dynamic and rapidly evolving nature of these issues, it is critical to understand how they interact and affect the well-being and sustainable development of Ghanaian communities.

It is pertinent to note that although this study makes a valuable contribution to household welfare and women's empowerment, it does not purport to provide a comprehensive examination of all development-related issues in Ghana. Other critical development challenges, such as health, education, and infrastructure, could impact Ghanaian communities' well-being and sustainable development. Nonetheless, this study remains focused on constructing an empowerment index while assessing the effect of empowering women on food insecurity and environmental poverty.

Limitations of the Study

Despite the study's valuable contributions to knowledge, it has limitations. The expected sample size was not obtained for the five fishing communities: Axim, Elmina, Moree, Biriwa, and Anomabo. This was because resources were limited. Nonetheless, the total households (690) obtained for this study is still relevant for analysis as it is within what other studies (Alkire et al., 2013; Narayanan et al., 2019) sampled. Additionally, the reliance on self-reported data collected through surveys raises the potential for response bias,

particularly in sensitive issues such as women empowerment, household food security, and environmental poverty. This may lead to a limited understanding of these complex issues, as respondents may be less likely to report sensitive or personal information accurately or truthfully. Also, the extent of this research is limited to rural areas in Ghana, meaning that the findings may not be generalizable to other regions or populations in Ghana or other countries with different cultural, economic, and political contexts. The study's time frame is also restricted to the current status of these issues in Ghana, and it is possible that the results may not reflect changes or trends over time.

Contributions of the Study

Per the literature, this study is the first to use a multidimensional method to develop an empowerment index specifically for coastal communities to measure women's empowerment against the men in their households in Ghana. This is particularly important because the developed index provides policymakers with the appropriate tool to track women's progress over time and monitor and evaluate which empowerment aspect they need to focus on.

Although various empirical studies have established a correlation between women's empowerment and food insecurity, this study adds to the academic literature by considering the role of other household deprivations, such as water and energy poverty, in moderating this correlation. It also shows how prosocial behavior mediates this relationship. To achieve zero hunger, it is essential also to consider other developmental issues that could impact food security in the household. Since women are responsible for water and fuel collection, their disempowerment will affect these well-being indicators, affecting food security in the household. Furthermore, even though

environmental poverty is a growing concept, there needs to be more literature on the role of women in mitigating environmental poverty in Ghanaian households, specifically with a focus on coastal communities. Therefore, this study brings a gender perspective to the ongoing discussion on environmental poverty.

Organization of the Study

The thesis comprises eight chapters. Chapter two provides an overview of the fisheries sector and the status of food security and environmental poverty in Ghana. Chapter three comprehensively reviews relevant literature on empowerment, environmental poverty, and food security. This chapter examines the conceptual and measurement dimensions of the critical study variables. Chapter four expounds on the research methodologies employed, including the research philosophy, data sources, collection and analysis techniques, estimation techniques, and measurement of variables. The results from the empowerment index are presented in chapter five, with chapter six focusing on food security and women's empowerment. The findings on women's empowerment and environmental poverty are presented in chapter seven. At the same time, the final chapter summarises the study findings and provides conclusions and recommendations for future research and policy development.

CHAPTER TWO

LITERATURE REVIEW

Introduction

This chapter provides a comprehensive examination of the existing literature on women's empowerment, food security, and environmental poverty in Ghana. Beginning with an overview of Ghana's fisheries sector, the chapter explores current trends in food security and environmental challenges within the country. The review then establishes a theoretical foundation for the study by analyzing relevant frameworks and concepts. Subsequently, it examines empirical evidence from previous research, contextualizing the study within the broader academic discourse. Through this thorough review of both theoretical perspectives and empirical findings, the chapter identifies critical knowledge gaps in the existing literature while providing a solid conceptual framework for the present study. This structured approach ensures a robust foundation for understanding the interconnections between women's empowerment, food security, and environmental concerns in Ghana's fishing communities.

The Fisheries Sector in Ghana

Ghana's thriving fishing industry can be traced back to when Fante fishermen began to ply their trade along the coastlines in the 17th and 18th centuries (Tobey et al., 2016). The country's shoreline stretches approximately 550 km from the east in Aflao to the west in Half Assini, with a total continental shelf area estimated to be around 24,300 square kilometers. In addition, Ghana's exclusive economic zone (EEZ) extends to about 200 nautical miles from the shore (Nunoo et al., 2014). The industry's fishery resource is sourced from marine and inland sectors, including aquaculture. The marine sector is

particularly crucial to local fish production, with approximately 70% of total fish production in 2017. Ghana's fisheries sector encompasses diverse production systems, with inland fisheries comprising both wild capture and aquaculture accounting for thirty percent of the country's total fish production. The nation's waters harbor economically significant fish stocks, including various species of anchovies, tuna, yellowfin, and chub mackerel. Ghana's combined annual fish production from marine fisheries, inland waters, and aquaculture operations reaches approximately 400,000 metric tonnes, highlighting the sector's substantial contribution to the country's economy and food supply. However, the annual fish requirement in the country is estimated to be 720,000 metric tonnes, resulting in an average annual deficit of 320,000 metric tonnes (FAO, 2016c; MoFEP, 2007). To fill this gap, Ghana imports fish worth US\$200 million each year (MoFEP, 2007).

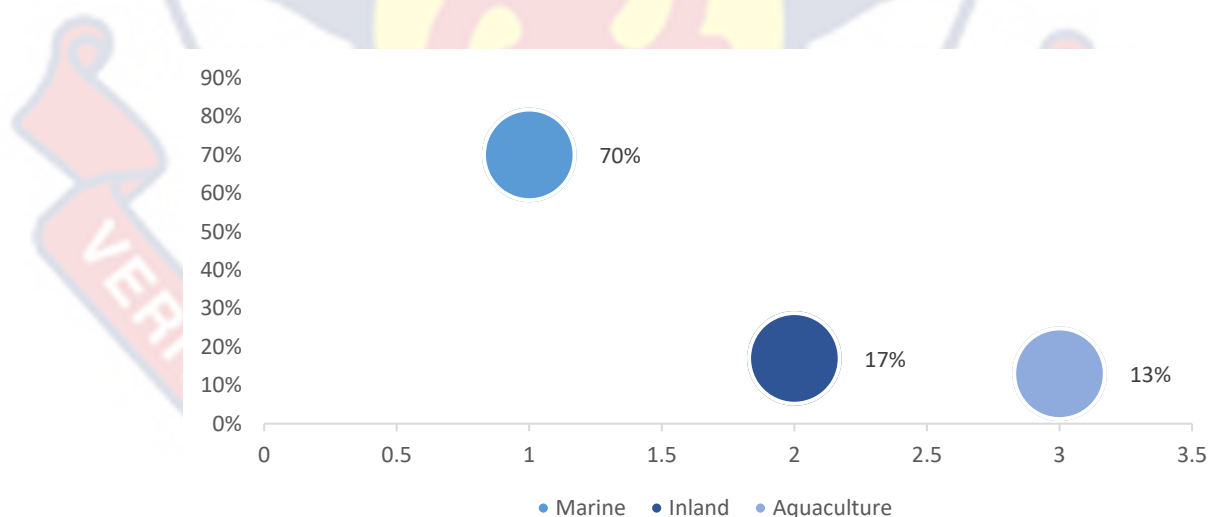


Figure 1: Contribution to total fish production by sector.

Source: Fisheries Commission (2017)

Marine Fishery Sector

In Ghana, the local fish supply is mainly derived from the marine subsector, which accounts for approximately 70% of the total production (FAO, 2016c). This subsector encompasses the artisanal sector, semi-industrial, industrial, and tuna fishing.

Artisanal Fishery

This sector is a vital component of the marine fisheries in Ghana, accounting for the majority of the catch landed and the number of vessels (Tobey et al., 2016). This sector primarily uses simple gears, including purse seine nets, canoes, beach seine nets, drift gill nets, surface set nets, and hook and line (Bailey et al., 2010). Over 12,000 artisanal canoes are estimated to operate in Ghana, with 6405 motorized (Nunoo et al., 2014). An estimated 80% of the marine catch is landed by artisanal fishermen working from 304 landing sites across 200 fishing (Samey, 2015; FAO, 2016c). This sector is considered small-scale, relies on local resources, and is predominantly involved in catching species such as anchovy, sardinella, mackerels, and burrito.

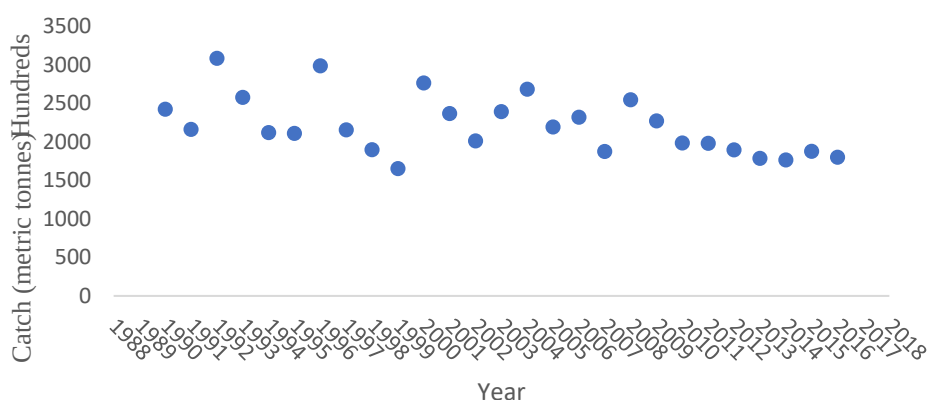


Figure 2: Trends in the artisanal catch (1990-2016).

Source: Fisheries Commission (2017)

Over the years, the contribution of the artisanal sector to total marine production has been fluctuating, with some years experiencing an increase and others recording a decline. In 2004, the sector recorded its highest fish production of about 270000 metric tonnes. It declined significantly in 2005, increased in 2008, and continuously declined through 2016. This could be due to the increasing number of vessels in the artisanal sector as they are managed as unregulated common pool resources leading to overcapitalization (Akpalu, 2015).

Industrial Fishery

The industrial sector contributes 6% to Ghana's total marine fish production (FAO, 2016c). The industrial sector comprises large foreign-built trawlers and shrimpers (Mensah et al., 2006). At present, there are approximately 84 licensed trawlers that operate in Ghana's waters (FAO, 2016c), with operations centered in Tema and Takoradi, where proper berthing facilities and deep water ports exist (Nunoo et al., 2014). Previously, these trawlers had fished in more productive waters beyond Ghana's borders, primarily Angola and Mauritania (Nunoo et al., 2014). However, with other countries laying claim to 200 nautical miles of exclusive economic zones, the trawlers have been limited to operating within Ghana's waters, which is in line with the Third United Nations Convention on the Law of the Sea (Nunoo et al., 2014; Mensah et al., 2006). These vessels exploit both demersal and pelagic species, and by law, they must exploit fish resources in waters deeper than 30m (Fisheries Act 625 of 2002).

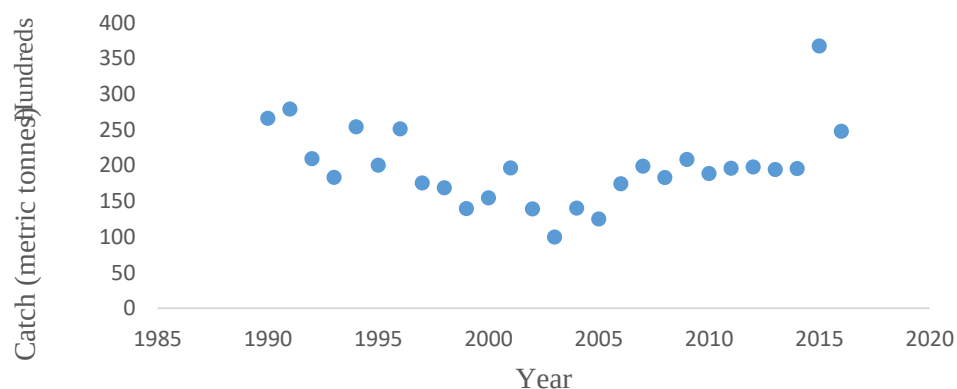


Figure 3: Trends in industrial sector catch (1990-2016).

Source: Fisheries Commission (2017)

The industrial sector's contribution to total marine production has also been increasing and declining over the years. The sector recorded its highest fish production of about 37000 metric tonnes in 2015 and minor production of 9900 metric tonnes in 2003.

Tuna Fleet

The tuna fishing vessels primarily target yellowfin, skipjack, and big-eye tuna, with the latter two species exhibiting different levels of exploitation (Nunoo et al., 2014). Specifically, yellowfin and big eye are overexploited, whereas skipjack remains underexploited, as assessed by the International Commission for the Conservation of Atlantic Tunas (ICCAT) (Nunoo et al., 2014). In Ghana, most tuna fishing fleets operate under a joint venture system, in which Ghanaian owners must hold a minimum of 50% of the shares, as stipulated by the Fisheries Act 625.

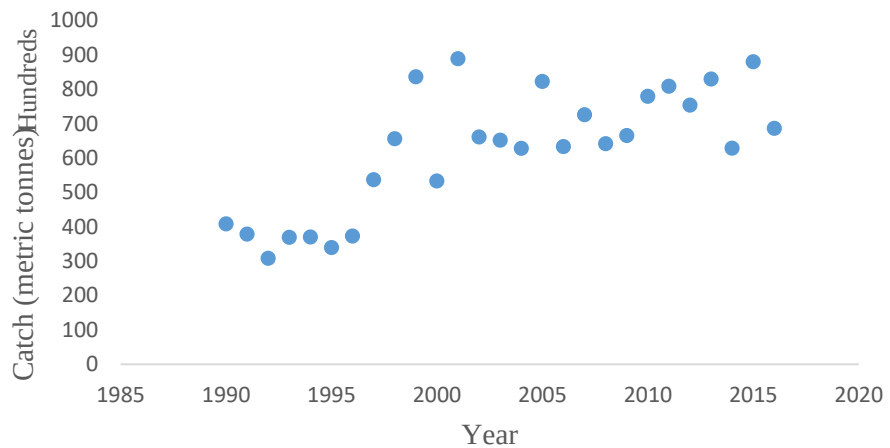


Figure 4: Trends in tuna fleet catch (1990-2016).

Source: Fisheries Commission (2017)

The Tuna sector's contribution to total marine production has been following a decreasing trend in recent years. For instance, production has declined from 87960 metric tonnes in 2015 to 68553 in 2016 in the Tuna subsector.

Semi-Industrial Sector

The semi-industrial sector contributes an estimated 2% to the total marine catch while operating from 8 landing sites (FAO, 2016c). This sector comprises about 560 locally carved wooden vessels attached to inboard engines of 400 HP with lengths ranging between 8 and 37m and operates in Tema, Axim, Winneba, Apam, Elmina, Mumford, Sekondi and Takoradi (Mensah et al., 2006). The trawlers operated in this sector are used multi-purposely for both bottom trawling and purse seining.

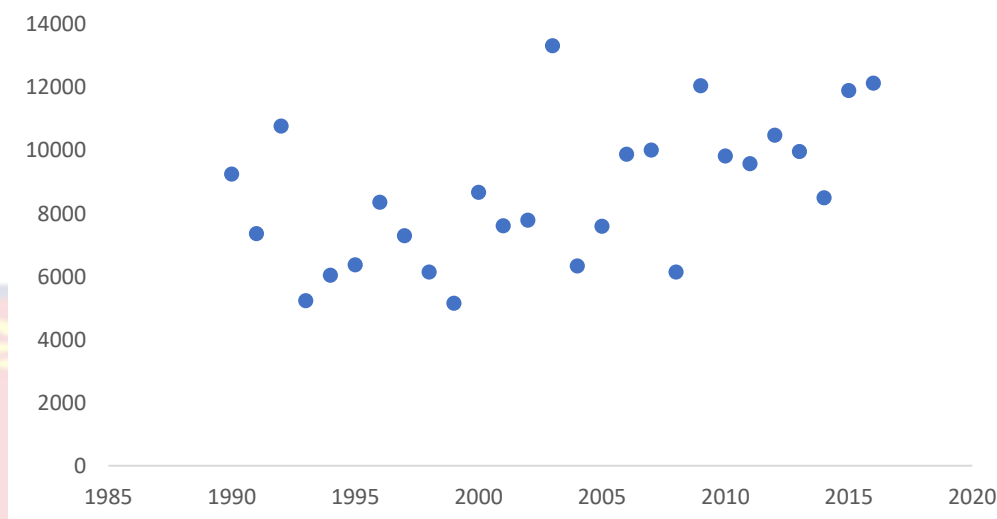


Figure 5: Trends in the semi-industrial catch (1990-2016).

Source: Fisheries Commission (2017)

There has been a fluctuating trend in the contribution of the semi-industrial sector to the total marine supply. For instance, in 2003, the sector recorded its highest contribution of about 13318 metric tonnes to total marine production. It further decreased in 2013 to 9960 metric tonnes and increased in 2016 to 12131 metric tonnes of fish.

Inland Fishery

In Ghana, the inland fisheries are mainly artisanal, and the Volta Lake is the primary fishing ground, employing about 80,000 fishermen and 20,000 traders and processors (Nunoo et al., 2014). The sector contributes about 20percent of the total fish production in Ghana, landing approximately 80,000 metric tonnes of fish per year (FAO, 2016c). The sector uses different fishing gears, such as cast and gillnets, hook and line, traps, and spears, with an estimated 17,500 to 24,000 canoes actively operating on Lake Volta (FAO, 2016c). Lake Volta is home to diverse fish species, with tilapia being the most commonly caught.

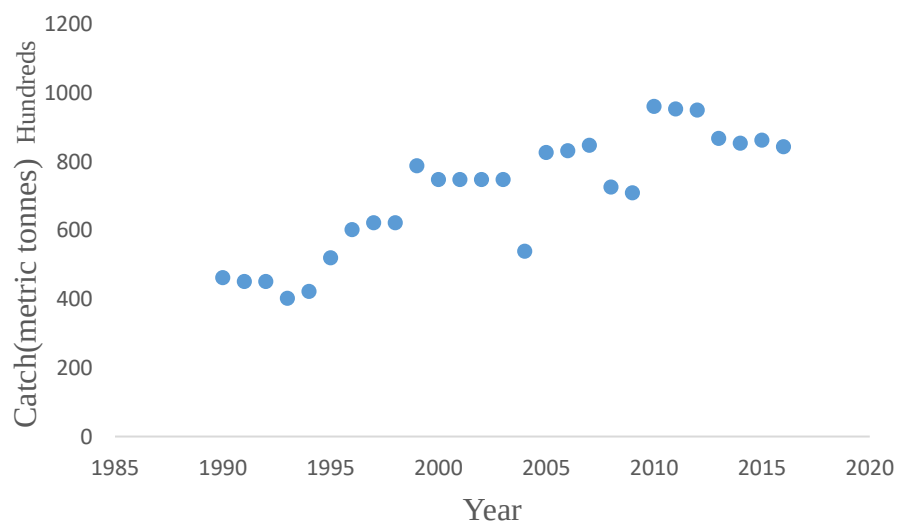


Figure 6: Trends in the inland catch (1990-2016).

Source: Fisheries Commission (2017)

Although there have been years when fish production in the inland sector decreased, it can be said that the sector recorded an increase in production in some years. Available catch data shows that from 2008 to 2010, inland capture fish production continuously increased from 72590 metric tonnes to 96195 metric tonnes. It decreased to 95353 metric tonnes in 2011 and 84344 in 2016.

Economic Impact of the Fisheries Sector

In Ghana, the industry is significant in socioeconomic development and poverty alleviation (FAO, 2016c). It provides dietary protein, creates employment, and contributes to foreign exchange earnings and GDP in developing coastal economies (Akpalu & Eggert, 2020). Most coastal dwellers work along the fisheries value chain to sustain themselves and their families (Sumaila & Cheung, 2022). The fisheries sector represents a significant source of employment in Ghana, engaging approximately twenty percent of the country's active labor force. Within this sector, women constitute a notable yet disproportionately small percentage, accounting for just 3.6 percent of those

employed. This gender disparity in formal employment statistics often understates women's actual participation, as many engage in informal or unreported activities throughout the fisheries value chain (Attah-Mills et al., 2004; Akpalu & Eggert, 2020). Additionally, the sector contributes 4 percent to Ghana's GDP annually, while the value addition of fish production is about 15% of the agriculture GDP (MoFAD, 2020). For the average Ghanaian, fish constitutes 60% of their animal protein intake, emphasizing the importance of fish as food and a source of food security in the country (MoFAD, 2020). According to the (MoFAD, 2020), fresh fish is Ghana's most significant non-traditional export commodity. Total earnings generated from the fish export were estimated to be 300 million US dollars in 2015. However, the fishery resources are overexploited and over-capitalized, with the sector facing a reduction in total production (FAO, 2016c).

Women in Fisheries

In the Ghanaian fishery value chain, women are essential in producing, processing, marketing, and financing fleets in both large and small-scale fisheries sectors (Nunoo et al., 2014). They are deeply engaged in fishing by carrying out their responsibilities efficiently and effectively to prevent spoilage and losses (Mensah et al., 2006). They finance fishing expeditions and remain a reliable source of credit for most fishermen along the coast (Overå, 1993; Akrofi, 2002; Mensah et al., 2006; GIZ, 2013; FAO, 2016c; Torell & Okyere Nyako, 2015). According to Britwum (2009), traditionally, women are to finance fuel purchases since they can add monetary value to fish. This role gives them extraordinary power in the sector because the cost of fuel is prioritized in the distribution of catch (Britwum, 2009).

In fish marketing, their roles in handling, grading, packing, and retailing are crucial to ensure timely catch distribution (Nunoo et al., 2014). They also distribute fish to other fish processors and customers in the fish marketing chain (Mensah et al., 2006). They engage in other complex fishing activities and assume leadership roles. A rare occurrence in fishing activities that corroborate the finding that women are engaged in complex post-harvest fishing activities is the setting of the price of fish (Torell & Okyere Nyako, 2015). This act is common in most Ghanaian fishing communities and carried out by an influential woman called the **konkohene**, who is different from the Queen mother of the town and should not necessarily be the chief fisherman's wife (Torell & Okyere Nyako, 2015).

Governance and Institutions

The industry is subjected to numerous regulations and legislation, and the government of Ghana has established institutions responsible for developing and directing research priorities in the sector (MoFAD, 2020). Both traditional authorities and state agencies carry out the management of the industry. Traditional authorities, such as the Chief Fisherman and Fish Queen, govern landing sites. The Chief Fisherman is known locally as Apofohene (Fante), Woleiatse (Ga-Adangme), and Dotorwafia (Anlo), while the Fish Queen is known as Konkohene in Fante (Odotei, 1999; Torell & Okyere Nyako, 2015). At the same time, the Ministry of Fisheries and Aquaculture Development (MoFAD) is the state agency with legal authority to enforce policies and processes (MoFAD, 2020).

The Chief Fishermen

In Ghana, the chief fishermen serve as a link between fishermen and higher-level government organizations. According to Kraan (2009), the chief fishermen chair the affairs of the fishing committees and advise the village chief on all fisheries matters. The roles played by the Chief Fishermen in all coastal areas in Ghana vary from one tribe to the other. The fishermen select them based on experience and expertise except in other coastal areas (Cape Coast, Winneba, and Ga-Adangme) where the position is hereditary (Odotei, 1999; Overå, 2005). They work with a council with similar qualities (Odotei, 1999).

The chief fishermen are influential leaders who oversee all fishing activities, including management of the beach and landing sites (Torell & Okyere Nyako, 2015). The Chief Fishermen and their councils witness a negotiation between fishermen and help settle disputes between fishermen and fish traders (Overå, 2005). They use their religious powers, which are highly respected, to instill discipline among fishermen by making sure that fishing regulations are adhered to (Overå, 2005; Torell & Okyere Nyako, 2015). For instance, in the Volta region, the chief fishermen perform religious rituals to ensure good fishing (Kraan, 2009). In addition, they also oversee emergency response efforts during accidents at sea and generate income through fines imposed on fishers who violate regulations or on migrant fishers who engage in fishing on their shores (Bannerman, 1998; Overå, 2005; Kraan, 2009). They also liaise with the government regarding benefits, credit, and inputs for fishermen (Kraan, 2009). In Winneba, they play a critical role as senior divisional chiefs and stand in for the paramount chief when he is away (Overå, 2005). The chief fishermen are members of the Ghana National Canoe Fishermen's Council.

The Fish Queen -Konkohene

The fish queen is a significant figure in Ghana's fishery sector, and her role can be traced back to the early 20th century (Gordon et al., 2011). She is prominent at fish landing sites in Ghana and is widely considered the most influential woman in this domain (Odotei, 1999; Chu, 2015; Torell & Okyere Nyako, 2015). In contrast to the chief fisherman's position, the fish queen need not be the spouse of the chief fisherman. However, she should have a deep understanding of the sector to manage the affairs relating to women in the community (Torell & Okyere Nyako, 2015). In specific fishing communities, the position is inherited. In contrast, to other communities, it is an honorary title bestowed by the chief fisherman and the village chief and presented to fish processors for approval or, in some cases, elected to the high office (Odotei, 1999; Torell & Okyere Nyako, 2015).

The selection of a fish queen in certain Ghanaian fishing communities is a process that demands specific attributes from candidates. These communities seek individuals who demonstrate a comprehensive set of skills and character traits. A prospective fish queen must possess extensive experience in fish handling, showcasing her practical knowledge of the trade. Additionally, she is expected to exhibit patience and tolerance, crucial qualities for mediating conflicts and managing diverse interests within the fishing community. The role requires boldness, enabling her to advocate effectively for her community's needs. A genuine concern for others is essential, as the fish queen often serves as a community leader and advocate. Finally, candidates must display both mental acuity and physical vigor to handle the multifaceted demands of this influential position. These stringent criteria underscore the fish queen's pivotal

role in maintaining social cohesion and economic stability within fishing communities (Odotei, 1999). The election is conducted by elders and the candidate elected is lifted, sprinkled with white powder, and cheered for success. Later, the candidate is presented to the chief fisherman and the village chief for recognition (Odotei, 1999). Like the chief fisherman, the fish queen has a council that helps her execute her duties. The role played by the fish queen requires a very high level of expertise from mothers, sisters, and aunts (Chu, 2015; Torell & Okyere Nyako, 2015). She has power over all post-harvesting activities and market control (Chu, 2015).

In most parts of the coastal communities in Ghana, the konkohene sets the prevailing price of that day's fresh catch every morning depending on the nature of supply and demand (Overå, 2005; Odotei, 1999; Chu, 2015; Torell & Okyere Nyako, 2015). Each morning, she inspects several landings, typically three or four, to assess the market price. While the fish queen's pricing decisions are influenced by supply and demand signals, the day's fish catch remains unpredictable. The price she sets remains the standard at which fish is traded (Chu, 2015). Also in certain instances, the fish price may fluctuate during the day, especially at landing sites closer to urban centers like Accra (Torell & Okyere Nyako, 2015). Interestingly, the fishermen adhere to the price she sets by selling their catch at the said price. She is sometimes asked to advise the chief fisherman (**apofohene**) and help him settle disputes between fishermen and fish traders (Overå, 2005).

She mediates and settles debt cases between men and women at landing sites (Odotei, 1999; Torell & Okyere Nyako, 2015). Whenever there is a ritual performance for the sea gods, she either contributes in kind or cash (Odotei,

1999). The Fish Queen and her council occasionally meet when they need solutions to a problem at the beach (Odotei, 1999). Despite her contributions to the fishing communities, her traditional power has been challenged, albeit it is still highly recognized and respected (Torell & Okyere Nyako, 2015). Also, with politics entering the fisheries sector, the traditional authority is sometimes overlooked, and their roles seem to be fading out (Torell & Okyere Nyako, 2015).

State Agencies

The fisheries industry is regulated by the Fisheries Act, 2002 (Act 625), Fisheries Regulations, 2010 (L.I. 1968), Fisheries (Amendment) Act, 2014 (Act 880), and Fisheries (Amendment) Regulations, 2015 (L.I. 2217). According to FAO (2016c), the Ministry of Fisheries and Aquaculture Development (MoFAD) is responsible for planning and overseeing the management and development of fisheries in Ghana's jurisdictional waters. The objectives of MoFAD are multifaceted, comprising the promotion of sustainable fisheries via research and development and provision of support services to fish traders and processors, ensuring a reliable supply of fish from captured fisheries for both local and international markets, and extending technical assistance to fishers, fish traders, and fish processors. Under MoFAD are two agencies, the Fisheries Commission, and the National Premix Fuel Secretariat.

Fisheries Commission

The establishment of the Fisheries Commission is under section 1 of the Fisheries Act, 2002 (Act 625) and section 2 highlights the main objective of the Commission as “to regulate and manage the utilization of the fishery resources in Ghana and coordinate the policies related to them”. It is an implementing

agency under the Ministry of Fisheries and Aquaculture Development and has the mandate to establish policies and regulations to manage all fishing sites in Ghana, ensure that fisheries resources are sustainably exploited, settle disputes among operators and advice government on all aspects of fisheries under the Fisheries Act, 2002 (Act 625) (FAO, 2004). The Commission as a state agency is responsible for monitoring, controlling, supervising, and evaluating its compliance function in all aspects of fisheries management and development in Ghana which includes; fish health and safety, post-harvest activities and quality assurance. Due to the importance of the sector in the economic growth of the country, the composition of the Commission as dictated by the Fisheries Act, 2002 (Act 625) must include stakeholders who are relevant to the sector (Kwadjosse, 2009). Thus section 4 (1) of Act 625 establishes the composition of the Fisheries Commission as:

- A chairman appointed by the president of Ghana in consultation with the council of state.
- A representative from the Ministry of Transport.
- A representative from the Ministry of Defence.
- A representative from the Ministry of Environment.
- A representative from Ghana Marine Fishing Officers.
- A representative from Water Research Institute.
- A representative from Ghana Irrigation Development Authority.
- Two representatives from the National Fisheries Association of Ghana- one representing artisanal fishermen and the other representing industrial vessel owners.

- One person with the requisite knowledge of the fishing industry or natural resource management.
- The Director of the Commission

The Fisheries Commission has Divisions and Units that effectively assist the Commission to achieve its sets objectives and ensure the smooth running of the organisation. They serve as the policy making, administrative and enforcement structures of the Fisheries Commission and also very core to the management of the fisheries resources (Kwadjosse, 2009). The Divisions and Units include: Marine Fisheries Management Division (MFMD), Inland Fisheries Management Division (IFMD), Fisheries Scientific Survey Division (FSSD), Monitoring, Control, and Surveillance Division (MCSD), Operations and Administration Divisions (OAD), Fish Health Unit (FHU), Monitoring and Evaluation Unit (MEU), Post-Harvest Unit (PHU), and Projects Unit (PU).

National Premix Fuel Secretariat

The secretariat was established by government under the National Premix Fuel Committee Regulations, 2016 (L.I. 2233). The secretariat provides administrative support and see to it that premix fuel which is subsidized by government is distributed on time to artisanal fisher folks.

Challenges Facing the Fishery Industry in Ghana

Even though the fishery sector remains valuable to the Ghanaian economy, it currently needs help. Ghana's vibrant marine fisheries are threatened primarily due to increased fishing efforts and subsidies with weak enforcement and unregulated fisheries management (Tobey et al., 2016; Sumaila, 2022). This increase in fishing effort and poor fisheries governance enable resource users to rely on illicit and destructive fishing practices leading

to the overexploitation of marine species (Coulthard et al., 2011; Sumaila, 2022). Climate change exacerbates the depletion of fisheries stocks through multiple mechanisms. Rising ocean temperatures force fish populations to migrate, disrupting established ecosystems and fishing patterns. Ocean acidification threatens shellfish and coral reefs, which serve as crucial habitats for many species. Altered ocean currents affect nutrient distribution and fish migration routes, while more frequent extreme weather events damage coastal habitats and fishing infrastructure. Sea level rise destroys vital coastal breeding grounds and nurseries. These factors collectively lead to reduced fish populations in affected areas, changes in species distribution, alterations in breeding patterns and productivity, and increased vulnerability to overfishing as stocks become stressed. The cumulative impact of these climate-induced changes accelerates the decline of fisheries stocks globally, compounding the existing pressures from overfishing and habitat destruction (Sumaila, 2022; Lam et al., 2020).

A more recent ecological disaster unfolding off the coast of Ghana, particularly in Elmina, an ancient fishing town, is the transshipment at sea popularly known as “Saiko.” This term describes the illegal transfer of fish between industrial trawlers and artisanal canoe owners at sea (EJF, 2019). An activity that started as an informal trading system saw industrial trawlers licensed to catch demersal fishes target fishes meant for artisanal fishers and resell them to them as commercial species decline due to overfishing (EJF, 2019). The situation threatens marine biodiversity, and coastal livelihoods exacerbate poverty and increase food insecurity (Akpalu & Eggert, 2020; Tobey et al., 2016).

Over depletion of the fishery resource is widening the fish consumption deficit in Ghana (MoFAD, 2020). The continuous expansion of the fishing industry, rapid increase in IUU fishing, and the top-down approach to fisheries management in Ghana have negatively impacted fish landings and artisanal fishers' income (EJF, 2021). This accentuates the need to strengthen fisheries governance and management policies to save the sea from drying and thereby protect the livelihoods of coastal communities.

Fish Marketing and Processing in Ghana

Fish trade takes place in both international and local markets. However, the local market is the most important for fish production in Ghana (Gordon et al., 2011). Women are intensely involved in the marketing and processing of fish and can go the extra mile to finance fishing trips, giving them control over the sales beyond fishing seasons (Akrofi, 2002; Bortei-Doku, 2002; Britwum, 2009; Gordon et al., 2011). According to Britwum (2009), fish traders are solely responsible for searching for markets outside their vicinity. Fresh fish landed at beach sites are traded on wholesale and retail bases and distributed nationwide by small and large-scale operators (Mensah et al., 2006). To ensure quick and efficient distribution, fish landed are sorted and arranged according to sizes and types of species (Mensah et al., 2006). The catches are measured with a plastic or wooden crate or a basket and weigh between 20kg to 33kg, depending on the species (Akrofi, 2002; Mensah et al., 2006).

In the fish marketing chain, the first contact of most fishermen at the beach is the wholesalers, usually the fishermen's wives and relatives (Mensah et al., 2006). The queen fish mongers, locally known as the konkohene, set prices based on demand and supply and distribute them to other fish traders and

customers (Mensah et al., 2006; Torell & Okyere Nyako, 2015). In distributing the catch, fish traders and processors who advanced expedition costs and the repair of fishing gears get the highest share (Mensah et al., 2006; Gordon et al., 2011). If the fish processor is also a wholesaler, she buys the bulk of fish to be smoked and sells the unsmoked ones to other fish traders who cannot buy direct from the source (Mensah et al., 2006). Fishing communities typically process their catch in two ways: about 80% is smoked, while the remaining 20% is fried and sun-dried for local market distribution (Akrofi, 2002; Quagrainie et al., 2016).

Through processing, women can add value to fresh fish, ensuring its availability in lean seasons (Britwum, 2009). Fish processing in Ghana is small-scale, mainly done by smoking, curing, salting, drying, and frying (Akrofi, 2002; Britwum, 2009). The fish type and freshness level largely determine the processing method used (FAO, 2016c; Britwum, 2009). For instance, curing is a process reserved for fish that could be fresh, while smoking extends the life span of fresh fish to last as long as a year (Britwum, 2009). According to Britwum (2009), fish processing by women gives them control over the fish prices by regulating the quantity to be sold in the markets. The expertise of fish traders gives them knowledge of the consumer preference of various ethnic groups, which helps them determine the marketing strategy of fish across the board (Akrofi, 2002).

Smoked fish is sent to nearby markets for sale or stored to be sold in lean seasons. Fish processors smoke or store fish such as anchovies, sardinella, and shrimp between August and December to be released for sale between March and April (Mensah et al., 2006). The main markets for the sale of anchovies in

Ghana are Denu, Mankesim Abuesi, Tema New town, Ankaful, and Kormatse (Mensah et al., 2006). The catches weighing 20kg to 25kg from the industrial vessels are landed at the shore, frozen, and sold to wholesalers to be retailed to other fish traders. An estimated 70% of tuna landed is sold to Pioneer Food Cannery Limited at export prices (Mensah et al., 2006). In the semi-industrial sector, marketing and distribution of catches are undertaken by women. They sometimes finance fishing trips to ensure consistent fish supply to be sold to their customers (Mensah et al., 2006).

Inland fisheries' market facilities are only available along the lake for the primary 32 fish marketing centers. About 1232 inland fishing villages have to adapt to these markets. These 32 major fish marketing centers are the first point of contact in the distribution chain, with the urban marketing centers of Accra, Kumasi, Techiman, Nkawkaw, Tamale, Koforidua, and Ho being the second in the distribution chain. Fish from Lake Volta is distributed across all rural and urban markets in the country. However, transporters encounter several problems in the form of accidents due to the overloading of boats and tree stumps on the lake. Also, catches from lake Volta are exported to neighboring countries like Togo, Burkina Faso, and Cote d'Ivoire (Mensah et al., 2006).

Food Insecurity in Ghana

Food insecurity remains a critical issue in Ghana, with many individuals relying on insufficient and unsafe food. According to the Ghana Statistical Service (GSS) (2020), an estimated 3.6 million people in Ghana, or 11.7% of the population, are food insecure. Of this population, 5.2% face severe food insecurity, while 6.5% face moderate food insecurity. Rural areas are particularly affected, with 78% of residents experiencing food insecurity.

Malnutrition is also a significant concern, with WHO (2018) estimating that 42% of children under five in Ghana experience stunted growth due to malnutrition. Contributing factors include poverty, limited access to nutritious food, and poor hygiene and sanitation practices (FAO, 2020).

Food insecurity is most severe in the Upper East Region, where almost 49% of the population faces limited access to sufficient, nutritious, and safe food. The North-East Region has the second-highest food insecurity rate, with nearly 33% of the population affected (GSS, 2020). Poverty and limited access to resources are significant drivers of food insecurity in the Northern Region, where an estimated 31% of the population is food insecure. In the Upper West Region, approximately 23% of the population is estimated to be food insecure. Coastal communities in the Central, Western, and Greater Accra regions have a combined food insecurity rate of 10% (GSS, 2020).

Multiple factors contribute to food insecurity in fishing households in Ghana, including poverty, climate change, overfishing, degradation of fish stocks, and limited market access (Harper et al., 2013). Poverty, particularly in rural areas, limits access to adequate and nutritious food and essential healthcare and education services (FAO, 2018). Climate change alters weather patterns, affecting fishing and agriculture through changes in precipitation and extreme weather events, and rising sea levels, which can reduce access to fish and other food sources (Sumaila, 2022). Overfishing and degradation of fish stocks decrease the availability of fish, reducing income and economic opportunities for fisherfolk (Akpalu, 2015). Limited access to markets limit access to food and essential resources, and opportunities for trade and economic development (FAO, 2016a).

Efforts to address food insecurity and malnutrition in Ghana are underway. The government and development organizations are working to increase access to food, improve the nutritional content of diets, and promote sustainable agriculture and fisheries practices (Essilfie et al., 2021). For example, the government of Ghana has launched programs such as the Planting for Food and Jobs initiative and the One-Village-One-Dam initiative to increase food production and improve access to food (GoG, 2020). Since its launch in 2017, Ghana's Planting for Food and Jobs (PFJ) Programme and the One-Village-One-Dam initiative have made significant contributions to the nation's agricultural sector. Data indicates a substantial rise in fertilizer application, increasing from 8kg per hectare in 2017 to 20kg per hectare by 2020. Additionally, there has been a marked uptick in the use of certified seeds, fostering the development of a robust seed industry. The initiative has also succeeded in attracting private sector collaboration with the government to achieve desired outcomes. About 461 dams have been completed across the country (MoFEP, 2022)

As of September 2021, the Ministry had distributed 31,797 metric tons of enhanced seeds to farmers nationwide. This allocation comprised 11,289 metric tons of maize, 16,382 metric tons of rice, 4,126 metric tons of soybean, and 26 metric tons of vegetable seeds. Furthermore, 259,500 metric tons of various fertilizers were disseminated to PFJ beneficiaries across the country. These efforts are anticipated to boost productivity, enhance incomes, and improve the overall quality of life for participating farmers.

To enhance cashew cultivation, a polyclonal seed garden has been established at the Wenchi Agricultural Station. This 4-hectare garden, replicated

in four blocks with ten cashew accessions, aims to produce improved planting materials. While initial steps such as ploughing, stumping, harrowing, and holing have been completed, further activities like replacement planting and maintenance are pending. This garden will serve as a reserve for grafted seedlings during high-demand periods and benefit farmers in remote cashew-growing regions, as polyclonal seeds are easier to transport than grafted seedlings.

The Ghana Peri-Urban Vegetable Value Chain Project (GPVVCP) has initiated Farmer Field School (FFS) training programs focusing on soil and nutrient management. These sessions have been conducted for two farmer groups in the Michel Camp area of the Kpone Katamanso Municipality, Greater Accra Region (MoFEP, 2022). Although these programs have succeeded, more must be done to ensure that all Ghanaians can access adequate, nutritious, and safe food.

Promoting sustainable fisheries practices represents a potential solution to food insecurity in Ghana. Sustainable fisheries practices, such as sustainable fishing methods and marine protected areas, can protect fish stocks and improve the livelihoods of small-scale fishers (Sumaila, 2022). According to FAO (2020), sustainable fisheries practices can help to increase food production, improve food security, and promote economic growth in developing countries like Ghana.

Environmental Poverty

Environmental poverty is defined as the inability of households and communities to access essential environmental services, such as sanitation, clean water, and energy, which can negatively affect the livelihoods, health, and

well-being (Nawaz & Iqbal, 2021; Essel-Gaisey & Chiang, 2022). Despite Ghana's growing economy and efforts to improve access to essential services, environmental poverty remains a persistent challenge (Essel-Gaisey & Chiang, 2022). Moreover, per the environmental performance index, Ghana ranks 39th out of 46 Sub-Saharan African countries, indicating the country's insufficient measures in addressing environmental challenges across eleven indicators, including sewage management, sanitation, and water (Wendling et al., 2020). Furthermore, UN-Habitat (2020) has noted significant challenges in providing improved drinking water, waste management strategies, and sanitation in Ghana.

According to Cobbinah et al. (2017), rising poverty in Ghana worsens access to environmental services, leading to pollution, flooding, environmental depletion, and an unhealthy built environment. Also, environmental poverty is a persistent challenge in rural Ghana as households' income status does not allow them to afford proper dwellings, better environmental services, and use clean fuels (Adusah-Poku & Takeuchi, 2019). Therefore, prioritizing sustainable and equitable development policies that promote access to essential environmental services, mitigate climate risks, and reduce poverty in Ghana is essential.

A report from the 2021 population census shows that about 48.4% of Ghanaian households live in owner-occupied dwellings, while 34.6% occupy rented dwellings (GSS, 2021). However, the quality of housing remains a concern for some regions in Ghana, with many households living in houses made of unimproved materials, such as mud or thatch. Although 64.1% of households were built with cement blocks at the national level, Greater Accra records the highest with 27%. The number of households built with cement blocks is 10.8% for the Central region and 6.5% for the Western region. This means that most

dwellings in both Central and Western regions need to be in better shape. This can lead to a lack of proper insulation, making homes challenging to keep cool or warm and increasing the risk of health problems.

Furthermore, safe and reliable water access is critical for human health and well-being. In Ghana, an estimated 79% of households depend on unimproved drinking water sources. They mostly rely on surface water, such as ponds and wells (GSS, 2021). For instance, Central and Western regions have 79.5% and 85.7% of their households, respectively, relying on surface water which is often contaminated. However, Greater Accra records the lowest, with only 17.4% of the households relying on an unimproved source of drinking water.

Regarding sanitation, the most prevalent method of wastewater disposal in Ghana is throwing it on the ground or street (70.6%). This mainly occurs in rural areas where about 89% of households dispose of their wastewater in the open. Again, only 14.1% of households have standard waste containers for collecting wastewater. An estimated 66.6% of households do not have waste collection systems; only 13.2% of households have tricycles that collect their solid waste for proper disposal. Only 2.4% of households in the Central region have their solid waste collected, while 4.5% are collected in the Western region. Most households that do not have solid waste collected resort to burning, while those in coastal regions dispose of them along the shore (GSS, 2021). While 59.3% of households have toilet facilities, 23 % rely on public toilets, and 17.7% have no toilets. Of the 17.7% that do not have access to toilet facilities, 77.7% of households in the Central region defecate within the open field, and 24.2% do so on the beaches. The situation is similar to the Western region, where 71.5%

open defecate in the bush while 19.4% of households do so on the beach and other water bodies.

In Ghana, some regions suffer from poor environmental and sanitation conditions, leading to significant economic losses (World Bank, 2020). These losses are primarily caused by the negative impacts of inadequate environmental management, including the widespread practice of open defecation (Nimoh, 2016). The detrimental effects of these practices are particularly felt in coastal communities, which are vital for sustainable livelihoods due to their reliance on fishing activities (Nimoh, 2016). To address these issues, the government and other stakeholders promote sustainable environmental management practices and ensure these communities receive the support they need to thrive (Lai & Nepal, 2006; Hamenoo, 2011).

A substantial portion of Ghana's population, like many in Sub-Saharan Africa, struggles to obtain clean, modern, and affordable energy services (Lin & Okyere, 2021). The reliance on biomass for cooking has contributed significantly to many health problems, with exposure to smoke accounting for approximately 55,000 deaths among Ghanaians in 2016 (WHO, 2015). However, Ghana has made notable progress in achieving universal access to electricity, with 85% of the population having access as of 2020. Additionally, Ghana has been experiencing persistent and erratic power outages, mainly due to the reduced water supply required to feed hydropower plants due to climate change. The country must prioritize investing in infrastructure, efficient pricing mechanisms, and innovative financing models to facilitate sustainable energy supply and affordability (Lin & Okyere, 2021).

Ghana's adoption of the Sustainable Energy for All (SEA4ALL) policy in 2012 was crucial to achieving universal access to efficient, affordable, and modern energy services. The policy outlined ambitious targets of achieving a 100% electricity and 50% LPG access rate by 2020 through interventions such as rural electrification expansion and price subsidy schemes for LPG targeting rural dwellers (Adusah-Poku & Takeuchi, 2019). Despite the well-intentioned policy, however, Ghana has experienced slow growth in the adoption of modern energy services, with approximately 50% of rural Ghanaians needing access to electricity and 90% needing access to LPG as of 2020 (USAID, 2020). These unmet targets have led policymakers to unravel the factors that render people energy-poor (Asante et al., 2018).

In addition, between 2012 and 2015, Ghana was plagued with severe power outages attributed to hydropower station problems such as low water levels (Abeberese et al., 2021). This led to a power rationing scheme where households were guaranteed only 13 hours of electricity supply within a 36-hour frequency (Lin & Okyere, 2021). These power outages and their implications on Ghana's socio-economic well-being, along with the SEA4ALL program's inability to meet its objectives, have raised concerns regarding the extent and incidence of energy poverty in the country (Kumi, 2017). The occurrence of power outages in Ghana due to low water levels has disrupted the country's industrial and commercial activities. It has also led to a decline in the standard of living, as households were forced to rely on alternative energy sources (Mensah & Adu, 2015).

Furthermore, the failure of the SEA4ALL program to meet its targets, coupled with the power rationing scheme's adverse effects, has emphasized the

need for a comprehensive strategy to address the underlying factors of energy poverty in the country (Asante et al., 2018). Resolving energy poverty requires investment in renewable energy sources, adequate policies, and incentives to encourage modern energy services (Lin & Okyere, 2021). Environmental poverty remains a persistent challenge in Ghana, with many households needing access to essential environmental resources and services. Consequently, it is important to identify environmental poverty and how women's empowerment can help mitigate it to achieve environmental sustainability.

Theoretical Review

It plays a crucial role in guiding research and shaping the understanding of complex phenomena. By synthesizing existing theories and concepts, a theoretical review helps to identify gaps in current knowledge and provides a foundation for developing new theories and hypotheses. In this theoretical review, the study explores the current state of knowledge surrounding women's empowerment, food security, and environmental poverty. By bringing together a diverse range of perspectives, this review aims to provide a comprehensive and nuanced understanding of these interrelated issues and to set the stage for further research in this field.

Capability Approach

The capabilities approach is a theoretical framework for assessing human development and well-being formulated by Amartya Sen in 1979. Unlike traditional measures focusing on income or consumption, this approach views well-being and freedom as the ultimate objectives of development (Sen, 1993). The approach emphasizes that development should aim to expand people's capabilities, which refer to the opportunities people have to lead lives they value

(Nussbaum, 2011). Sen argued that conventional welfare measures, such as gross domestic product (GDP), did not accurately represent the multifaceted nature of human well-being and freedom (Sen, 1993). In this regard, the capabilities approach seeks to provide a more holistic and human-centric view of development by emphasizing the importance of expanding people's capabilities (Essilfie et al., 2021). In the context of the capabilities approach, a person's capability is a combination of their ability to function in specific ways and the freedoms they have to achieve these functions (Sen, 1993). For example, a woman's ability to participate in political processes would be determined by her access to education and her right to vote (Sen, 1993). Ultimately, the capabilities approach highlights the importance of expanding people's opportunities to lead lives they value rather than just increasing their income or consumption.

The capabilities approach also argued that development should be centered on expanding human capabilities and freedom rather than solely increasing income or consumption (Sen, 1993). Sen's approach highlights the complex and multidimensional nature of well-being and freedom, which includes economic, political, social, and cultural dimensions. The interrelated nature of these dimensions should be considered rather than treated as separate entities (Nussbaum, 2011). The capabilities approach has been applied in various contexts, such as health, education, and poverty reduction, and can also be applied to women's empowerment. The approach suggests that women's empowerment should be measured by their ability to participate in and influence decisions that shape their lives (Alkire et al., 2013). This can be achieved by

selecting indicators that capture women's access to and control over resources, including education, income, and political representation (Alkire, 2007).

Although the capability approach has been used in various studies analyzing well-being and socio-economic indicators such as poverty, health, and empowerment, Dreze and Sen's (1989) analytical framework presented a comprehensive approach to investigating hunger and related aspects. This framework incorporated Sen's capability and entitlement approaches, offering a more generalized analysis of hunger-related issues beyond food security. While the entitlement approach has been widely utilized in food security analysis, Dreze and Sen argued that a capability approach is necessary for a more comprehensive food and nutrition security analysis. Sen (1981) also posited that to eradicate severe hunger among household members, the collective resources of the household can be used to purchase food or ensure a constant supply of food to the household. Suppose a household's initial endowments cannot be exchanged for sufficient food. In that case, the household members have a higher likelihood of experiencing hunger even if overall food availability in society improves. However, Burchi and Muro (2016) argued that human capabilities, not entitlements, should be prioritized and that the objective should be to enable individuals to avoid undernourishment and hunger-related deprivations. The capability approach considers food quality, utilization, and social acceptability, as well as its interplay with other fundamental capacities such as health, education, and family decision-making (Burchi & Muro, 2016). Per the capability approach, food insecurity results from poor health and the complete absence of primary education, which are detrimental to household welfare and decision-making ability (Essilfie et al., 2021).

The capability framework also acknowledges that societal and institutional structures often restrict people's potential to live fulfilling lives, particularly women, and emphasizes the capacity of individuals to create themselves freely (Essilfie et al., 2021). The capability approach comprises two primary elements: capabilities and functioning. Capabilities represent the various combinations of functioning that an individual can achieve, from which they may choose one set. Functioning refers to the aspects of a person's condition, encompassing numerous things that they manage to do or be while living their life, such as not experiencing hunger, being healthy, participating in community or household decision-making, being respected, and not experiencing abuse (Robeyns, 2003). The approach centers on freedom, emphasizing people's possibilities or capacities to live the lives they desire, to accomplish their goals and aspirations, and to be the person they choose to be (Sen, 1993; Owen & Goldin, 2015; Essilfie et al., 2021). Four crucial aspects of the capability model include the actual freedom a person has, the multifaceted nature of activities that lead to pleasure, concerns for the distribution of opportunities across society, and the balance of superficial and non-superficial aspects in determining human well-being, which were discussed by Sen (1999). He contends that regardless of gender, some critical skills that matter in social evaluations include the right to education and the ability to afford and access nutritious food (Robeyns, 2003; Owen & Goldin, 2015).

Several academics have researched the capability approach extensively, with Nussbaum (2011) being the most prominent. In contrast to Sen's approach, Nussbaum has compiled a comprehensive inventory of critical human abilities, recognizing that capabilities go beyond an individual's inherent skills to include

the opportunities and freedoms that arise. Sen (2005), on the other hand, consistently challenges the concept of a fixed or definitive list of capabilities. His catalog of critical abilities for social assessment includes the freedom to move without restrictions, receive education, engage in societal activities, and access healthy food and a disease-free existence. Although Sen acknowledges the significance of identifying capabilities, he strongly opposes the notion of a "grand mausoleum" to a single, definitive collection of abilities (Owen & Goldin, 2015).

Selvam (2008) argued that a clear articulation of rights specific to young people and women, who often find themselves in precarious positions during transition times, is necessary. This is particularly important in Africa, where cultural and contextual factors can significantly impact the capabilities of women. The approach also includes the concept of "agency," which refers to a person's ability to act and bring about change in pursuit of their objectives or ideals (Sen, 1999). For all members of society to achieve their potential, Selvam (2008) suggested that a government must create an environment that fosters individual agency and promotes the realization of rights for all citizens.

Feminist Political Ecology

The history of the Feminist Political Ecology (FPE) framework can be traced back to the 1970s and 1980s when feminist scholars began to question the dominant paradigm of environmentalism, which was primarily focused on conservation and wilderness preservation and often ignored the social and political dimensions of environmental issues (Rocheleau et al., 1996). These scholars recognized that gender, class, race, and other forms of inequality were deeply intertwined with environmental issues and thus began to incorporate

these perspectives into their research. It emerged as a response to the marginalization of women's experiences and perspectives in traditional ecological and political ecology research (Rocheleau et al., 1996). The field seeks to understand how gender inequalities and patriarchal power structures shape the distribution of environmental benefits, burdens, and decision-making processes (Elmhirst, 2015). One of the earliest contributions to FPE was made by feminist geographer and political ecologist Karen Warren in her 1986 article "Feminism and Ecology: Making Connections." In this work, Warren argued that mainstream environmentalism was based on a "masculinist" perspective that ignored how gender shapes natural resource access and the impacts of environmental degradation on marginalized groups. Warren also highlighted the importance of considering the intersectionality of identities, such as race, class, and age, in understanding how gender and the environment are interconnected.

Subsequently, several feminist scholars in various fields, such as anthropology, sociology, and development studies, further developed the FPE framework. Feminist anthropologists such as Riane Eisler and Maria Mies, for example, highlighted how patriarchal systems of power and control have led to the marginalization of women in decision-making processes related to natural resource management (Elmhirst, 2015). In the 1990s, feminist political ecologists Arturo Escobar and Isabelle Stengers started incorporating post-colonial and post-development perspectives into the FPE framework (Elmhirst, 2015). They argued that the dominant development model, based on modernization and progress, had destroyed traditional ways of life and displaced marginalized communities. They also highlighted how the global north had exploited the global south for its resources, leading to environmental

degradation and poverty. Plumwood (1993) also critiqued the dominant western paradigm of nature as something to be conquered and controlled, arguing that this mindset is intimately connected to patriarchal power systems. She calls for a shift towards more ecological feminism, which recognizes the interconnectedness of all living beings and the importance of respecting and living in harmony with nature.

In recent years, FPE has become an increasingly influential framework in environmental studies and has been used in diverse environmental problems, including climate change, conservation, and sustainable development (Elmhirst, 2015). Scholars have applied FPE to study various issues, such as the impact of extractive industries on women, women's role in community-based natural resource management, and the gendered impacts of climate change (Elmhirst, 2015). FPE also emphasizes the importance of local and indigenous knowledge in understanding and addressing environmental problems. This approach, known as "participatory" or "empowerment" feminism, seeks to empower marginalized communities, particularly women, by giving them a voice in decision-making processes and recognizing the value of their knowledge and experiences (Svarstad, 2018).

Regarding women's empowerment and environmental poverty, the study uses the FPE framework to argue that women are often disproportionately affected by environmental degradation and resource depletion due to their lack of access to resources and decision-making power (Elmhirst, 2015). Women are often considered secondary users and managers of natural resources, so their contributions to environmental sustainability are frequently overlooked (Elmhirst, 2015). Moreover, gender inequalities limit women's ability to

participate in environmental decision-making and advocacy, further exacerbating their vulnerability to environmental degradation (Peet & Watts, 2004). The FPE framework views the empowerment of females as a critical component in promoting environmental sustainability. Empowering women makes them active agents of change and contributes to developing sustainable and equitable environmental policies and practices (Rocheleau et al., 1996). Empowered women are more likely to participate in environmental decision-making processes, and their voices and perspectives are more likely to be included in environmental discussions (Rocheleau et al., 1996).

Furthermore, empowering women can help to ensure that the benefits of environmental conservation and sustainable resource use are distributed equitably and that the negative impacts of environmental degradation are reduced (Rocheleau et al., 1996). Overall, FPE has significantly expanded the scope of inquiry in environmental studies by highlighting the importance of considering gender and other social relations in understanding and addressing environmental issues. This approach has been applied in various contexts, including natural resource management, climate change, and environmental health (Elmhirst, 2015).

Conceptualizing Empowerment

Empowerment is a multifaceted term with many definitions in the literature. Some scholars have defined empowerment as reflecting on their experiences, personalities, local context, and cultural values. It is conceptualized as a system that amplifies an individual's capacity to make major independent life decisions that would otherwise be denied to them, which is deeply rooted in the work of (Kabeer, 1999; Alkire et al., 2013). Kabeer (1999) stressed a

significant shortcoming in comprehending the measurement and quantification of empowerment as a process and an advocacy tool. She reflected on these abilities through three dimensions: resources, agency, and achievements. Van Eerdewijk and Wong (2017) contend that institutional structure is essential in the dynamic and transformative process that characterizes empowerment, agency, and resources. On the other hand, Narayan (2005) has provided an operational definition of the concept by emphasizing four interrelated dimensions: access to information, inclusion and participation, accountability, and local organizational capacity. Narayan cautioned against limiting the definition of empowerment solely to choose, as the concept encompasses a strong linkage between people and institutions.

Tsikata and Darkwah (2014) argued that contextualizing empowerment is crucial as it is influenced by location, culture, and time and is sector specific. Reflecting on this, Alkire et al. (2013) developed the Women's Empowerment in Agriculture Index (WEAI) to measure women's empowerment in agriculture. This survey-based tool monitor and evaluates progress across five domains, identifying gender disparities between men and women in rural households. This index has been piloted in various countries, including Bangladesh, Guatemala, Uganda, and Ghana. Galiè et al. (2019) modified the WEAI to construct the Women Empowerment in Livestock Index (WELI) to examine the impact of women's empowerment on the health and nutrition of women and their children. Additionally, the Women's Empowerment in Nutrition Index (WENI) was developed by Narayanan et al. (2019) to diagnose the various deprivations among women that could distort nutritional outcomes, using dimensions such as health, nutrition, and institutions to measure empowerment. These studies

demonstrate that the context and focus of the research could impact the conceptualization of empowerment and that the specific dimensions and indicators used should be tailored accordingly (Galiè et al., 2019).

Women's empowerment in the fishing industry has become an important topic in social fisheries research. However, there needs to be more consensus on defining and measuring women's empowerment in fisheries, with the term often used interchangeably with women's participation (Freeman & Svets, 2022). Despite this, some studies have attempted to quantify women's contributions to the industry. For instance, Harper et al. (2013) estimated that women account for over half of annual artisanal catches in the Pacific, worth 363 million USD in revenue. In addition, Oloko et al. (2022) found that capital and access to credit facilities are critical factors in determining the sustainability of women fishers' livelihoods in Makoko, while lack of formal education, poor access to information, and biased gender norms can hinder their ability to sustain their livelihoods. These findings suggest that further research is necessary to understand better the factors contributing to women's empowerment in the fishing industry and to develop effective interventions supporting their livelihoods and well-being. Cole et al. (2020) explored how the gender accommodative approach, compared to the transformative approach, influences women's empowerment in the Barotse flood plain in Zambia. Recently, Freeman and Svets (2022) also measured and contextualized women's empowerment in artisanal fisheries considering the role of Fisheries' Local Action groups. These studies have focused on reechoing women's significant and established roles in fisheries; however, assessing empowerment at the household level makes it possible to disaggregate empowerment measures by

dimensions and indicators and establish the gender inequality among men and women residing in the same household remains under-researched.

The study conceptualized empowerment using six interconnected dimensions relevant to the fisheries sector to identify disempowerment and track fisheries intervention progress for policy focus and fisheries management. Thus, in the ability to make choices (production), in resources (value chain assets), in agency (control over decisions on income from fish and non-fish activities), in leadership that captures aspects of inclusion, participation, and organizational capacity, institutions (specifically gender attitudes toward inequitable norms and access to information and training) and on-time use and constraints on leisure. Considering these, the study develops an empowerment index anchoring Kabeer (1999) and other prominent framings of empowerment (Narayan, 2005; Alkire et al., 2013; van Eerdewijk & Wong, 2017).

Measuring Empowerment

There has been an ongoing debate on the viability of a universally accepted measurement of empowerment amongst individuals and countries (Tsikata & Darkwah, 2014; Galiè et al., 2019). Indicators like the Gender Development Index (GDI) and the Gender Empowerment Measure (GEM) developed by applying a broad set of dimensions for gender analysis have been critiqued for their usage of aggregate data only and not to measure empowerment precisely (Alkire et al., 2013). Alkire et al. (2013) posited that these measurements have no information on the socio-economic demographics of individuals relevant to analyzing issues of empowerment at the household level hence the inability to be disaggregated in terms of age, region, or other social subgroups. Regarding the fact that no indices measured agency at the

micro level, (Alkire et al., 2013) developed a multidimensional index to aggregate the achievement of women and men across various indicators. The multidimensional method allowed for various subjective and objective indicators to be grouped into dimensions that can further be disintegrated into social subgroups for policy-wise analysis (Alkire et al., 2013). This methodological approach has been used in other micro-level sectors like livestock production, agriculture, and nutrition to evaluate women's empowerment across different dimensions (Alkire et al., 2013; Galiè et al., 2019; Malapit et al., 2019; Narayanan et al., 2019). Because empowerment is contextual, the multidimensional approach also allows for other additions to indicators, differences in the choice of deprivation scores, and cut-offs relevant to the sectors understudied (Alkire & Foster, 2011).

Women Empowerment in Agriculture Index (WEAI)

The WEAI was developed as a groundbreaking initiative to evaluate and monitor the extent of women's empowerment in the agricultural sector. It serves as a survey-based measurement tool that assesses the agency and autonomy of women working in agriculture (Alkire et al., 2013). This index was formulated as part of the Feed the Future campaign initiated by the US government to address the root causes of poverty and hunger through sustainable solutions to malnutrition and food security (IFPRI, 2013). This campaign's focus on inclusive agricultural growth provides the impetus for the WEAI's creation, representing a significant advancement in understanding the intersections between gender, agriculture, and development. The WEAI's development and deployment thus far represent an essential step forward for policymakers, researchers, and practitioners interested in enhancing women's agency and

autonomy within the agricultural sector (Das, 2016). The application of the WEAI holds the potential to guide evidence-based interventions, promoting more equitable, sustainable, and inclusive development outcomes in the agricultural domain (USAID, 2013).

It offers a comprehensive and varied assessment of individual empowerment, considering various dimensions of experiences within the sector. The index provides flexibility and allows for analysis at different levels, such as subnational, age, social group, and indicator (Alkire et al., 2013). Moreover, the WEAI aims to deliver a measurement tool that can be compared across regions, time, and different demographic groups (Das, 2016). Adapted to the indicators of production, income, and resources in the agricultural sector, the WEAI can measure the level of empowerment for rural women, irrespective of their occupation. Developed using the Alkire-Foster method, the WEAI employs a multidimensional poverty measurement approach based on the Foster-Greer-Thorbecke poverty measure (Foster et al., 1984). This poverty measure calculates various deprivations simultaneously in education, health, jobs, and overall standard of living to determine poverty. The resulting deprivation profiles are analyzed to establish a multidimensional poverty index (MPI) (Sraboni et al., 2014).

Components of the WEAI

The WEAI is a composite index that can be divided into various segments. It aggregates data from individual interviews of both men and women living in the same households and is reported at national or regional levels. The index has two parts: one measures women's five dimensions of empowerment (5DE), and another evaluates gender equality in the household. These sub-

indices, which are weighted, account for 80% and 20% of the index value, respectively. The final WEAI score is calculated by aggregating the 5DE and GPI results at the national or regional level and then weighting them. The overall WEAI score can be increased by improving the 5DE or GPI.

$$\text{WEAI} = 0.8 (5\text{DE}) + 0.2 (\text{GPI}) \quad (1)$$

The Five Dimensions of Empowerment

The WEAI comprises five interrelated dimensions based on extensive research to create metrics of empowerment and agency (Alsop et al., 2006; Alkire & Foster, 2007). This has resulted in the developing of empowerment indicators derived from individual-level or household-level surveys and calculated based on the Alkire-Foster methodology (Narayanan et al., 2019).

Alkire – Foster Methodology (AF)

This methodology consists of two distinct steps. The first step involves identifying "the poor" through an identification method. This method considers the range of deprivations a person experiences and uses this information to determine their poverty status. The second step involves creating intuitive poverty measures ($M\alpha$) by aggregating the information obtained from the first step. It also uses a dual cutoff method of identification. The first cutoff, denoted by k , examines deprivation in each dimension to assess whether an individual is deprived. The second cut-off, poverty, calculate the extent of deprivations an individual must experience across all dimensions to be considered poor. The identification function M_k , which determines whether an individual is poor, depends on the person's achievement vector x_i , the deprivation cutoff z , the weight w , and the poverty cutoff k . The function is evaluated to 1 if the

deprivation score c_i is greater than the poverty cut-off k , indicating that the individual is poor and 0 otherwise. therefore, it takes on a value of 1 if a person is considered poor and 0 otherwise. This means an individual's poverty status is determined based on whether their deprivation score exceeds the poverty cutoff k . The dual cutoff identification approach used in the AF method considers both the deprivation and poverty cutoff to evaluate poverty status.

The Alkire-Foster (AF) method employs a multidimensional poverty measurement approach that combines information on the incidence and intensity of poverty. Poverty incidence is captured through the Headcount ratio (H), which measures the proportion of individuals identified as poor out of the total sample of households. On the other hand, the intensity of poverty is represented by the Multidimensional Headcount Ratio (A), which quantifies the average number or weighted sum of deprivations experienced by the poor (Alkire & Foster, 2007). The adjusted Headcount ratio (M_0) is obtained by multiplying the H and A indices. It provides a composite measure of poverty by accounting for both the proportion and depth of poverty. The AF method is valuable for monitoring and evaluating poverty reduction initiatives. It provides a comprehensive and nuanced picture of poverty that accounts for the multiple dimensions of disadvantage experienced by the poor.

Table 1: Dimensions of Empowerment -WEAI

Dimensions	Indicators	Weights
Production	Input into productive decisions	1/10
	Autonomy in production decisions	1/10
Resources	Assets ownership	1/15
	Sale, purchases, and transfer of assets	1/15
	Access to and decisions about credit	1/15
Income	Control over the use of income	1/5
Leadership	Group membership	1/10
	Public speaking	1/10
Time	Workload	1/10
	Leisure	1/10

Source: Alkire et al. (2013)

Production

The production dimension evaluates a woman's ability to make agricultural decisions, aligning with women's empowerment as the capacity to choose. This dimension consists of two indicators: "input in productive decisions" and autonomy in agricultural production. The former assesses the degree of individual autonomy in decision-making and their involvement in the agriculture workforce. The latter considers the degree to which an individual can make personal decisions in aspects of household life related to agriculture (Alkire et al., 2013). The WEAI assesses input into productive decisions by creating a sub-indicator for each activity listed in the survey instrument. The sub-indicators are then aggregated so that an individual will not achieve adequacy in this indicator if they have no input into any decision-making regarding the farm work (Alkire et al., 2013).

Again, to achieve adequacy, the households must be empowered in at least two sub-indicators. The sub-indicators are based on the respondent's participation and decision-making ability regarding each agricultural activity and aspects of household life, such as purchasing inputs, determining crop types, and deciding when to take crops to market. The sub-indicators are scored based on a predetermined answer scale, and if the sub-indicator value is more significant than two, the respondent is considered adequate in that activity. Once the adequacy and inadequacy cut-offs are established, the adequate activity values are converted to one and added to calculate the input in the productive decision indicators. The input range in productive decision indicators varies from two to eight (Alkire et al., 2013).

The second indicator of the production domain in the WEAI is autonomy, which assesses an individual's ability to act according to his or her values and motivations rather than being influenced by the desire to please others or avoid punishment (Alkire et al., 2013). The autonomy indicator encompasses five areas related to agriculture: agricultural production, purchase of inputs, selection of crops, the timing of crop sales, and livestock production. The indicator measures a person's understanding of the motivations that influence his or her actions and draws upon the framework developed by psychologists to distinguish between different kinds of motivation, such as external, introjected, and identified motivations (Ryan & Deci, 2000; Chirkov et al., 2011). The autonomy indicator aggregates answer to three questions, each capturing different kinds of motivation. The scale ranges from 1 (never true) to 4 (always true), and the autonomy indicator sums up the responses. An individual is considered to have adequate autonomy if his or her actions are more

motivated by personal values than by coercion or fear of others' disapproval (Alkire et al., 2013). The autonomy indicator ranges from -9 to 9, with higher and more positive values indicating greater autonomy. This indicator under production evaluates how an individual's actions are influenced by different types of motivation and capture situations in which women may be the sole decision-makers but still lack autonomy due to social norms or circumstances (Das, 2016). It also distinguishes situations in joint households where a "joint" decision may be more or less autonomous (Ryan & Deci, 2000).

Resources

Three indicators, namely, asset ownership, sale, transfer of assets and purchases, and decision regarding financial credit, measure the resource dimension. The resources considered in the survey are agro-inputs, livestock, land, credit and loans, and durable goods (Alkire et al., 2013). The control over these resources is a critical aspect of women's empowerment, as it enables them to make decisions and act on them (IFPRI, 2015).

The ownership of assets and lands refers to whether women have legal rights to own productive assets such as land, livestock, or other durable goods. The second indicator measures asset transfer, sale, and purchase decisions. It assesses whether women have a say in these decisions and whether they can make such decisions independently or in collaboration. The third indicator of decision-making regarding credits evaluates the ability of women or the entire household to attain loans from formal or informal sources (Alkire et al., 2013).

The asset ownership indicator considers all household assets, agricultural and non-agricultural, in assessing whether ownership of those assets is for one person or jointly owned by a group of people within and outside the

household (Alkire et al., 2013). A comprehensive list of assets is used to create indicators reflecting ownership of each significant asset type to determine adequacy. These indicators are then summed across all asset types, creating the household ownership indicator. Another indicator measures an individual's ownership of each significant asset type (Das, 2016). The asset-specific indicators are then aggregated so that the household is considered empowered when household members own at least a significant asset. Those who live in households without ownership of any major asset type are considered inadequate. Finally, adequacy cut-offs are established, and the adequate activity value is converted to 1 and added to derive the ownership of assets score, which ranges from 2 to 14 (Alkire et al., 2013).

This indicator recognizes that asset ownership alone may not necessarily lead to empowerment but also considers the ability to make decisions regarding purchasing, selling, or transferring assets. Thus, the second indicator seeks to capture the extent to which an individual has the power to control and make decisions over these assets, even if full ownership is not possible in certain societies (Alkire et al., 2013). With this indicator, the individual responses on the sale, purchase, and transfer of assets are summed. An individual is considered to have adequacy in this indicator if the household owns at least one type of agricultural asset and can participate in asset transfer, purchase, and sale decisions. The individual is considered inadequate if the household owns no agricultural assets. Once adequacy and inadequacy cutoffs are established, the adequate activity value is converted to 1 and added. For example, if someone responds positively to owning agricultural land, small livestock, and mechanized farm equipment and also has decision-making power over these

assets, the sub-indicators for these assets would each take a value of 1, and the overall purchase, sale, transfer indicator would be $[1+1+1]$. The range of this indicator varies between 0 and 12, reflecting the different combinations of assets and decision-making power an individual can have (Das, 2016).

Access to decisions regarding credit evaluates the decision-making ability to source funds from both formal and informal sources (Alkire et al., 2013). Adequacy on this indicator requires access to credit through the household, even if credit has not been used, and participation in at least one decision regarding credit use if credit has been used by the household (USAID, 2013). Adequacy on this indicator requires at least one decision-making regarding the households' ability to access credit from at least one source (Alkire et al., 2013). Individuals living in households that have not used any credit source are classified as inadequate. This access to credit indicator reflects decision-making and control over credit and is calculated as the sum of the loan_borrow and decision_loan/borrow indicators (Alkire et al., 2013). For example, if a respondent indicates that their household has taken out loans or borrowed cash/in-kind from non-governmental organizations, informal lenders, and formal lenders (bank/financial institutions) in the past year and that they made borrowing decisions jointly with their partner/spouse, then they would be considered adequate on the decision-making indicator for these sources of credit. The lending sources for farming and non-farming households tend to remain the same and depend on the country's economy rather than household structure (Alkire et al., 2013). Non-governmental organizations, informal lenders, and microfinance groups are familiar sources of borrowing or lending among rural households. However, cooperative banks and rural financial

institutions are becoming increasingly popular among rural and semi-urban households (Das, 2016).

Income

Control over income is an essential component of empowerment, especially in agriculture. Even when women are the primary producers of crops or livestock, it is common for men to take control of the marketing process and retain most of the profits (Malapit et al., 2019). Therefore, monitoring control over income is crucial for measuring progress toward gender equality in agriculture. This dimension measures sole or joint control over income and expenditures. The single indicator for this dimension assesses the extent to which individuals have input into decisions about the use of income generated from their productive activities and whether they feel empowered to decide on what they use their income for (Alkire et al., 2013). By tracking changes in this dimension, the extent to which individuals can benefit from their efforts and exercise choice can be better understood.

This component of the income dimension under the WEAI is constructed from two sets of questions related to control over income. The first set of questions is on the degree of input into decisions using income generated from various income-generating activities (Alkire et al., 2013). The second set of questions measures how individuals feel they can decide how to use their earnings (Alkire et al., 2013). For each question, an indicator is created to assess the degree of input or control an individual has in decision-making. An individual is considered to have adequate control if they have at least some input into decisions related to the activity. For the second set of questions, an individual is considered to have adequate control if they make the decisions

themselves or feel involved in deciding the usage of the income (Alkire et al., 2013).

All these sub-indicators are then aggregated into the control over income indicator. An individual is considered to have adequate control over income if they have adequate control in at least one of the sub-indicators, except for the sub-indicator for making decisions about minor household expenditures. The control over income corresponds to the aggregated sum of the sub-indicators (Alkire et al., 2013). For instance, if an individual responds to the first question by indicating “no input” for food crop farming, “input into very few decisions” for cash crop farming, “input into some decisions” for livestock raising, and “input into most decisions” for fish culture, then they have adequate control in activities c and d. In the second set of questions, if an individual responds by indicating “to a great extent” for wage or salary employment, “medium extent” for major household expenditures, and “small extent” for minor household expenditures, then they have adequate control in activities a and b (Alkire et al., 2013). Once adequacy and inadequacy cut-off points have been established, the adequate values are converted to 1 and added together. The control over income indicators ranges from 1 to 7.

Leadership

According to Narayan (2002), this dimension encapsulates participating in leadership roles while being accountable for any action. It is measured at the individual level, as opportunities for women to exercise leadership within the community may translate into them needing help to avail such opportunities (Alkire et al., 2013). This could be due to domestic opposition or restrictions. This dimension focuses on the individual's leadership role in the community,

which is assessed by their membership in economic or social groups and their ability to speak confidently in public forums (Alkire et al., 2013). Confidence in speaking in public is determined by the individual's response to questions about their ability to voice out their views in the public domain to address issues like the construction of infrastructure such as small wells or roads, ensuring fair wages for public work or other programs, and protesting against the misconduct of authorities (Alkire et al., 2013). Social capital is a crucial resource that can enhance a person's agency and empowerment. This domain assesses individuals' participation level in at least one community association, whether it is agriculture-related or non-agriculture-related (Alkire et al., 2013).

Individuals are deemed to have adequate group membership if they actively participate in at least one group. In contrast, those who do not belong to any group are considered inadequate in this domain. The same groups applicable to agricultural households are also assumed to be relevant for non-farm households. The assessment for non-farm households can be achieved through questions such as "Is there a group in your community?" and "Are you an active member of this group?" (Alkire et al., 2013). An individual from a non-farm household is considered to have adequate group membership if they actively participate in at least one group and inadequate group membership if they do not participate in any group. Therefore, the study proposes that an individual in a non-farming household has adequate group membership if group membership $\geq$ one and inadequate group membership otherwise.

Speaking up publicly is essential to empowerment, enabling individuals to exercise their voice and participate in decision-making. The measurement of this dimension considers the level of comfort individuals show when speaking

against any public decision (Das, 2016). A household is said to achieve adequacy in this indicator if there is comfort in speaking in public. This indicator is independent of household structure and can be applied to non-farm households without modification.

Time

This dimension pertains to the distribution of time for both productive and domestic activities and the degree of satisfaction derived from the available time for leisure activities (Alkire et al., 2013). The dimension is comprised of two distinct indicators: workload and leisure. The former indicates the allocation of time to productive and domestic activities, while the latter measures the individual's contentment with the time available for leisure pursuits.

The workload indicator is derived from a detailed 24-hour time allocation module. Respondents were asked to recall the time spent on primary and secondary activities during the previous 24 hours, starting at 4:00 a.m. on the day before the interview (Alkire et al., 2013). The total number of hours worked is calculated by adding the time spent on work-related tasks as the primary activity and 50 % of the time spent on work-related tasks as the secondary activity. Adequacy in workload is achieved if members of the household work less than 10.5 hours in a day. The workload indicator does not differentiate between types of work and measures the total amount of work. Thus, it can also be used for non-farm work without modification.

The final indicator in the time domain is leisure, which is concerned with an individual's satisfaction with their available time for leisure activities. These activities may include visiting neighbors, watching TV, listening to the radio, seeing movies, or engaging in sports (Alkire et al., 2013). Respondents were

asked to rate their satisfaction level with the available time for such activities on a scale of 1 to 10, where one indicates not satisfied, and ten indicates very satisfied. An individual is considered to have adequate leisure time if they rate their satisfaction level as equal to or higher than 5, indicating indifference or satisfaction with the available leisure time (Alkire et al., 2013). It is important to note that this is a subjective question, and the response is influenced by the respondents' frames of reference and actual achievements. Women's time constraints burden them and negatively affect the care and welfare of their children and other family members (Alkire et al., 2013). The wage rate influences leisure time for farm and non-farm households among husbands and wives (Tokle & Huffman, 1991). As leisure activities are assumed to be similar for both farm and non-farm households, the same satisfaction value of 5 can be applied for non-farm households to indicate adequacy in leisure time.

Gender Parity Index (GPI)

Gender equality is a vital component in achieving empowerment and development. Previously, macro-level indicators such as the Global Gender Gap Index, Gender Inequality Index, and Social Institutions and Gender Index were used to evaluate the level of inequality between men and women at the country level (Hausmann et al., 2011). The Gender Parity Index (GPI) is a relative inequality measure that reflects the empowerment gap between the primary adult male and female in each dual-adult household (Alkire et al., 2013). Intra-household inequality has also been shown to have costs for agricultural productivity (Quisumbing & Kumar, 2011). Neglecting intra-household gender inequality can also have costs for attaining development objectives, particularly in child nutrition and schooling (Quisumbing, 2003).

Computing Gender Parity Index

The Gender Parity Index (GPI) is constructed using two components: the percentage of women who lack gender parity with their male counterparts and the extent of inequality between the women who lack parity and the men they live with. The GPI is calculated by replacing the inadequacy score of disempowered women with the disempowerment cut-off value of 20% and combining this with the censored inadequacy score of men in the same household (Alkire et al., 2013). In order to improve the GPI score, efforts must be made to reduce the household's empowerment gap. The GPI for Women Empowerment in Fisheries Index (WEFI) does not require any specific modifications since the household composition for agricultural and fishing households is similar. Therefore, the same components used to calculate the GPI for agricultural households can also be applied to fishing households.

$$GPI = 1 - (HGPI \times IGPI) \quad (2)$$

Where HGPI is the proportion of households that lack gender parity, and IGPI is the mean empowerment gap between women and men living in households that do not have gender equality.

The Concept of Food Security

Food security is recognized as a fundamental human right and is enshrined in the Universal Declaration of Human Rights adopted by the United Nations General Assembly in 1948. The Declaration recognizes that "everyone has the right to a standard of living adequate for the health and well-being of himself and his family, including food, clothing, housing, and medical care and necessary social services." (Eide, 1998; UNHR & FAO, 2006). In addition, the United Nations has explicitly recognized the right to food in other instruments,

including the International Covenant on Economic, Social, and Cultural Rights (ICESCR) adopted in 1966. The ICESCR recognizes the right to an adequate standard of living, including adequate food, and obliges state parties to ensure that this right is realized for everyone within their jurisdiction (Eide, 1998).

In 2004, the United Nations General Assembly adopted the Voluntary Guidelines to assist in the sensitization of acknowledging the fundamental right to accessing sufficient food about global food security. These guidelines guide governments and other stakeholders in ensuring everyone can access adequate food and address the underlying causes of food insecurity (Coates et al., 2007). Also, in 2012, the United Nations Human Rights Council adopted the Guiding Principles on Business and Human Rights, which state that businesses are responsible for respecting human rights, including the right to food, and avoiding contributing to adverse human rights impacts, such as food insecurity. While there is no universal agreement on conceptualizing food security, Maxwell (1996) identified many definitions published in writings, arguing that this diversity reflects the varied experiences and descriptions of the problem. Despite this complexity, there is broad consensus on adopting the definition of the 1996 World's Food Summit (Maxwell, 1996). The 1996 World Food Summit defined food security as a state in which all individuals have access to enough food that is safe and nutritious to meet their dietary needs at all times. This definition emphasizes the importance of availability and access to food, as well as the nutritional quality and safety of the food (Maxwell, 1996).

The Concept of Food Security

The Universal Declaration of Human Rights, adopted by the United Nations General Assembly in 1948, established food security as a basic human

right. It states that everyone is entitled to a living standard that ensures health and well-being, specifically including access to food, along with clothing, housing, medical care, and essential social services (Eide, 1998; UNHR & FAO, 2006). The United Nations further reinforced the right to food in the 1966 International Covenant on Economic, Social, and Cultural Rights (ICESCR). This covenant acknowledges the right to an adequate standard of living, explicitly including food, and requires member states to ensure this right for all individuals under their jurisdiction (Eide, 1998).

The United Nations General Assembly adopted Voluntary Guidelines in 2004 to promote awareness of the fundamental right to adequate food in the context of global food security. These guidelines provide direction to governments and stakeholders on ensuring universal access to sufficient food and tackling the root causes of food insecurity (Coates et al., 2007). In 2012, the United Nations Human Rights Council introduced the Guiding Principles on Business and Human Rights. These principles assert that businesses must respect human rights, including the right to food, and avoid actions that negatively impact human rights, such as contributing to food insecurity. While food security lacks a universally agreed-upon definition, Maxwell (1996) noted numerous published definitions, reflecting diverse experiences and interpretations of the issue. Despite this conceptual variety, there's widespread acceptance of the definition provided by the 1996 World Food Summit. At the 1996 World Food Summit, food security was defined as a condition where everyone, at all times, can obtain sufficient, safe, and nourishing food to satisfy their dietary requirements. This definition highlights three crucial aspects: the

consistent availability of food, the ability to access it, and the food's nutritional value and safety (Maxwell, 1996).

Food security measurement

Accurately assessing food security is essential for tracking global hunger and evaluating the effectiveness of related policies. Despite its importance, developing comprehensive indicators that capture all dimensions of food security has proven to be a persistent challenge for researchers and policymakers over the past few decades. Many existing metrics fail to encompass the full complexity of food security, leaving gaps in our understanding and ability to address this critical issue (Clay, 2002; Upton et al., 2016). Historically, food security was primarily assessed through measures of food availability. However, a significant paradigm shift occurred in the 1980s, broadening the understanding of food security beyond mere availability. This shift drew the attention of stakeholders and policymakers to additional crucial dimensions, particularly food access. This evolution in thinking highlighted that the presence of food alone doesn't guarantee food security if people lack the means to obtain it (Jones et al., 2013). To assess food security at the household level, researchers and policymakers have employed proxy measures, with dietary diversity being a notable example. These indirect indicators serve as practical tools to gauge food security when direct measurements are challenging or resource-intensive. Dietary diversity, which reflects the variety of foods consumed by household members, offers insights into both the quantity and quality of food access, making it a valuable proxy for overall food security status (Maxwell, 1996; Essilfie et al., 2021). Experience-based questionnaires, developed in the 1990s to capture individuals' subjective experiences of hunger, have become the

primary method for assessing food security. These tools aim to quantify personal perceptions and experiences of food insecurity. Nevertheless, a variety of other measurement techniques remain in use, with the selection of a particular approach often guided by the specific research context and objectives (Webb et al., 2006).

Anthropometric measures

These function as proxy indicators for evaluating the impact of food security on individuals' health and nutritional status. For assessing young children and infants particularly, researchers commonly utilize anthropometric measures such as weight-for-age, height-for-age, and weight-for-height ratios. These metrics provide indirect insights into the effects of food security without directly measuring food consumption or availability (Perez-Escamilla et al., 2017). These measurements offer crucial insights into an individual's nutritional condition, revealing indicators of both long-term and immediate malnutrition. They can identify patterns of persistent undernourishment as well as recent or sudden nutritional deficits (WHO, 1995). Although anthropometric measurements provide a normalized and economical approach to assessing nutritional well-being, a comprehensive evaluation of food security necessitates the consideration of specific domestic circumstances. These familial factors can significantly influence food access and utilization beyond what physical measurements alone can reveal (Jones et al., 2013).

Household Dietary Diversity Score-HDDS

The Household Dietary Diversity Score (HDDS) was established as part of the Food and Nutrition Technical Assistance (FANTA) II project in 2006. This tool evaluates food security by examining the variety of food groups

consumed within a household during a specified timeframe. The HDDS calculation involves a binary scoring system across 12 distinct food categories, such as grains, produce, and dairy. Each category receives a score of 1 if consumed or 0 if not, resulting in a composite measure of dietary diversity.

(Kennedy et al., 2011). A household's dietary diversity is quantified on a scale from 0 to 12, reflecting the total count of distinct food groups consumed during the specified timeframe. This metric not only correlates with the adequacy of overall caloric and protein consumption but also provides insights into the proportion of animal-derived proteins in the diet. As such, the score serves as a multifaceted indicator of nutritional quality and food security at the household level (Swindale & Bilinsky, 2007).

$$HDDS = \text{Sum} (A + B + C + D + E + F + G + H + I + J + K + L) \quad (3)$$

Where the letters A-L represent the 12 food groups used to calculate the HDDS.

Table 2: The Household Dietary Diversity Score Food Groups

A	Cereals
B	Roots and Tubers
C	Vegetables
D	Fruits
E	Meat, Poultry, Offal
F	Eggs
G	Fish and Seafood
H	Pulses, Legumes, nuts
I	Milk and milk products
J	Oil/Fats
K	Sugar/ Honey
L	Miscellaneous

Source: Kennedy et al. (2011)

The Household Dietary Diversity Score (HDDS) is particularly effective for evaluating economic access to food and identifying the range of food groups consumed within a household, as noted by Kennedy et al. (2011). To provide a more comprehensive assessment of food security at the household level, researchers often employ the HDDS in conjunction with complementary measures. A common pairing is the Household Food Insecurity Access Scale (HFIAS), which, when used alongside the HDDS, offers a multifaceted view of a household's ability to access various food groups (Cafiero et al., 2014).

Despite its usefulness, the Household Dietary Diversity Score (HDDS) has several constraints. One key limitation is its focus on household-level data, which means it doesn't capture individual eating patterns across food groups. This insight comes from research conducted by the INDDEX Project. Another challenge lies in comparing households based on dietary adequacy. The absence of a universally accepted threshold makes such comparisons difficult. While the HDDS questionnaire is designed to be straightforward and accessible, it lacks cultural specificity. This means that researchers need to carefully adapt the tool to suit the particular context of their study, following established guidelines. This adaptation is crucial to ensure the tool's relevance and accuracy in diverse settings. These limitations underscore the importance of using HDDS as part of a broader toolkit for assessing food security, rather than as a standalone measure (Kennedy et al., 2011; INDDEX Project, 2018).

Household Food Insecurity Access Scale-HFIAS

Among the various tools used to evaluate food insecurity, the Household Food Insecurity Access Scale (HFIAS) stands out as a frequently employed measure within the Data4Diets framework. This instrument, which emerged

from the Food and Nutrition Technical Assistance (FANTA) initiative, takes a unique approach by focusing on lived experiences. The HFIAS examines how households behave and respond when faced with challenges in accessing food. It also explores their experiences of hunger. Unlike some other measures, this scale looks back over a month-long period, asking participants to recall their experiences during this time. By centering on behavioral patterns and personal experiences, the HFIAS offers insights into the real-world implications of food insecurity at the household level (Ballard et al., 2011). The Household Food Insecurity Access Scale (HFIAS) employs a nuanced approach to categorizing households based on their level of food access insecurity. This categorization is achieved through a carefully structured questionnaire. The survey instrument is composed of two main parts, each containing nine questions. The first set aims to determine the occurrence of specific food insecurity situations. The second set delves into how often these situations arise. For each query, respondents can provide answers that are assigned a numerical value ranging from 0 to 3. This scoring system allows for a quantitative assessment of food insecurity experiences. By analyzing the responses, researchers can place households along a continuum that reflects varying degrees of food access challenges. This approach provides a more detailed picture of food insecurity, moving beyond simple binary classifications of 'secure' or 'insecure' (Coates et al., 2007). The Household Food Insecurity Access Scale (HFIAS) employs a comprehensive scoring system ranging from 0 to 27, with higher scores indicating greater food insecurity. This numerical range translates into a spectrum of food security statuses, allowing households to be classified as food secure or experiencing varying degrees of food insecurity, from mild to

moderate to severe. This nuanced approach provides a more detailed picture of food security challenges within a population. Researchers and policymakers find the HFIAS particularly valuable for its versatility. It serves as an effective tool for gauging the prevalence of food insecurity within communities and for tracking changes in food security levels over time. This dual functionality makes the HFIAS especially useful in the context of program monitoring and evaluation, enabling organizations to assess the impact of their interventions and adjust strategies as needed to address food insecurity more effectively (Coates et al., 2007; INDDEx Project, 2018).

Concept of Environmental Poverty

The concept of environmental poverty, as described by Liu (2012), refers to the absence of access to environmental conditions essential for societal progress and survival, often resulting from human-induced ecological degradation. To quantify this phenomenon, Nawaz and Iqbal (2021) introduced the environmental poverty index (EPI), building upon the Alkire-Foster methodology (Alkire et al., 2013). The EPI, a multifaceted measure, incorporates both quantitative and qualitative aspects of environmental services. Nawaz and Iqbal's (2021) research identified four key areas of household environmental deprivation: dwelling conditions, water access, sanitation facilities, and energy sources. These dimensions align with those used by Dehury and Mohanty (2017) in their assessment of India's household environmental index, as noted in Nawaz and Iqbal's study.

To evaluate these four dimensions, Nawaz and Iqbal employed nine distinct environmental indicators. The dwelling dimension was assessed using four criteria: wall quality, roof condition, floor type, and crowding levels.

Water access was measured through a single indicator focusing on safe water availability. Sanitation was evaluated using two factors: toilet facilities and refuse disposal methods. The energy dimension considered two aspects: cooking fuel type and electricity access. In constructing the EPI, both Nawaz and Iqbal (2021) and the earlier work of Alkire and Foster (2011) applied an equal weighting system. This approach assigned uniform importance to each dimension and each indicator within those dimensions, ensuring a balanced representation of environmental poverty factors.

Empirical Literature

Research has consistently highlighted the multifaceted benefits of enhancing women's autonomy and decision-making power within households. These benefits extend across various domains of family well-being, including environmental stewardship, nutritional security, and health outcomes for both mothers and children. The interconnections between women's empowerment, ecological conditions, and food availability have garnered significant scholarly attention. Numerous investigations have explored how strengthening women's roles can influence these critical areas of household and community life.

Women Empowerment and Food Security

The advancement of women's rights and capabilities has emerged as a pivotal strategy in development efforts, with far-reaching implications for household well-being and poverty alleviation. Researchers have observed that when women lack agency, it exacerbates issues of food scarcity and widespread hunger. Recognizing the crucial role that women's empowerment plays in bolstering household food security, numerous academics have delved into this relationship. Their findings consistently point to a beneficial link between

enhancing women's access to and control over resources and improved food security within families. This connection was notably highlighted in the work of Meinzen-Dick and Quisumbing (2001).

Among the various facets of empowerment, economic autonomy stands out as particularly impactful in addressing food insecurity, as emphasized by Sharaunga (2015). The rationale, as explained by Barker (2005), lies in how economic empowerment enables women to exert control over productive assets. This control, in turn, allows for a diversification of income sources and more stable household earnings, ultimately contributing to enhanced food security. By fostering women's economic independence, communities can create a ripple effect that addresses multiple dimensions of development simultaneously, with food security being a primary beneficiary of these efforts.

For instance, Essilfie et al. (2021) conducted research examining the relationship between women's empowerment and household food security in Ghana. Their study analyzed data from 1,017 households, drawn from the Ghana Living Standard Survey. The researchers investigated various aspects of female empowerment, including educational disparities between partners, women's roles in household decision-making, and their exposure to domestic violence. Employing a generalized ordered logit model, Essilfie et al. uncovered significant associations between specific empowerment factors and food security. Notably, women's relative educational attainment and their involvement in family decisions emerged as key influences on household food security. These findings underscored the variability of empowerment's impact across different domestic contexts. Despite its insights, the study by Essilfie et al. (2021) had limitations. It did not account for other household deprivations

that might affect the empowerment-food security relationship. The current research aims to address this gap by broadening the analytical scope. The study incorporates additional variables such as water and energy poverty, as well as prosocial behaviors, into the study's investigation. This expanded framework seeks to provide a more comprehensive understanding of how women's empowerment interacts with other household factors to shape food security outcomes. By exploring these previously unconsidered elements, the study strives to offer a more nuanced perspective on the complex interplay between gender dynamics, resource availability, and nutritional well-being in household settings.

In Bangladesh, Sraboni et al. (2014) investigated the influence of women's empowerment on nutritional outcomes, specifically examining adult body mass index and dietary diversity. Their research utilized data from the 2012 Bangladesh Integrated Household Survey, encompassing 3,273 households. The findings of Sraboni et al. (2014) revealed a positive correlation between enhanced women's empowerment and improved household nutrition. Specifically, they observed increases in both calorie availability and dietary variety at the family level as women's empowerment expanded. However, the study had certain limitations in its approach. It did not employ a food security measure that directly assessed households' experiences of hunger. Additionally, the research overlooked other potential factors that might impact food security, such as access to water and energy resources, or behavioral aspects like prosocial tendencies within the community.

The current research aims to address these gaps, particularly in its second and third objectives. By incorporating these previously unexamined elements,

the study seeks to provide a more comprehensive analysis of the relationship between women's empowerment and household food security. This expanded approach allows for an exploration of how various household conditions and behaviors interact with empowerment to influence nutritional outcomes.

Additionally, a study conducted in Ghana by Banyen and Kotin (2015) investigated the impact of Non-governmental Organisations (NGOs) on women's empowerment through agricultural activities and its potential effect on food productivity. They used a sample size of 220 respondents and found that women who benefited from NGOs' outreach programs extended the knowledge acquired in their farming activities compared to non-participants. Food production increased for empowered women, reducing the likelihood of food insecurity. Hence, their study recommended women's empowerment to ensure household food security. However, it had limitations as it focused only on a unidimensional measurement of empowerment and did not use an experience-based scale to measure food security. The current study addresses this limitation in the first and second objectives.

Another study conducted by Tsiboe et al. (2018) to investigate the relationship between women's empowerment in agriculture and household nutrition in northern Ghana found a positive relationship between these two variables. The sample size included 2,642 households, and the study used instrumental variable estimation techniques to analyze the data. The findings indicated a positive association between women's empowerment and nutrient availability. However, the study did not consider other household welfare indicators that may interact with women's empowerment to impact food security at the household level. This is addressed in the current study.

Again, Sharaunga et al. (2016) conducted a study in KwaZulu-Natal rural areas to examine the dimensions of women's empowerment in agriculture that can reduce household vulnerability to food insecurity. The study used cross-sectional data from 300 female household heads. Their findings revealed that when women are empowered in areas that used to hinder their agricultural activities, it increases farm yield, translating into the household's food security. This study overlooked the multidimensional nature of women's empowerment, which could generate inaccurate results. In response to this limitation, the current study aims to adopt a multidimensional measurement of empowerment and examine its consequences on household food security.

Similarly, Olumakaiye and Ajayi (2006) examined the relationship between women's educational attainment and food provision for household members. The study was conducted in Osun state, Nigeria, where 220 women were interviewed. Using elemental frequency distributions, percentages, and chi-squares for the analysis, their results revealed a positive correlation between women's educational attainment and household food provision. This implied that women who have attained better education were more likely to serve various food, which may reduce food insecurity. However, the study did not use experienced-based food insecurity, highlighting the need for further research.

Amugsi et al. (2016) explored the link between women's autonomy and higher dietary diversity among women in Ghana. The authors utilized data from the Ghana Demographic and Health Survey, which included 2,262 women aged 15 to 49. Using logistic regression, their study's results show that women's control over significant household expenses influenced dietary diversity

positively. Additionally, women with primary education were more likely to diversify their food. However, the study did not use an experience-based measurement tool to assess household food insecurity. This research addresses this gap by incorporating such a measurement tool in its analysis.

Women Empowerment and Food insecurity: The role of water and energy poverty

Extant literature has established the link between women's empowerment and various developmental outcomes, including household food and nutrition security. Women are traditionally responsible for unpaid productive activities such as providing food and fetching fuelwood for cooking and potable water (Fleifel et al., 2019). Promoting innovations in access to water and modern energy services will likely reduce women's time in these activities (Villamor et al., 2018). Improved cook stoves have been identified as a technology that can empower women and improve food and nutrition security (Jada & Berg, 2022). They have the potential to empower women directly by freeing up the time they typically spend on fuelwood collection and food preparation, which are often considered women's responsibilities (Villamor et al., 2018). This can lead to greater gender equality regarding time allocation, a critical aspect of the Women Empowerment in Agriculture Index, as identified by Alkire et al. (2013).

Additionally, by reducing the time and effort required for household chores, improved cook stoves can create new opportunities for women to participate in income-generating activities, as highlighted by Jada and Berg (2022). This, in turn, can positively affect household food and nutrition security outcomes. Moreover, women may use the saved time to prepare more nutritious

meals, which could directly impact food and nutrition security (Jada & Berg, 2022). Improved cookstoves also have a higher energy efficiency than traditional stoves, thereby reducing the time spent on meal preparation and making the preparation of other dishes less burdensome, which could further contribute to food and nutrition security (Vahlne & Ahlgren, 2014).

Jada and Berg (2022) conducted a study investigating the impact of improved cooking stoves on food and nutrition security in rural households in highland areas of Ethiopia. The study utilized a sizeable rural household dataset and applied the instrumental variables to investigate if there exists a causality. According to their results, households with improved cooking stoves experienced improved nutritional outcomes, including increased access to food, higher consumption of vitamin A-rich food groups, and reduced incidence of food insecurity. The study also revealed that improved cooking stove adoption decreases women's domestic workload, providing opportunities for women to engage in income-generating activities, enhancing women's empowerment, and contributing to positive outcomes for household food and nutrition security. The research emphasizes the significance of energy-efficient technologies in reducing women's domestic labor and enhancing household food security. However, it is noteworthy that the study used household dietary diversity score as a measure of food security, which may not capture the sufficiency and experiences of households regarding food security. This limitation is addressed in the current study's objective two, which utilizes an experienced-based scale to measure food security.

Sola et al. (2016) conducted an exploratory review highlighting the potential impact of fuelwood scarcity on cooking practices and dietary choices.

The study suggested that a fuelwood shortage could lead to reduced cooking times, skipping meals, and a shift towards less fuel-demanding foods. This could decrease the intake of highly nutritious foods such as beans, leading to poorer nutritional balance. In addition, the scarcity of fuel for cooking could affect the type, quantity, and quality of foods consumed, as well as their ability to be digested, ultimately leading to malnutrition. The study also noted that poor access to cooking fuel might cause households to divert their income from food access to procure modern energy services, increasing time spent on income-generating activities. This could lead to lower household income, which may be used to purchase fuelwood instead of food. While the study looked at the impact of energy on food security, it failed to consider the gender dynamics such as what happens to food security when a woman is empowered or disempowered. This is addressed in the present study.

In addition, despite the importance of energy in reducing poverty and improving health, there need to be more empirical studies that examine the role of wood fuels in household food security in developing countries (Mekonnen et al., 2017; Duguma et al., 2014). A study by Waswa et al. (2020) in Kenya revealed that wood fuel scarcity led to changes in cooking practices, including the shift towards composite meals and a reduction in the frequency of meals. Mekonnen et al. (2017) found that fuel wood collection was associated with increased food production in Ethiopia. Barany et al. (2005) reported that households' food security was improved due to their reliance on fuel wood, based on an exploratory study conducted in Malawi and Mozambique. Jimoh and Haruna (2007) also found that fuel wood played a significant role in achieving food security for some communities in Nigeria. In their analysis,

Duguma et al. (2014) concluded that reducing fuel wood usage is more likely to improve household food security in Ethiopia. These studies did not also look at the direction of impact when a woman is empowered or disempowered in the household. The present study addresses this gap.

Similarly, Adjei-Mantey et al. (2022) conducted a study on gender dimensions of food security and the impact of wood fuel on household food security in Ghana. The authors analyzed data from the Ghana Living Standards Survey (GLSS VII, 2016/2017). They used the Exogeneous Switching Treatment Effect Regression to examine the association between wood fuel usage and food security. The study revealed significant heterogeneities among different gender groups regarding food security. The study also found that wood fuel usage, household size, and location in the northern part of the country were associated with reduced food security, while education and income increased household food security. The study, although using gender dimensions, did not precisely measure women's empowerment. This current study addresses the issue.

Also, Fleifel et al. (2019) researched the vulnerabilities different genders face concerning water insecurity. The study found that improving water access in rural Sub-Saharan Africa could result in substantial time savings for women, who often have to spend several hours fetching water. These time savings could enable women to engage in income-generating activities, improving their families' financial situation and potentially enhancing household food security.

Prosocial behavior and Household Food Security

As Eisenberg and Fabes (1998) described, prosocial behavior involves actions that benefit others, such as helping, cooperating, comforting, sharing,

and donating (Eisenberg & Fabes, 1998; Greener & Crick, 1999). It pertains to an area in positive psychology that concerns the actions and attitudes of individuals towards the betterment of others and society as a whole. It centers on how people assist each other and work towards a common goal (Eisenberg & Fabes, 1998). This behavior has been the subject of extensive research, with scholars and practitioners interested in understanding the factors that motivate individuals to engage in such behavior (Bekkers & Wiepking, 2011). While relatively few studies have focused on the experiences of volunteers or donors, some evidence suggests that engaging in prosocial behavior can lead to a sense of well-being (Podsakoff, 2009), increased societal trust (Glomb et al., 2011), recognition (Fehrler & Przepiorka, 2013), and internal satisfaction (Blumkin & Sadka, 2007). According to the literature, volunteering and donating have been shown to positively affect the beneficiaries of such behavior (Konrath, 2014).

Social capital refers to the resources embedded in the network of individuals that could support an individual. According to Portes (1998), social capital comprises the network of people who can provide such support. This network of individuals generates resources through formal and informal relationships within a community, and as such, it encompasses any resources that can be accessed through such relationships (Oluwatayo, 2009). According to Bekkers and Wiepking (2011), people join social networks and raise social capital due to prosocial behavior. Furthermore, prosocial behavior can serve as a means of building social capital during times of distress (Lamidi, 2019).

Niles et al. (2021) conducted a study to explore how household and community social capital relates to food security among smallholder farmers. They reviewed 13 online data in East and West Africa and South Asia. They

used group membership to examine social capital and found that household social capital impacts food security positively. They also found that when households belong to social groups, it reduces the average month of food security by 10 %. The study recognizes that attempts to eradicate food security in the household and community should explore the potential impact of social networks as an avenue to raise economic or social capital. Also, Rusmawati (2021) conducted a study on food security in Indonesia and the role of social capital. Employing the Lewbel two-stage least squares, they found that social capital, both within and outside the household, positively impacts household food security.

Similarly, Nosratabadi et al. (2020) conducted a comprehensive literature review to examine social capital's effect on food security. Their study highlighted that social capital has a positive spillover effect on the entire community. Relying on 39 articles for this review, the authors found that social capital through contribution and food sharing improves household food security. They further stated that constant interaction among community members results in food sharing, which enables access and availability of food and increases the household's resilience to vulnerability, strengthening food stability.

However, a study conducted by Lamidi (2019) examining the role of social capital, education, and time use on the impact of household composition on food insecurity showed a contrasting result. Using household survey data for Nigeria with a sample size of 5000, the findings from the study showed that economic support from family, community members, friends, and lending agencies was instead linked to a higher risk of food insecurity. Even though

these studies examine the effect of contribution or social capital that prosocial behavior necessitates on food security, they did not look at its role in women's empowerment. This current study addresses the anomaly.

Women Empowerment and Environmental Poverty

Empowering women is essential in achieving sustainable development, including access to potable water, sanitation, and affordable clean energy. Environmental poverty is a new concept that measures the lack of access to environmental services (UN Women, 2014; Narayanan et al., 2019). Nawaz and Iqbal (2021) quantified the concept using four interconnected dimensions: energy, water, sanitation, and dwellings. Although no studies have examined the association between women's empowerment and environmental poverty, few studies have investigated the relationship between empowerment and individual dimensions of environmental poverty, such as energy, water, and sanitation. This literature review comprehensively analyzes empirical studies on women empowerment's impact on environmental poverty.

For instance, Ssennono et al. (2023) conducted a study in Uganda to examine women's empowerment's role in mediating the relationship between climatic shock and energy poverty. Using the Ugandan National Panel Surveys from 2014-2020, they found that women's empowerment is associated with energy poverty reduction. They also concluded that women's empowerment should be prioritized in policy agendas to end energy poverty to improve climatic conditions. Another study on the impact of the empowerment of women on the acquisition of clean cooking technology was conducted by Yasmin and Grundmann (2020). They used Pakistan's household survey to establish this relationship. They found that women with agency and control

over their resources are more likely to acquire modern energy like biogas technology in their homes. Their results also show that women's asset ownership and employment status can influence their decision and participation in fuel choices in the household.

Similarly, a study in Indonesia sampled 351 households in an agrarian economy. It found that when a female spouse is involved in household decision-making, it facilitates adopting modern fuel technology such as biogas (Putra et al., 2017). Additionally, the study conducted by Puzzolo et al. (2016) in India showed that women prefer to adopt modern cooking fuels over men, mainly when they can finance it. Similarly, Mohapatra and Simon (2017) assert that women's intra-household bargaining power improves the household's decision to adopt cooking fuel.

Using data covering 36 African nations, Opoku et al. (2021) examined the interplay between women's political engagement and access to modern energy services. This study used women's political participation to assess their empowerment. Their findings reveal that more women in political positions or parliament are more like to facilitate the extension of electricity access, including adopting sustainable energy sources. Furthermore, the study by Choudhuri and Desai (2020) revealed that households are more likely to use clean cooking fuels when women have higher decision-making ability over major household expenditures.

Cunning et al. (2019) conducted a study in Nepal to examine if water, sanitation, and hygiene practices mediate the relationship between women's empowerment and child length for age z-scores. Using cross-sectional data from a sample of 4080 households in 240 rural areas in Nepal, they found in

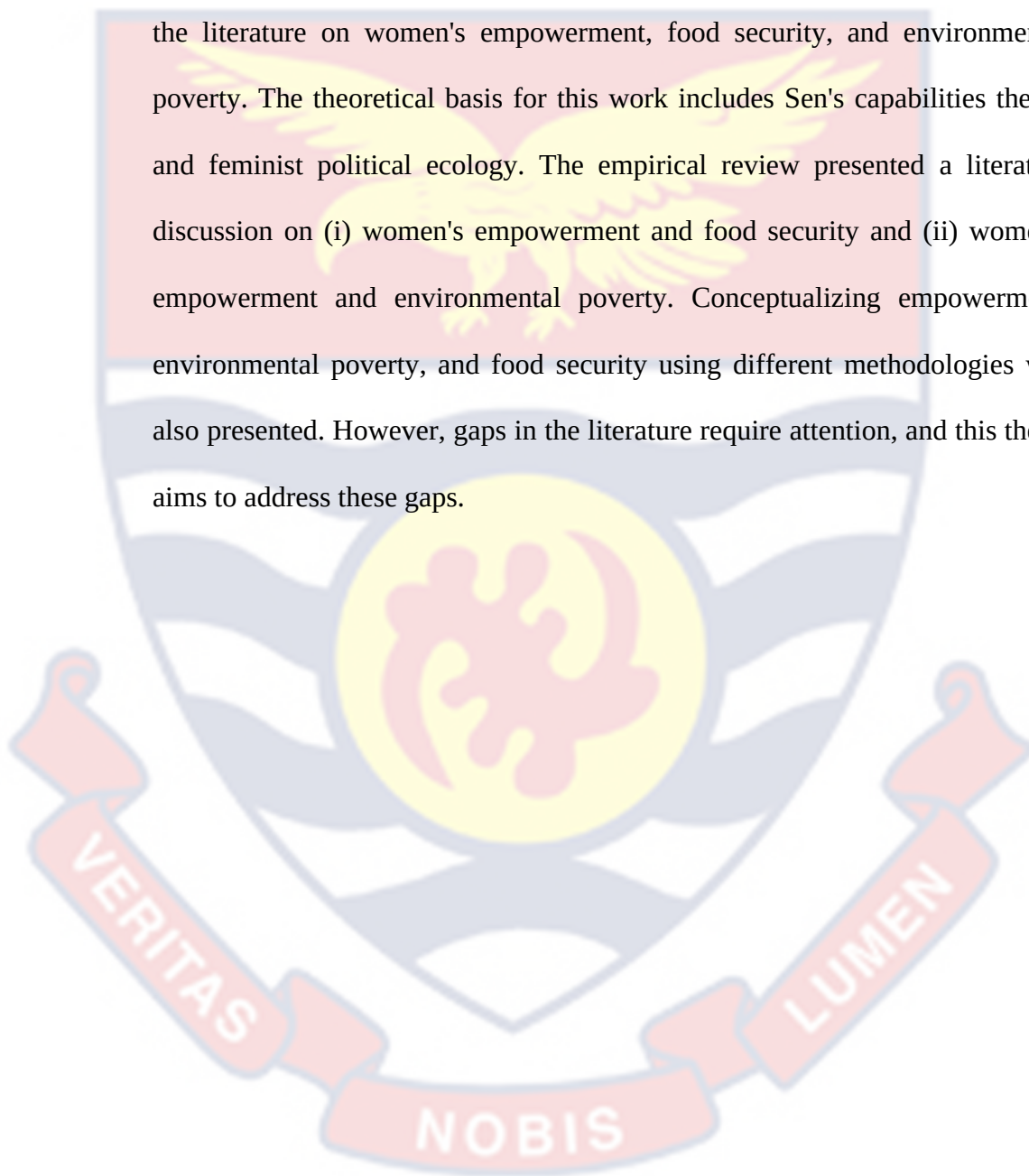
their mediation analysis that women's empowerment is associated with access to water, sanitation, and hygiene services. Their results showed a significant positive relationship, meaning women's empowerment gives them agency and decision-making ability over water and sanitation services. Thus, disempowered women have worse water and sanitation hygiene practices than empowered women. Similarly, Bogale (2021) investigated the link between women's empowerment and access to water, sanitation, and hygiene services in Ethiopia. The study explored this relationship using Ethiopia's demographic and health survey data collected in 2016. Using a multilevel logistic regression, their results reveal that women empowerment was associated with 18 percent of the community or household having improved sanitation facilities.

It is evident from these studies that it is essential to comprehend the impact women's empowerment has on environmental poverty, especially from the context of coastal developing countries. Although these studies revealed that women's empowerment is essential in combating the individual dimensions of environmental poverty, they have only relied on unidimensional measures of environmental poverty. Thus, this study will fill this gap by developing a composite index that integrates these dimensions and examines the implication of women's empowerment in environmental poverty.

Chapter Summary

The overview of the fishery sector, the status of food security, and the environment were discussed in this chapter. Highlighted in this chapter were the challenges facing the fishing industry and the governance structures that regulate activities in the industry. Also, given that food security and environmental sustainability remain significant components for development, particularly in

developing countries, it is imperative to address the persistent problems of hunger and environmental degradation. Multiple theories and integrative methods are necessary to comprehensively explain women's empowerment, food security, and environmental poverty. This chapter provided an overview of the literature on women's empowerment, food security, and environmental poverty. The theoretical basis for this work includes Sen's capabilities theory and feminist political ecology. The empirical review presented a literature discussion on (i) women's empowerment and food security and (ii) women's empowerment and environmental poverty. Conceptualizing empowerment, environmental poverty, and food security using different methodologies was also presented. However, gaps in the literature require attention, and this thesis aims to address these gaps.



CHAPTER THREE

MATERIALS AND METHODS

Introduction

This chapter explains the materials and methods used to assess women's empowerment in coastal Ghana on household food security and environmental poverty. The study concentrates on three topical issues: (i) the development of a multidimensional women empowerment index in coastal Ghana, (ii) Food security in coastal Ghana and the role women's empowerment play (iii) women empowerment and environmental poverty. The chapter begins with an extensive description of the research philosophy and design. In the first section, the justification of positivism as the philosophical view of the study is also presented. The subsequent sections profile the study areas, describe data sources, specify analytical models, and present the study's estimation techniques.

Research Philosophy

In conducting research, making explicit the philosophical underpinning is essential. Research philosophy establishes a framework for researchers to perceive the world and how it functions. Saunders et al. (2009) define research philosophy as a set of suppositions that characterizes the evolution of knowledge along with identifying the ontological, epistemological, methodological, and axiological foundation of any field of inquiry. These assumptions inexorably influence how the researcher answers the research questions, explains the methodologies employed, and interprets the findings (Saunders et al., 2009).

While several philosophies or paradigms are recognized and debated in the literature, Guba and Lincoln (1994) and della Porta and Keating (2008)

espoused four of these philosophical worldviews as a lay-down background to inform social research. These include positivism, critical theory, constructivism, and post-positivism. However, Clark (1998) and Proctor (1998) believed that positivism and post-positivism should be the only paradigms a researcher has to consider before deciding on research methodologies. Proctor further asserted that all other philosophies are essentially modified versions of positivism and post-positivism.

Critical theory as a research philosophy emerged from the Frankfurt School and challenges dominant power structures and societal norms. It aims to critique and change society rather than simply understand or explain it (Horkheimer, 1972). This approach emphasizes the examination of social inequalities, power dynamics, and historical contexts that shape human experiences and knowledge production (Kincheloe & McLaren, 2011). Critical theorists argue that research should not be value-neutral but should actively work towards emancipation and social justice (Habermas, 1984). They contend that traditional research often reinforces existing power structures and fails to address systemic inequalities (Freire, 1970).

In practice, critical theory-based research often involves participatory methods, giving voice to marginalized groups and aiming to empower research subjects (Mertens, 2009). It encourages reflexivity, urging researchers to examine their own biases and positions of privilege (Denzin & Lincoln, 2011). Critics argue that critical theory can be overly politicized and may compromise objectivity in research (Hammersley, 1995). However, proponents maintain that all research is inherently political and that critical theory simply makes these dynamics explicit (Apple, 2019).

Positivism has gained dominance in economic research. Regardless, Patton (2002) argued for constructivism as a research philosophy that is a better option for explaining the differences between the human world and natural sciences. The idea of constructivism emanated from Mannheim and the philosophical works of researchers like Lincoln and Guba (1985). Constructivists contend that humans pursue the understanding of the world they live in based on the subjective meanings they develop using their lived experiences (Creswell, 2014). This view opposes the positivists' mindset of studying the world without reliance on personal experience and value judgment. Thus, this thesis will discuss positivists' philosophical worldviews in detail.

Positivism was started by a group of twentieth-century philosophers and scientists known as the Vienna Circle, Francis Bacon, and Auguste Comte (Saunders et al., 2009). It is based on the natural scientist's philosophical position, which includes gathering observable data on the social environment to produce theoretical generalizations (Saunders et al. (2009). This philosophical stance forms the basis of quantitative research, where data collection and results interpretation are objectively made (Hovenkamp, 1990).

It also claims that a researcher cannot be prejudicial about the observable data by preventing any form of normative judgment (Friedman, 1953). Positivists reckon that social reality is a steady condition that can be objectively examined without relying on value judgment and metaphysics (Taale, 2018). They also posited that understanding any reality requires scientific validation and empirical conclusions through a series of methodological inquiries rather than relying on personal experience and subjective opinions. They advanced the argument that social sciences are just like the natural sciences. Hence, social

research can be undertaken objectively without the researcher's influence (Taale, 2018).

Although the positivist philosophical worldview has continued to shape social science research, especially economics, there has been a critique of its assumptions and relevance to human and social research. For instance, Popper (1959) objected to the stance of positivism and argued that rather than concentrating on the simplistic method of verification, researchers should look at what theory has suggested will not happen and examine its occurrence. He believed theories should easily be tested and falsified empirically, emphasizing his stance on falsification rather than verification.

Clark (1998) argued that positivism is an ancient research philosophy that should not be considered in any scientific inquiry. Similarly, Perri and Bellamy (2012) critiqued the positivists' standpoint by stating that apart from developing theories from observable facts and synthesized data, they need to elaborate on how the patterns they see during their analysis behave the way they do. Again, Laudan (1997) maintained that positivism usually misconceives the scientific process, which includes social science, to mean applying robust empirical methods to existing research data to produce rich findings even when new observations are not predicted.

Nonetheless, this study relies on positivism as its philosophical underpinning because the objective and research questions to be answered do not align with any other philosophical worldview. Since this study is well grounded in economic research, positivism remains the most suitable approach. Also, positivism supports mathematically inclined research and would be able to provide a more detailed analysis.

Research Design

Research design can be looked at as the toolbox that guides researchers to conduct their research systematically. Creswell (2014) defined it as the overall approach to the research, which spans from theoretical assumptions, data collection, analysis, and interpretation of findings. Three main approaches to research are identified by Creswell (2014). These are qualitative, quantitative, and mixed methods. Qualitative research design is formed based on constructivism.

Mixed methods research is an approach to inquiry founded on a philosophical basis, combining both qualitative and quantitative research methods. The qualitative research approach explores and understands human issues using inductive reasoning. The quantitative research approach, which situates itself in positivism, tests theories by investigating the causal relationship among variables (Creswell, 2014). The aim is to comprehensively understand and validate research findings through the corroboration of results (Johnson et al., 2007).

Over the years, economic research has always been based on positivism. However, the approach used in the research depends on the research questions and objectives to be answered. This study, therefore, uses a quantitative research approach to objectively examine women's empowerment and its impact on food security and the environment in coastal Ghana.

Study Area

This study was conducted in five small-scale fishing communities along Ghana's central and western coasts: Axim, Elmina, Moree, Biriwa, and Anomabo. These sites were selected based on their historical catch data, fishing

gear, and many fishers (Nunoo et al., 2014). Their contribution to artisanal fishing is extremely notable (Akpalu, 2015).

Axim is a coastal town located in the Western Region of Ghana, serving as the capital of the Nzema East Municipality district (GSS, 2014). The town lies in the Southwestern equatorial climatic region, on latitude 4° 51' 55"N and longitude 20° 14' 28"W (Adam et al., 2016). With a population of 29,829 (GSS, 2014), Axim is among the most prominent business centres in Ghana, along with Sekondi-Takoradi and Tarkwa, with significant economic activities in the fishing industry (Adam et al., 2016). The town of Axim comprises Upper Axim and Lower Axim, with fishing being the dominant occupation and women actively involved in the post-harvest sector. Elmina is a densely populated fishing community in the Komenda-Edina-Eguafo-Abrem (KEEA) District of the Central Region, Ghana. The community is situated at longitude 1° 20' and 1° 40' West and latitude 5° 05' N and 6° N, with a population of approximately 32,819 (GSS, 2010). Small-scale fishing, fish processing, and marketing are the primary economic activities in the community.

Moree is a typical fishing community that lies on longitude 001° 19' 07.4 "W and is located 120 km from Accra and about 6km east of Cape Coast (Marquette et al., 2002). It is one of the many towns in the Abura-Asebu-Kwamankese (AAK) District (Marquette et al., 2002). Moree is the most populous of the eight towns in this district (Marquette et al., 2002). The inhabitants of Moree are mainly from the Fante ethnic group. The number of fishing folks in Moree could constitute about 50 percent of the town's population (Marquette et al., 2002). Marine fishing and fish processing remain the main occupations in Moree (Marquette et al., 2002). According to Marquette et al.

(2002), there are about eight landing sites in Moree, and fishing remains the most crucial employment avenue for the inhabitants. Women in this fishing community are actively engaged in fish processing, marketing, and distribution. Biriwa (5.1656° N, 1.152° W) and Anomabo (5.176° N, 1.1233° W) are coastal communities in the Mfantseman District. The dominant occupations in these two communities are fishing and fish processing. Most men and women are fishermen, fish processors, and mongers. Men are involved in fishing, while women control the post-harvesting sector. Repairing broken nets, fish marketing, and petty trading abound in these two communities.

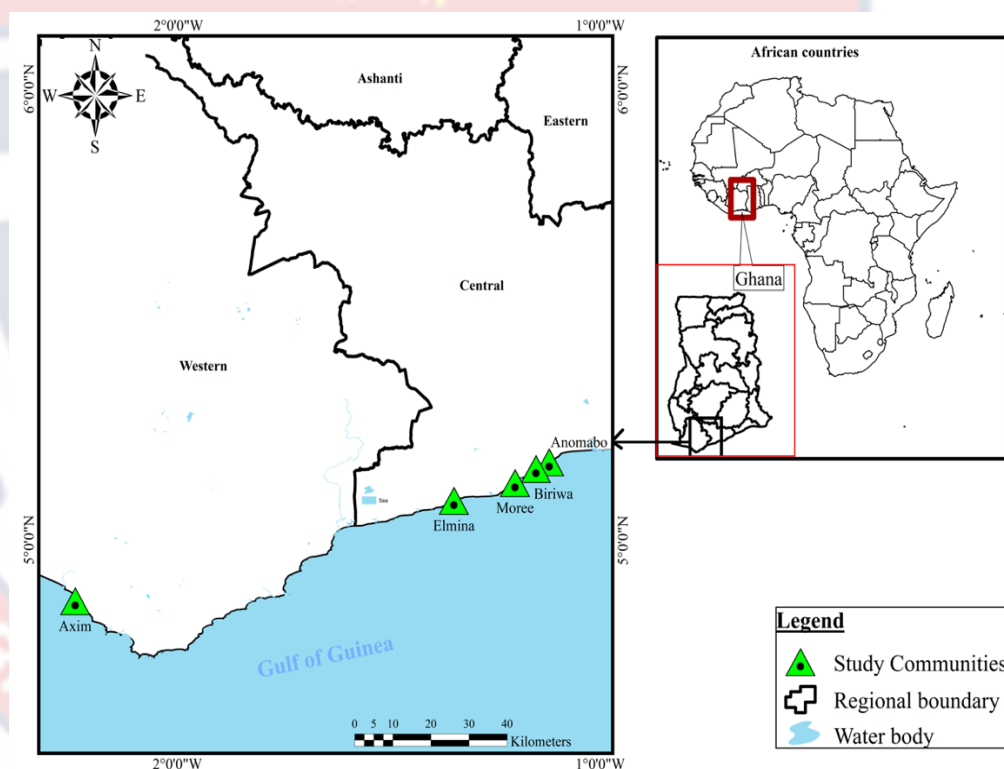


Figure 7: Map showing the five fishing communities.

Population of Interest

In research, the population of interest is the target group of the study. However, due to practical and logistical constraints, it is often only feasible to include part of the population in the study. Therefore, researchers commonly select a representative sample from the population of interest. In doing so, the

aim is to generalize the study findings from the sample to the entire population of interest (Majid, 2018). The population of interest for this study is fishing households in Axim, Elmina, Moree, Biriwa, and Anomabo. The interest of this study is to administer the questionnaire to fishing households from which information will be collected to measure social well-being variables. For households that have children, consent was sought from their caregivers before engaging them. Also, information on children below the age of 5 was sought from their caregivers. In order to satisfy the objectives of the research, the sample for the study was drawn from these target groups (fishing households).

Sampling Technique and Procedure

This study employed the multistage sampling technique. The research focused on sampling from the population of fishing households in five selected communities: Axim, Elmina, Moree, Biriwa, and Anomabo. These fishing communities were chosen based on multiple criteria. Firstly, their historical significance in fishing activities and substantial contribution to total fish production were considered, as noted by Nunoo et al. (2014). Additionally, the selection process considered the diverse socio-economic activities present in these regions, ensuring a representative sample of the broader coastal economy. Importantly, the study also prioritized areas with notable involvement of women in fisheries-related activities, recognizing the crucial role women play in the fishing industry and community economic structures. This multifaceted selection approach aimed to provide a comprehensive view of the fishing households, capturing both the traditional fishing practices and the evolving socio-economic dynamics, including gender roles, in these coastal communities.

The simple random sampling technique was implemented on the field to select fishing households for interviews. This method was chosen for its simplicity and ability to minimize bias in participant selection. The process began with researchers identifying all fishing households in each of the five selected communities. A comprehensive list of these eligible households was then compiled to serve as the sampling frame. Each household in this frame was assigned a unique number or identifier. Using a random number generator or a lottery method, households were randomly selected from the sampling frame. This approach, as noted by Gupta and Shabbir (2008), ensured that each household had an equal probability of being chosen for the study. In cases where a single house contained two or more fishing households, researchers employed an additional random count method. As suggested by Singh & Masuku (2014), this likely involved randomly selecting which of the multiple households within a single structure would be interviewed. The randomly selected households were then approached for interviews. This methodology ensured that the selection process was unbiased and that the sample was representative of the broader fishing household population in these communities. The random selection helped to avoid systematic errors that could arise from researcher bias or convenience sampling, thereby enhancing the validity of the study's findings.

A convenience sampling technique was used to draw a sample for testing the strength of the survey instrument. In Axim, about five fishing villages named; Brawire, Upper Axim, Lower Axim, Apewosika, and Akyinim, a simple random sampling was applied in selecting the fishing villages for the enumeration. Households were then sampled from the selected fishing communities in Ghana's western and central coasts. Axim has about 5001

households, Elmina has 6353, Moree has 5782, Anomabo has 3621, and Biriwa has 1675 according to the 2010 population census (GSS, 2010). The sample size of households was ascertained from the targeted population by adopting Krejcie and Morgan (1970). The authors formulated a sample size from a finite population to obtain a sample that would be representative. The equation below was used to calculate the sample size for each study area.

$$n = \frac{X^2 NP(1-P)}{d^2(N-1) + X^2 P(1-P)} \quad (4)$$

The formula for calculating the required sample size in a study is based on various parameters. These parameters include the confidence level (represented by 'x'), the population size (represented by 'N'), the population proportion (represented by 'p' and assumed to be 0.5 for maximum sample size), the degree of accuracy (represented by 'd' and usually set at 5percent), and the margin of error (also represented by '.05'). The required sample size 'n' can be calculated using the formula in equation 4. Table 3 illustrates the estimated sample size for each of the five study areas drawn from the total household population using equation (4) regarding the sample size table provided by Krejcie and Morgan (1970).

Table 3: Sample size of the selected study areas

Coastal Communities	Total Household Number	Sample Size
Axim	5001	357
Elmina	6353	361
Moree	5782	361
Biriwa	1675	322
Anomabo	3621	351
Total sample		1752

Source: Krejice & Morgan (1970)

Data Collection Instrument

The study employed a questionnaire with five distinct sections to collect household data. The first section focused on gathering demographic information such as age, gender, education, religion, locality, and household size. The second section sought information about the dwelling characteristics of the households. The third section was designed to gather household expenditure data on food and non-food items. These three sections were modeled after the Ghana Living Standard Survey Round 7 (GLSS7) survey tool. The fourth section was developed by revising the Women's Empowerment in Agriculture Index (WEAI) and the survey tool Cole et al. (2020) used to assess women's empowerment in fisheries. The survey tool was modified using the Gender Transformative Communication tool (GTC) and Practical Gender Needs Approach (PGNA). The study developed a unique survey tool, the Women Empowerment in Fisheries Index (WEFI), to capture women's empowerment in Ghana's fishing communities.

Following Alkire et al. (2013) and Cole et al. (2020), the study developed a unique survey tool to fit the fisheries context in Ghana. The survey tool designed for the Women Empowerment in Fisheries Index (WEFI) was administered to the same households from which social well-being indicators of interest to the study, such as food security and environmental poverty, are collected. According to (Alkire et al., 2013), if this standard protocol is not followed, the linkages the study wants to establish between women empowerment and outcome variables of interest will not hold. Comments on the survey tool or the section on empowerment were sought from fisheries actors- fishers, fish processors, fisheries extension officers, office of the chief

fishermen, and the assembly to ascertain its adaptability to the local context, in this case, fishing communities.

The final section was on food security. The study adopted the Household Food Security Survey Model (HFSSM), a food security assessment instrument created by USAID's Food and Nutrition Technical Assistance (FANTA) Project, to collect the data necessary to estimate the food security indicators. A pre-test was conducted using ten households, two in each of the five communities, to test the viability of the survey instrument used for the study. Using the Computer Assisted Personal Interview (CAPI), the questionnaire was programmed in CSentry. Due to the nature of the questionnaire, administering it lasted 120 minutes.

Choice of Respondents

One significant focus of the women empowerment survey tool is who should be included or interviewed and whose measurement should be tracked over time. In this study, the households were not characterized based on “headship,” given the complexity and assumptions inherent in defining and classifying “headship.” It is evident in the literature that variations in the definition of a household bring about different household compositions, which may affect the indicators used to assess labor activities and consumption (Alkire et al., 2013). To know who is considered as “household,” who qualifies as an interviewee, and who should be identified as the “primary” and “secondary” respondents, the study relies on Ayad (1994) and Glewwe (2000) as cited in Alkire et al., (2013). According to Ayad (1994) and Glewwe (2000), a household is a collective of individuals who reside together and share meals from a common source. For a group to be considered a household, they must cohabit,

share some essential household items, participate in budgetary and expenditure decisions, and consume food from the same source. To also be identified as a household member, the person must have stayed in the household for at least six months, including persons who are not blood related (Alkire et al., 2013).

The working definition used in this study for primary and secondary respondents is household members who identify themselves as the main people responsible for household socio-economic decision-making (Alkire et al., 2013). They are mainly husband and wife but, in some cases, there may be adults above 18 who decide too. In contrast, even if the person is blood-related but does not satisfy the conditions of being a household member, the person is not part of the household. The study considered both single female-only adult households and dual household where both adult males and females are present. The study also did not limit the dual-adult household to just husband and wife but to other households where there could be a mother and her adult son. The inclusion of the household is to aid in measuring intra-household empowerment.

Ethical Considerations

Ethical clearance was accessed from the Institutional Review Board (IRB) of the University of Cape Coast before data collection commenced. All published and unpublished literature were cited to avoid any issues of plagiarism. Community-entry protocols were adhered to as the surest way of introducing the research to the community leaders to obtain permission to collect data.

As such, community heads, the assembly, the outfit of the chief fishermen and fish queens, as well as the opinion leaders of each community were engaged in a meeting to explain the research objectives, the survey tools,

the research approaches used, and the expected roles of the community and its members in facilitating the research activities. These meetings were used to seek oral consent from the community leaders and traditional chiefs to engage the community in field activities.

These community leaders were located during the reconnaissance survey, and a day and a time of their interest were scheduled for the discussion during the actual data collection. The venue of meetings in all five communities was held in the chief fishermen's palace. Also, it was explained to the participants that the exercise was voluntary. As such, they can withdraw at any point without being held accountable.

The possible risks and benefits regarding the study were made known to participants. Also, participants were assured that any information they shared would be analyzed with that of others and that their names would not be attached to the responses. They were further assured that all information they provided would be treated with confidentiality and anonymity.

Training of Field Assistants

Five field assistants were recruited to aid in data collection. The training was held to take them through the questionnaires in both English and Fante/Twi language. The training exercise was to ensure field assistants' understanding of questions, familiarization of tools to be used in administering questionnaires, and for trainees to have a hands-on experience with the software used to configure the questions, bearing in mind the objectives of the study. The principal investigator led data collection.

Data Collection

The survey was conducted from August to November 2021. Seventy-five days were used for data collection, with 15 days each per study area. A maximum of 120 minutes was spent administering the questionnaire. The questionnaire was administered to fishing households that were categorized into two. These are households with only females and dual-adult households (households with both adult males and females present). This research defines a household as a group of individuals who share meals and make collective decisions about their social and economic requirements. The primary reason for including a dual-adult household was to generate empowerment measures for both women and men within the same household.

Given that one of the objectives of this research is to gauge empowerment measures for both women and men living in the same household, questionnaires were administered to men and women. Where possible, interviews of women and men in their households were conducted simultaneously and privately to avoid conflicting responses. The first section of the questionnaire, which was on demographics, was administered to the primary respondent- the one with the most knowledge of household members and who makes the most decision. The section on food security was answered by the person that prepares food or is responsible for food and nutritional needs in the household. The principal investigator and the field assistants conducted the interviews separately.

Measurement of Key Variables

The study begins by developing a multidimensional women empowerment index to measure and assess women's empowerment relative to

men in the same fishing household. This study divides the variables into four categories: dependent, explanatory, moderating, and mediation. The explanatory variables are women's empowerment plus the socio-economic characteristics of the household. With the second objective on investigating the link between women's empowerment and food security in the household, the dependent variable is food security.

Drawing from the concept of intersectionality, the study also looks at how different household deprivations facilitate the interplay between women's empowerment and food security. In that sense, water and energy poverty were considered moderators that can potentially affect the strength and direction of the effect of women's empowerment on food security. Again, Prosocial behavior was used as the mediating variable to explain or show the potential mechanism through which empowerment can affect food security. The third objective has environmental poverty as the dependent variable and women empowerment with socioeconomic variables as the independent variables.

Women Empowerment

This study's modification efforts of the Women Empowerment in Agriculture Index (WEAI) and (Cole et al., 2020) model to produce the Multidimensional Women Empowerment in Fisheries Index (WEFI). This index incorporated changes to these tools by adding dimensions and indicators due to their relevance in defining empowerment in fishing communities in developing countries. The dimensions and indicators needed to help understand empowerment in coastal communities were settled on after an extensive review of the literature (Harper et al., 2013; Alkire et al., 2013; Galiè et al., 2019; Cole et al., 2020).

The study extended the dimensions to include institutions measured through gender norms and access to training and information. The inclusion of gender norms as an indicator of measuring empowerment is due to the sector's significant role in driving the socio-economic development of any coastal country, especially in a developing one, although highly gendered (Britwum, 2009; Harper et al., 2013). Women's engagement in artisanal fisheries and governance is shaped by gender norms and power dynamics (Gustavsson, 2021; Freeman & Svendsen, 2022). In Ghana, for instance, women are active in the fisheries with a concentration in the post-harvest domain (Britwum, 2009); however, these roles do not receive the necessary attention due to the perceived male dominance (Harper et al., 2020). While this is defined by the traditional gendered nature of the sector, some women own fishing vessels and remain the main financiers of fishing expeditions (Britwum, 2009). As a result, incorporating gender analysis in this sector will help in designing effective behavioral change interventions that can make fisheries management more gender-balanced and likely resolve gender inequalities in Ghana (Torell et al., 2020) and elsewhere in the world (Harper et al., 2013, 2020; Oloko et al., 2022). On access to training and information, the study related to the empowerment framings of (Narayan, 2005), who emphasized that access to information introduces individuals to a myriad of opportunities, skill training, and being aware of their rights and privileges. This includes information on access to essential government services such as fisheries extension services, financial services, markets, and prices (Narayan, 2005). These services are vital to measuring empowerment in the fisheries sector.

The availability of livelihood resources in fishing households provides profitable enterprises needed for sustenance (Appiah et al., 2021). This study also included alternative livelihood to ascertain the number of people in the non-fishing business and their control in deciding the income they earn from such ventures. Due to the seasonal nature of the fisheries sector, access to and the control of income from alternative livelihoods may influence the empowerment of individuals in the fishing community.

Although the additions to dimensions and indicators were drawn from literature, comments about the survey tool developed were sought from fisheries actors-fishers, fish processors, key stakeholders, and fisheries extension officers. The primary reason was to explore the additions to the dimensions and indicators to ascertain their relevance in gauging gender-based empowerment in the fisheries sector. It was also done to comprehend and assess the prominence of the dimensions in local contexts, specifically on access to information and training, gender norms, and alternative livelihoods.

Dimensions and Indicators to Measure Women's Empowerment

The dimensions and indicators to quantify empowerment was drawn from literature and policy considerations (Kabeer, 1999; Alkire et al., 2013; van Eerdewijk and Wong, 2017; Malapit et al., 2019). Each dimension was measured with two to three indicators through several relevant questions.

Production

This dimension discussed the choices about fish catch and other activities in the fisheries value chain. It assessed the respondents' ability to make decisions solely or jointly in fish production, fish processing, fish marketing, fish transportation, and autonomy in activities along the fisheries value chain.

The dimension follows (Kabeer, 1999; Alkire et al., 2013; Malapit et al., 2019) definitions of empowerment as the ability to make choices, particularly in critical areas of the fisheries value chain. To measure this dimension, input into productive decisions and autonomy in fish-related activities were used. An individual is set to be deprived in this dimension or indicator if they do not participate in at least one of the fishing activities and have no input or some input in decisions regarding the activities. The second indicator under this dimension is autonomy in fish-related activities. This describes a person's ability to act on their values without coercion or fear of disapproval from others (Alkire et al., 2013). A subindex is constructed by adapting the Relative Autonomy Index (RAI) measure (Ryan and Deci, 2000; Malapit et al., 2019). The RAI is measured by summing the weighted responses under this indicator (see. Table 1). An individual is said to be deprived of their Relative Autonomy Index is less than one (1), and their actions are motivated more by coercion or fear of social disapproval.

Resources

Quisumbing et al. (2015) state that owning assets controls livelihood vulnerability while increasing social and economic empowerment. Research has shown that access to resources positively influences women's empowerment (Trommlerová et al., 2015; Galiè et al., 2019). Also, it has been noted that gender and socio-cultural norms influence people's worth, power, and asset acquisition (Galiè et al., 2019). This dimension included three indicators. (1) ownership of assets (measured through asset ownership, number possessed, and level of ownership (2) purchase, sale, and transfer of assets (measured through the individual's ability to buy, sell, and transfer assets) (3) access to and credit

decision (assessed through household's ability to acquire a loan from different sources). A person is said to be deprived of these indicators if they report having no sole or joint ownership of assets. In cases where there is ownership, they own very few of it, they do not participate in the purchase, sale, or transfer of assets, and finally, they cannot access loans.

Income

It was measured using two indicators: (1) control over income from fish-related activities (measured through “decisions about the use of income generated from fishing activities”); and “the extent to which the individual feels he or she can make his or her own decisions regarding wage or salary employment); and (2) control over household expenses (measured through “decisions about the use of income for household expenditures”). A person is considered deprived if they do not have input into the decision on income generated from fish-based activities and alternative livelihoods and have no significant control over household expenditure.

Leadership

This dimension has two indicators. (1) Group membership (measured through “being an active member of fisheries and non-fisheries related community-based associations). Other group members outside the fisheries value chain were added because they are the primary source of social connections and capital necessary to define empowerment (Meinzen-Dick et al., 2013; Galiè et al., 2019). The individual has achieved this indicator if they recognize associations in their community and are members of at least one group. The second indicator, “public speaking,” is measured via the person's ability and comfortability in speaking in public on issues affecting their

community and illegal fishing in their communities. The person is said to be deprived if they show distress in public speaking on issues affecting the community and their business.

Institutions

van Eerdewijk and Wong (2017) defined institutional structures as “the social arrangements of formal and informal rules and norms and practices that enable and constrain the agency of women and girls and govern the distribution of resources.” Women’s empowerment occurs when institutions available aid their choices, voice, and ultimately their lives and futures. It is expressed in three areas: (1) formal laws (includes: rules and conducts, established states, and international treaties); (2) Norms (cultural ideals and norms on how males and females should socialize in all aspects of life); and (3) relations (the contacts they interact with daily).

Sociocultural norms such as gender norms and access to training and information are potent elements in defining the ability or decision to make choices and development (Narayan, 2005). This dimension has two indicators; (1) Gender norms (measured through scaling responses to questions projecting the right and privileges of men over women along the fisheries value chain and household activities) and (2) access to training and information (measured through “whether respondents have access to information and training). Gender norms were measured by adapting the scale proposed by (Nanda, 2011; Cole et al., 2020) to measure egalitarian beliefs about male and female rights and privileges. Respondents were asked if they “agree” =1 “partially agree” =2 “disagree” =3 to eight statements on the gender attitudes scale. The responses were summed with “24” being the highest score (extreme egalitarian belief) and

“8” as the lowest score (unequal gender attitude). An individual is said to be deprived in the second indicator if they do not have any training or information in fishing, fish processing, storage, and marketing.

Time

Individuals are considered deprived if they are unsatisfied with leisure, implying a higher workload. Considering the nature of the fisheries-related activities, this dimension was only measured with the satisfaction indicator on the available leisure time. The indicator was measured through responses to questions on how many hours they dedicate to fishing activities and if they have enough time to enjoy leisure.

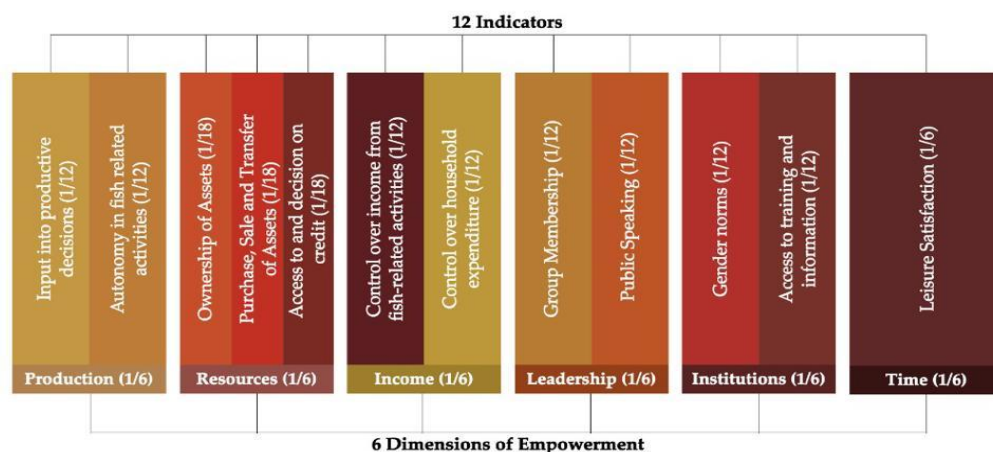


Figure 8: Composition of the Women Empowerment in Fisheries Index.

Constructing the Index

In developing the index, the study applied the Alkire-Foster (A-F) methodology, precisely the multidimensional poverty approach- a self-explanatory and count-based methodological process constructed to measure poverty (Alkire and Foster, 2011; Alkire et al., 2013). This framework can be contextualized to include significant dimensions and indicators such as

institutions in the study. It can further be decomposed into subgroups and other population characteristics (Alkire et al., 2013). Similar to the A-F model, the index construction involved (1) identifying and defining relevant indicators, (2) Normatively selecting an empowerment cut-off for each of the indicators identified, (3) assigning codes to new binary indicators such that one means an individual is disempowered and 0 means otherwise (4) allocating weights to each of the new binary indicators which will be used to compute the empowerment scores (5) constructing the index and summing the scores for each of the dimensions or indicators. (6) setting a disempowerment cut-off such that if the individual falls below the threshold, he or she will be considered multidimensionally disempowered.

Table 4: Dimensions, indicators, and deprivation cut-offs

Dimension	Indicator name	Deprivation/Achievement cut-off
Production	Input in productive decisions	Deprived if an individual does not meet at least one of the following conditions for all fish-related activities they participate in: makes a related decision solely, makes the decision jointly and has at least some input into the decision and feels could make decisions if wanted to.
	Autonomy in fish-related activities	RAI score is calculated by summing responses to the three questions on autonomy in fish related activities using the following weighting scheme: -2 when a person decides to act so not get into trouble, -1 to avoid being thought poorly and +3 if the person thinks their actions are right. Inadequate if an individual's decision making and choices are influenced by the disapproval of others and the Relative Autonomous Index is <1.

Resources	Ownership of assets	Inadequate if an individual does not own any asset or the household owns the type of asset, BUT they do not own most of it alone, and the individual does not own it solely or jointly: at least three small assets [mobile phones, baskets, nets, sacks, hook, and line] and at least two significant assets (canoes, gears, ovens, and processing equipment).
	Purchase, sale, or transfer of assets	Inadequate if an individual does not own any asset or household owns the type of asset, BUT they do not participate in the decisions to purchase, sell or transfer them.
	Access to and decisions on credit	It is inadequate if an individual has no access to credit OR used a source of credit but did not participate in any decisions about it.
Income	Control over income from fishing related activities	Inadequate if the individual participates in an activity BUT needs more input in decisions about the income generated from fish-related activities.
	Control over household expenses	Inadequate if an individual does not have input in the decision on spending on major and minor household expenditure.
Leadership	Group Membership	Inadequate if they are not part of at least one group
	Public Speaking	Inadequate if they are not comfortable speaking in public
Institutions	Gender norms	Inadequate if the individual scores 8 on the gender attitude scale.

	Access to training and information	Inadequate if they have never received any training or have no information on fish-related activities
Time	Leisure Satisfaction	Inadequate if not satisfied with leisure implying more hours of work.

Source: Author's construct based on literature. Notes: (1) All dimensions are equally weighted (1/6). (2) The Relative Autonomy Index (RAI), based on self-determination theory, is a measure of internal and external motivations that determine a person's decisions (Chirkov, Ryan, & Deci, 2011; Ryan and Deci, 2002). (3) The Gender Attitude Scale was constructed from the (Nanda, 2011) measurement of gender norms.

The study used six dimensions of empowerment and assigned equal weights for each dimension and indicator (see Fig.8). The reasons for constructing this index by drawing from the literature on Alkire-Foster methodology include the fact that the A-F approach presents a significant framework for policymaking and monitoring evaluation (Alkire et al., 2013). It also allows for the metric developed to be decomposed into sub-groups that helps users track the progress of beneficiaries by uncovering challenges that prevent the attainment of empowerment (Alkire et al., 2013; Narayanan et al., 2019). This is important because empowerment is a process that can change at different times and occur in different dimensions of the empowerment framings (Kabeer, 1999) as cited in (Narayanan et al., 2019).

To distinguish between disempowered and empowered, a cut-off of 33%, which falls within the accepted range Field (Alkire & Foster, 2011), was used to assess deprivation at the household level. The multidimensional Women Empowerment in Fisheries Index (WEFI) was estimated by finding the weighted average of two sub-indices: the Six Dimensions of Empowerment (6DE) and the Gender Parity Index (GPI), with weights of 80% and 20 %, respectively.

The assigned weights align with Alkire et al. (2013), emphasizing the 6DE while acknowledging disparities that may be present in the households. The 6DE assesses women's empowerment across six dimensions: Production, Resources, Income, Leadership, Institutions, and Time. The GPI compares the empowerment score between adult women and men living in the same household. It must be noted that the WEFI was not limited to spouses. It also included mothers living with their adult males (18 years and above). To measure empowerment, the study focused on the areas of disempowerment across the dimensions that should be quelled.

Identifying the Disempowered

The six dimensions of empowerment (6DE) can be constructed in two ways. The first path concentrates on the proportion of the empowered and the adequacy of achievement of the disempowered. The second method analyses the number of disempowered individuals and the proportion of inadequate or deprived dimensions. This study focuses on the second method because to assess empowerment, it is essential to pay attention to the aspects of disempowerment that must be overcome.

The Alkire-Foster method employed in this study uses a dual cut-off method to estimate the number of disempowered. The dual cut-off means that deprivation and disempowerment cut-offs must be applied before a person is considered disempowered. A cut-off is first set for the weighted sum of all inadequacies in the indicators. Another cut-off is to know the proportion of multidimensionally disempowered individuals compared to the censored inadequacy cut-off. This is consistent with the multidimensional poverty

measure (M_0) estimated in the Alkire-Foster method on poverty (Alkire & Foster, 2011).

In order to identify the disempowered and also know the proportion of dimensions and indicators they are deprived of, the disempowerment index (M_0) is calculated. All the indicators used to measure the six dimensions of empowerment are first coded such that they take a value of 1 if a woman is deprived in any of the indicators and a zero (0) if the woman has significant achievement in those indicators. An inadequacy score of each woman is computed by summing the average of all the deprivations the woman experiences. The score computed lies between 0 and 1 when the woman reaches a maximum of 1. Then it means she is deprived in all 12 indicators considered in this study. When the score is 0, the woman has achieved adequacy in all the indicators. The inadequacy score is computed as follows:

$$c_i = w_1 I_{1i} + w_2 I_{2i} + \dots + w_d I_{di} \quad (5)$$

Where c_i equals the inadequacy score for each woman in the sample, $I_{di}=1$ if the woman has an inadequate achievement in indicator d , and $I_{di}=0$ otherwise, w_d is the weight attached to indicator i with $\sum_{d=1}^D w_d = 1$.

After estimating the inadequacy score and summing all weighted inadequacies in the indicators, a second threshold (disempowerment cut-off) was introduced to identify the number of multidimensionally disempowered women. The threshold, also known as the disempowerment cut-off, is the proportion of the total average deprivations a woman has to experience to be classified as disempowered.

The next important step was to censor the inadequacies of the empowered so that the focus measurement could be on the disempowered. In

this study, the disempowerment cut-off was expressed as k and set at 33percent (adequacy in four out of six dimensions to be classified as empowered). For those whose inadequacy score was less than or equal to the disempowerment cut-off, their score was replaced with zero (0) and added to the empowered, and the rest of the inadequacies were not added to the censored headcount. The censored inadequacy score took the notation $c_i(k)$, different from the original inadequacy score c_i computed. The censored inadequacy score will now be used to estimate the headcount ratio and the intensity of deprivation. A woman is classified as disempowered if her censored inadequacy score exceeds the disempowerment cut-off. In the WEFI, k was set at 0.33 showing adequacy in at least 4 of the six dimensions.

Estimating the Six Dimensions of Empowerment

The disempowerment score has two components; the incidence (Headcount- H), which captures the percentage of women who are deprived in the 12 indicators, and the Intensity (A), which measures the average share of deprivation the individuals' experience.

Headcount ratio (H): the proportion of the sampled population who are disempowered in the indicators. That is:

$$H = \frac{d}{p} \quad (6)$$

where d represents the disempowered and p is the total sampled household.

The intensity of deprivation (A): This denotes the average proportion of indicators that the individuals were deprived in, calculated as:

$$A = \frac{\sum_{i=1}^d c_i(k)}{d} \quad (7)$$

Where $c_i(k)$ is the censored inadequacy score of individuals i , k is the disempowerment cut-off (0.33), and d is the number of disempowered individuals.

By multiplying the Headcount ratio (H) by the intensity of deprivation (A), the disempowerment score (M_0) is generated. It takes the following form.

$$M_0 = H * A \quad (8)$$

Where M_0 is the disempowerment score between 0 and 1. Therefore, 6DE is obtained as:

$$6DE = 1 - M_0 = (1 - H * A) \quad (9)$$

Therefore, a woman or man is categorized as disempowered in the six dimensions of empowerment (6DE) when he or she has not achieved adequacy in 67% of the weighted indicators. These individual-level scores are then aggregated to construct the Women Empowerment in Fisheries Index (WEFI), which can be used to monitor the progress of adult males and females in coastal communities over time or during any empowerment interventions by government or donor agencies.

Decomposition of M_0 by dimensions and indicators

The disempowerment metric can be used as a monitoring and diagnostic tool to uncover potential barriers that may hinder the attainment of empowerment. This is possible because the disempowerment Score M_0 can be disintegrated to know the contribution of each dimension and respective indicators to disempowerment. This is specifically relevant in policy analysis since it reveals the indicators individuals are deprived of. This makes it easy to target areas that need intervention to drive the empowerment of individuals while tracking progress over time.

The censored headcount is the number of individuals deprived and disempowered in a particular indicator. The censored head count for each indicator is estimated to allow for decomposition into subgroups. After calculating the censored headcount ratio, M_0 can be rewritten as the summation of the censored headcount ratio of all 12 indicators:

$$M_{0_{\text{population}}} = w_1 CH_1 + w_2 CH_2 + \dots + w_{12} CH_{12} \quad (10)$$

Where w_1 is the weight for indicator 1, CH_1 is the censored headcount ratio for indicator one, and so on for the other indicators. Censoring makes it possible not to include those empowered so that there will be attention on the disempowered women and their progress over the period tracked. The contribution of each indicator to the overall disempowerment score adds up to 100 %. Thus, the contribution of indicator d to the disempowerment score is expressed as:

$$M_0 = \frac{w_d CH_d}{M_{0_{\text{population}}}} \quad (11)$$

Gender Parity Index (GPI)

The GPI assesses the inequality within dual-adult households. While the 6DE only focuses on women's deprivation score, the GPI computes the disempowerment score for both men and women about the total sample of the dual-adult household. First is the identification of the households that have gender inequality. The males' deprivation scores are computed similarly to that of the females. Households lack equality if the woman is disempowered and her censored deprivation score is more significant than her male counterpart. The GPI has two major components. The first component measures the percentage of women who lack gender parity relative to men in their households. It is expressed as follows:

$$H_{GPI} = \frac{m}{u} \quad (12)$$

where m is the number of households with gender disparities, and u is the total dual-adult households in the sampled household population.

The second component measures the average empowerment gap, which captures the extent of inequality between women and men in their households. Given as:

$$I_{GPI} = \frac{1}{m} \sum_{j=1}^m \frac{c'_j(K)^M - c'_j(K)^W}{1 - c'_j(K)^M} \quad (13)$$

Where $c'_j(K)^W$ and $c'_j(K)^M$ are the censored inadequacy scores of the primary women and man respectively living in the same household. j and m are the numbers of households that are gender parity inadequate. Therefore, the GPI is obtained as follows:

$$GPI = 1 - (H_{GPI} \times I_{GPI}) \quad (14)$$

Food Security

The study utilized the Household Food Insecurity Access Scale (HFIAS) indicators and estimation guidelines by Coates et al. (2007) to measure food security. The HFIAS is a scale based on individuals' experiences and behaviors related to food insecurity. It comprises nine occurrence items categorized into three aspects: anxiety and uncertainty about food availability, insufficient food quality, and insufficient food intake and its physical implications. Each question has a recall duration of four weeks, and a frequency-of-occurrence question is asked if the respondent answered "yes" to an occurrence question. The study computed two HFIAS indicators, the Household Food Insecurity Access-related domains and Household Food Insecurity Access Prevalence (HFIAP), using the Coates et al. (2007) guidelines. Household Food Insecurity Access-related domains were converted into binary variables denoting food security or

insecurity. At the same time, Household Food Insecurity Access Prevalence categorizes households into four levels of food insecurity (access): food safe, mildly food insecure, moderately food insecure, and severely food insecure. The study created the HFIA category variable for each household, assigning a code for the food insecurity (access) category in which it falls, and coded the frequency of occurrence as 0 for cases where the answer to the corresponding occurrence question was "no." The four food security categories were created sequentially to ensure that households were classified according to their most severe response.

Energy Poverty

This study's measurement of energy poverty was based on a multidimensional framework following the approach of (Alkire & Foster, 2011; Nussbaumer et al., 2012; Lin & Okyere, 2021). This approach combines the accessibility and end-usage components of energy poverty and is suitable for reflecting modern energy services' adoption rates in developing countries (Nussbaumer et al., 2012; Lin & Okyere, 2021). The study employs five domains: cooking fuel, electricity access, and services provided by end-use appliances for entertainment and communication (Nussbaumer et al., 2012) to develop the energy poverty index. To estimate the deprivation score of the household, weights were assigned to these dimensions. A household is deemed deprived if it routinely uses unclean fuels such as charcoal, firewood, and residue for cooking and heating and does not have access to electricity or electrical gadgets.

Due to the cooking and lighting dimensions' relative importance, higher weights (0.333) were assigned to these dimensions (Lin & Okyere, 2021). It

concerns cooking fuel being a fundamental need in all developing country households. Also, using biomass fuel negatively impacts health and time consumption (Adusah-Poku & Takeuchi, 2019; Lin & Okyere, 2021). The Multidimensional Energy Poverty Index (MEPI) was computed using the weighted sum of these deprivations. The score ranges between 0 and 1, with a score of 1 indicating that the household is deprived in all dimensions of MEPI. For a household to be considered multidimensionally energy poor, its aggregate deprivation score should either be the same as the deprivation cut-off or more than it.

Water Poverty

This study also measured water poverty by adopting an Alkire and Foster (2011) multidimensional framework. This variable was developed using three interconnected dimensions: water availability, affordability, and processing. The study assigns the exact weights of 0.333 to all three dimensions. A household is identified as deprived if: 1) they need a suitable source of drinking water; 2) they need to process water before usage; 3) they can not afford water. The average summation of the deprivations is computed to find each household's total deprivation score (water poverty). The score lies between 0 and 1. A household's maximum deprivation score of 1 indicates they are deprived in all dimensions.

Environmental Poverty

This study utilized a multidimensional environmental poverty index originally developed by Nawaz and Iqbal (2021) and cited in Essel-Gaisey and Chiang (2022) to quantify environmental poverty. The environmental poverty index (EPI) employed in this study considers four dimensions of deprivation,

each mapped across eight indicators (refer to Table 5). The weights assigned to the indicators are consistent with those in previous literature (Alkire & Foster, 201; Nawaz & Iqbal, 2016), as cited by Nawaz and Iqbal (2021).

Table 5: Dimensions and indicators of the Environmental Poverty Index

Dimension	Indicator	Deprived if	Weight
Dwellings	Type of walls	The wall of the house is made of wood, mud, or similar material	0.0833
	Type of roofing	The roofing is made of wood or similar material.	0.0833
	Type of floor	The floor is dirty, sandy, or made of dung.	0.0833
Water	Access to water	The household members do not have access to improved drinking water or have no water availability.	0.25
Sanitation	Access to toilet facility	The members of the household do not have access to improved toilet facility or have no toilet.	0.125
	Access to refuse dump	The members of the household do not have access to improved refuse disposal site.	0.125
Energy	Type of cooking fuel	Members in the household use biomass fuel such as dung, wood, or charcoal to cook	0.125
	Access to electricity	A household has no access to electricity	0.125

Source: Nawaz and Iqbal (2021) as cited in Essel-Gaisey and Chiang (2022).

Prosocial Behaviour

Prosocial behavior refers to actions that benefit others, such as cooperating, helping, sharing, comforting, volunteering, and donating (Greener & Grick, 1999; Eisenberg & Fabes, 1998; Lin & Okyere, 2021). This study

operationalized prosocial behavior as individuals donating to foes, mosques, and community-based groups to help community members. Monetary contributions were used to measure prosocial behavior by asking respondents if they donated or contributed to any community member and how much they contributed. Contributions to funerals, church activities, community-based groups, parties, and fundraising for community services were included. Respondents both primary and secondary who participated in any of these activities were coded as 1, and those who did not were coded as 0.

Econometric Framework

This section presents the estimation technique employed to analyze each objective. For each empirical analysis, the econometric model is specified.

Women empowerment and food security

The empirical analysis of the second objective focused on testing three hypotheses:

- i. Women's empowerment will affect food security.
- ii. Prosocial behavior will significantly mediate the correlation between women's empowerment and food security.
- iii. The combined effect of women empowerment, water poverty, and energy poverty will impact food security.

Model Specification

In testing whether there is indeed a significant effect women's empowerment has on food security, the model below was estimated:

$$FS_i = \alpha_0 + \beta_1 \text{women empowerment}_i + \sum_k \gamma_k X_{k,i} + \rho_c + \varepsilon_i \quad (15)$$

Where, FS_i represents food security for household i , which is equal to 1 when the household is food-insecure and 0 otherwise;

Women Empowerment_i denotes the multidimensional women empowerment index for household *i*; *X* represents household and individual characteristics of the primary respondent; ρ_c represents the location characteristics; the error in the model is ε_i while α_0 is the constant term and β_1, γ_k signify the coefficients of the regressors. The ordinary least square (OLS) technique was first applied in estimating equation (15). However, the study employed the probit regression model since food security (FS) is a binary variable. Due to the potential biases that may arise from linear techniques such as Ordinary Least Squares (OLS), the general conclusions of the results may be affected. Cameron and Trivedi (2009) assert that these linear techniques may produce estimates outside the natural range of values for the dependent variable, leading to biased estimates.

Probit Regression Model

This model is a binary choice-based regression model such that the dependent variable in the regression analysis is binary, taking zero (0) or one (1) value only (Cameron & Trivedi, 2009). With the Probit model, the concentration is on what determines the probability *p* of one outcome occurring as opposed to another choice with an occurrence probability of $1 - p$ (Cameron & Trivedi, 2009). The main aim of regression analysis is to evaluate the differences in the probability *p* among distinct individuals when it is set as a function of the explanatory variables.

The Probit calculates the maximum likelihood estimates of regression parameters and models the probability of the dependent variable using the cumulative standard normal distribution function (Cameron & Trivedi, 2009). All the models used to estimate binary outcomes follow a similar framework.

That is, the dependent variable, y_i which is binary in nature, has two values, making the cumulative distribution a Bernoulli with a probability of p_i .

The Basic Model

Assume the dependent variable y_i , takes one of these two values:

$$y = \begin{cases} 1 & \text{with probability } p \\ 0 & \text{with probability } 1 - p \end{cases} \quad (16)$$

The Probit model focuses on model p as a function of the explanatory variables, so the outcome values are set to 1 and 0 (Cameron & Trivedi, 2009). The probability mass function of the outcome variable y , is $P^y(1 - P)^{1-y}$, with $E(y) = P$ and $\text{Var}(y) = P(1 - P)$.

Thus, a regression model is formed by setting p to depend on an index function $X^1\beta$, where X is a $K \times 1$ regressor vector and β is a vector of the unknown parameters. For any conventional binary model, conditional probability takes the form in equation (17).

$$P_i = P_r(y_i = 1|x) = F(X_i^1\beta) \quad (17)$$

Where $F(\cdot)$ is a specified parametric function of $X^1\beta$, usually, a cumulative distribution function (c.d.f.) on $(-\infty, \infty)$ because this ensures that the bounds $(0 \leq p \leq 1)$ are satisfied. While the models differ in the choice of function, $F(\cdot)$, the Probit functional form for $F(X^1\beta)$ is given as:

$$P_i = P_r(y_i = 1|x) = \Phi(X^1\beta) = \int_{-\infty}^{X^1\beta} \phi(z)dz \quad (18)$$

With a marginal effect of $\Phi(X^1\beta)\beta_j$, the Probit model specifies that $F(\cdot) = \Phi(\cdot)$, the standard normal cumulative distribution function with $\Phi(\cdot)$ denoting the standard average density.

Again, the Probit model is derived by formulating a latent variable with a standard normal distribution function. The latent variable y^* is specified as:

$$y^* = X^1\beta + u \quad (19)$$

Although y^* is unobservable, y can be observed in the form:

$$y = \begin{cases} 1 & \text{if } y^* > 0 \\ 0 & \text{if } y^* \leq 0 \end{cases} \quad (20)$$

The zero (0) threshold will not impact or influence the outcome variable if X has an intercept.

Considering the latent-variable models in equations (16) and (17), the function takes the form of:

$$P_r(y = 1) = P_r(X^1\beta + u > 0) \quad (21)$$

$$= P_r(-u < X^1\beta) \quad (22)$$

$$= F(X^1\beta) \quad (23)$$

Where $F(\cdot)$ is the cumulative distribution function of $-u$. If u is standard normally distributed, the function becomes a Probit model.

Endogeneity and Instrumental Variable

In most social science research, specifically economics, endogeneity is one of the many problems in regression model estimations. It occurs when an explanatory variable shows significant correlations with the error term in the regression model. It may happen due to three conditions: reverse causality, omission bias, and measurement error (Lin & Okyere, 2021). If these conditions are ignored, they will cause bias and inconsistency in the ordinary least square (OLS) estimates. According to (Lynch & Brown, 2011), resolving endogeneity is sometimes difficult, even using simple cross-sectional data sets.

Various instrumental variable methods are employed in linear regression estimations. The standard method involves finding variables or instruments that correlate with the endogenous predictor variable (x) while remaining uncorrelated with the disturbance or error term, regressing the initial explanatory

variable x on the found instruments to form potential values that replace the endogenous x variable, and estimating the model by regressing the outcome on the exogenous x variables and the predicted values formed. Using instrumental variables (IV) has become the preferred method for dealing with endogeneity in economic research, as linear techniques such as Ordinary Least Squares (OLS) are susceptible to biases. However, finding appropriate instruments that satisfy the above conditionality in much applied research can be challenging. Therefore, this study investigated whether the estimates were free from endogeneity since factors affecting women's empowerment in a household might be the same factors affecting food availability, accessibility, affordability, and the demand for environmental services. To address this, the study employed the instrumental variable technique using the procedure developed by Lewbel (2012).

The approach proposed by Lewbel (2012) differs from other instrumental variables (IV) regression methods. It involves identifying structural covariates in regression models affected by endogeneity and measurement error and then internally generating instruments for the endogenous variable. This two-stage least squares estimation technique developed by Lewbel has been used in several studies, including (Churchill & Smyth, 2020; Koomson & Danquah, 2021; Lin & Okyere, 2021).

As per Lewbel's (2012) approach, the instruments are created based on heteroscedasticity observed in the error terms. This method can be utilized when valid IVs are unavailable or with precise external IVs. The procedure is outlined below:

$$Y_1 = X' \beta + Y_2 \delta + \mu_1, Y_2 = X' \alpha + \mu_2 \quad (24)$$

Where Y_1 represents the outcome variable (food security); Y_2 is women empowerment denoting the endogenous variable; X' represents the vector of independent variables while μ_1 and μ_2 are the error terms in the model. This

approach relies on strategies to identify the heteroscedasticity μ_2 in solving an endogeneity problem without external instruments.

Lewbel (2012) suggests that the explanatory variables and the heteroscedastic error terms should not correlate. However, it is acknowledged that based on higher moments, this method may need to produce reliable estimates from the 2SLS. Nevertheless, Lewbel argued that estimates obtained using his method are similar to other IV methods (Mishra & Smyth, 2015).

Propensity Score Match

To enhance the robustness of observational datasets' results, this study utilized Propensity Score Matching (PSM) (Lin & Okyere, 2021). The average treatment effect of being empowered on food security and environmental poverty was then estimated using this method, which involves the following equation:

$$\tau \equiv E(\theta_1 - \theta_0 | \mathcal{G} = 1) \quad (25)$$

$$\tau = E\left(E(\theta_1 - \theta_0 | \mathcal{G} = 1, p(\varpi))\right) \quad (26)$$

$$\tau = E\left(E(\theta_1 | \mathcal{G} = 1, p(\varpi)) - E(\theta_0 | \mathcal{G} = 0, p(\varpi)) | \mathcal{G} = 1\right) \quad (27)$$

Where τ is the average effect of the treatment, is the outcome variable (food security or environmental poverty) while $\mathcal{G}$ is the binary variable equal to 1 if the woman is disempowered and 0 otherwise. The pre-treatment vector variables explained by the control variables are denoted as. The propensity score is the

probability of being highly likely to be food insecure, given the covariates. To ensure robustness, the study applied multiple matching techniques, which are encouraged in the literature.

Potential Mechanism of Influence

Neglecting the indirect effect of women's empowerment on food security can lead to biased estimates (MacKinnon et al., 2012) and affect the overall conclusions. To account for this, the study utilized Baron and Kenny's (1986) stepwise regression method to test for the indirect or mediation effect. Using Equation (15), the study constructed a mediating effect model to investigate how women's empowerment influences food security. This approach has been widely used in literature (Churchill et al., 2020; Lin & Okyere, 2021; Zhang et al., 2021).

$$M_i = \sigma_0 + \sigma_1 \text{women empowerment}_i + \sum_k \gamma_k X_{k,i} + \rho_c + \varepsilon_i \quad (28)$$

$$FS_i = \delta_0 + \delta_1 \text{women empowerment}_i + \delta_2 M_i + \sum_k \gamma_k X_{k,i} + \rho_c + \varepsilon_i \quad (29)$$

Equation (27) is used to test the influence of empowerment on the mediating variable, while Equation (28) is used to test whether the mediating variable plays a significant role in the interplay between women's empowerment and food

security. M_i represents the mediation variable. The mediating variable in this paper is prosocial behavior. If after testing it shows β_1 and σ_1 are significant, then it implies that women empowerment has a direct impact on food security and the mediating variable, respectively. The coefficients of δ_1 and δ_2 were observed. If δ_1 is not significant although δ_2 is it, then it means that M_i mediates the relationship between the outcome and explanatory variables. However, δ_1 and δ_2 partially mediates the relationship if either of them is

statistically significant and $\delta_1 < \beta_1$, The model relies on the Monte Carlo, Sobel, and Delta to know if the mediators used are valid and that they indirectly or directly mediate the relationship.

Women Empowerment and Environmental Poverty

The present section employs fractional regression to assess the impact of women's empowerment on environmental poverty. The study also uses the Lewbel 2SLS to address potential endogeneity and enhance the study's robustness by using propensity score matching.

Hypotheses

1. Women's empowerment will have a significant effect on environmental poverty.

The equation below is estimated to test the following.

$$EPI_i = \alpha_0 + \beta_1 \text{women empowerment}_i + \sum_k \gamma_k X_{k,i} + \rho_c + \varepsilon_i \quad (30)$$

Where EPI_i represents environmental poverty for the i th the household, $\text{Women Empowerment}_i$ denotes the multidimensional women empowerment index for household i ; X captures the characteristics of the primary respondent; ρ_c represents the location level fixed effect; ε_i and α_0 are the residual and constant terms respectively, respectively; and β_1, γ_k signify the coefficients of the regressors.

Fractional Regression

The study uses the fractional regression model to examine the impact of women's empowerment on environmental poverty. It was adopted because the outcome variable, environmental poverty, is bounded from zero to one. Wulff (2019) stated that fractional regression models are used for modeling fractional or proportionally bounded dependent variables. According to Gallani et al.

(2015), unlike probit models, which require the assumption of normality, fractional regression models can accommodate a wide range of distributions, including skewed or bounded between zero and one. One of the significant advantages of fractional regression models is their ability to estimate the marginal effects of the independent variables on the dependent variable. Marginal effects are essential for understanding the underlying causal mechanisms driving the observed relationships between variables (Ramalho et al., 2011).

Fractional regression models can provide interpretable marginal effects, critical for decision-making in many scientific fields, such as economics, public health, and environmental studies (Wulff, 2019). Also, the fractional regression models can model heteroscedasticity. In contrast, probit models assume that the variance of the dependent variable is constant across all levels of the independent variables. This assumption can be problematic if the variance of the dependent variable changes across different values of the independent variables. Fractional regression models can account for this and allow for the modeling of heteroscedasticity, which can improve the estimates' accuracy and the inference's validity. Finally, fractional regression models can accommodate different functional forms of the independent variables. This feature enables researchers to model nonlinear relationships between the dependent and independent variables, such as quadratic or logarithmic relationships. This flexibility can lead to a better fit of the model and provide more accurate estimates of the effects of the independent variables.

The fractional regression technique can be estimated using the methodological approach suggested by Papke and Wooldridge (1996). Assume

an outcome variable, falls within the range $(0 \leq y \leq 1)$ and it is predicted by a group of independent variables x :

$$E(y|x) = G(x_i\beta) \quad \forall i \quad (31)$$

$G(.)$ satisfies the condition $0 < G(z) < 1 \quad \forall z \in \mathbb{R}$ that allows the explanatory variables to fall between zero and one. Generally, $G(.)$ can also be seen as the logistic function or the cumulative distribution model, $G(x) \equiv \Lambda(z) \equiv \frac{\exp(z)}{1 + \exp(z)}$ and $G(x) \equiv \Phi(z)$. $\Phi(.)$ denotes the standard function which has a normal cumulative distribution. G can take the form of any non-linear function. Given the above, (Eqn. 31) can be re estimated to be:

$$l_i(b) \equiv y_i \log [G(x_i b)] + (1 - y_i) \log [1 - G(x_i b)] \quad (32)$$

The study uses primary household data in five fishing communities to investigate the relationship between women's empowerment and environmental poverty. Thus, this study assumes that environmental poverty may satisfy a probit model, making it possible to use the command `fracreg probit` in STATA (Dorta, 2016). The study also uses propensity score matching to test the estimations' robustness further.

Chapter Summary

This chapter highlighted the methodological procedures adopted in the study. A description of the research philosophy, research design, and justification for choosing positivism as the worldview of the study was provided. The chapter also presented a detailed explanation of all measurement and estimation techniques. The Probit model and the Fractional response model was chosen as the most suitable estimation technique to assess the research objectives. Endogeneity and how to resolve it was also presented. The

subsequent chapter reviews the findings of the first objective and develops a multidimensional index to measure women's empowerment.



CHAPTER FOUR

WOMEN EMPOWERMENT IN FISHERIES INDEX

Introduction

The chapter focuses on the first objective, which sought to develop a multidimensional index to measure women's empowerment and that of women and men living in the same fishing households. The study extended the Women Empowerment in Agriculture Index (WEAI) to fit the fisheries context to achieve this.

Descriptive Statistics

The summary statistics of respondents are presented. Most primary respondents who identify as primarily responsible for household socio-economic decisions are female (91%), with an average age of approximately 43 years. In this study, 50% of the primary respondents are married. The respondents, on average, have spent about three years in formal education. They have been involved in fishing and value-added activities for nearly 22 years. The average income of the households is approximately GH¢591 per month, with an average household size of about 5. Although most people in fishing communities rely on fishing and its value chain as their primary source of income, this study reveals that an estimated 16% of women and 11% of men in fishing households are engaged in other economic activities besides fishing. This corroborates the findings of Appiah et al. (2021), who found that about 76% of women fishers were not engaged in other alternative livelihood activities. It also supports the results of Asiedu and Nunoo (2013) on the lack of supplementary and alternative livelihoods for most people in resource-dependent societies such as fishing communities.

Table 6: Summary statistics (mean or percentage)

Variable	Description	Mean/Percentage
Sex	Equals 1 if the primary respondent is Female.	0.910 (0.286)
Age	Age of the primary respondent in years	42.634 (11.492)
Household Size	Household Size	4.768 (1.726)
Education	Highest Education level in years.	3.320 (3.368)
Marital Status	Percentage of primary respondents married.	50%
Income	Monthly average income of the Household	590.725 (630.112)
Alternative Business	Participation in alternative business	
Women		15.9%
Men		10.9%
Duration	Number of years spent in fish related activities.	22.339 (14.123)
Time	Hours Dedicated to fishing activities within a day	
Women		7.430 (3.691)
Men		11.839 (8.522)

Note: Standard deviations in parenthesis

Table 6 reports the results of the multidimensional women empowerment in fisheries index for women. The study mainly shows results of the incidence (H), which is the proportion of disempowered women, the intensity of their disempowerment (A) which also denotes the average proportion of indicators that the individuals are deprived of, and the multidimensional disempowerment index (M_0). Approximately 41% of women are disempowered. For all the women disempowered, their average deprivation score in the dimensions is 42.8%. The 6DE scores explain the overall achievement of women in all 12 indicators. It expresses women's performance in all the empowerment indicators in the WEFI. It defines the percentage of multidimensionally disempowered people in the sample and the extent of

intensity of their disempowerment across the six dimensions. At the cut-off of 33%, the multidimensional disempowerment index is 0.177. Before a woman is considered multidimensionally disempowered, it is crucial to establish that she may have faced multiple deprivations in the six dimensions (production, resources, income, leadership, institutions, and time) concurrently.

Table 7: Multidimensional Women Empowerment in Fisheries Index

Indexes	Women
Number of observations	690
Disempowered Headcount (H)	41.4%
Empowered Headcount (1-H)	58.6%
Average Inadequacy Score (A)	42.8%
Average Adequacy Score (1-A)	58.2%
Disempowerment Index ($M_0 = H * A$)	0.177
6DE Score ($1-M_0$)	0.823

Results from Table 7 indicate that the incidence of disempowerment of women is highly associated with lacking autonomy in their fish-related activities (99.4%). Even with 76% of women empowered to make productive decisions, 99% lacked freedom reflecting the influence of societal norms in what motivates their actions. About 96% of women lacked access to training and information. This finding corroborates the works of (Appiah et al., 2021; Oloko et al., 2022), who found that poor access to extension services training and market information contributed much to the vulnerability of women fishers in Ghana and Nigeria.

Also, about 55% of women did not have access to credit decisions from formal or informal sources. It confirms Appiah's et al. (2021) conclusion that women fisherfolks expressed higher vulnerability in accessing funds. The result is attributed to a poor loan reimbursement scheme that made them pay both principals and left them worse off than before (Ameyaw et al., 2020; Appiah et al., 2021). While the study's findings show that 80% of women belong to social groups and can speak publicly regarding issues and interests weekly, affecting their communities and emphasizing their leadership roles, Appiah et al.(2021) found otherwise, citing it to be one of the indicators that contributed much to the deprivation of women fishers in some fishing communities in Ghana. However, this study's result is consistent with Oloko et al. (2022), who found that women belonging to social networks can express their opinions regarding social issues.

On the other hand, approximately 92% of women did have input in decision-making regarding their major and minor household expenditures. This is expected because, in most fishing households, home management is the sole responsibility of the women, and fishermen seldom give housekeeping money (Ameyaw et al., 2020; Torell et al., 2020). They instead ask their wives to rely on the profit they make from their post-harvest activities to take care of the home, giving the women the necessary power and control in the decision-making on general household expenses (Ameyaw et al., 2020). This result emphasizes Torell's et al. (2020) findings that women are the home managers and are expected to step in when things become challenging for the household. Most women believe they should have equal rights and opportunities with men in their households or communities. This is expressed in just 24.5% upholding the beliefs in biased gender norms. This result on gender norms is consistent

with the works of Torell et al. (2020) on analyzing gender roles in Philippine fishing communities. Their impacts on assessing gender perspectives using the gender attitude scale show that most respondents disagreed that it is only the primary responsibility of women to maintain a healthy and peaceful family. The respondents from their study also disagreed with the statement that “men should be the ones to control fisheries earnings.” While the respondents agreed that women should not embark on fishing expeditions, they disagreed that women should not own fishing gear like boats and canoes (Torell et al., 2020).

To know which dimensions of empowerment will require policy attention, Fig. 9 captures each indicator's contribution to women's disempowerment. Although 22% of women are deficient in the time dimension, inadequate leisure satisfaction (20.4%) is the highest contributor to their disempowerment. This study's result is not surprising because they spend on average 7 hours/ per day (table 5) engaged in fish processing and marketing, which does not include time used for household chores that are usually not considered as work (Floro 1995; USAID Oceans, 2018) as cited in Torell et al., (2020). They also rely on inefficient fish processing equipment that takes longer to process fish. Although a study by Anane (2020) asserted there had been an improvement in adopting improved fish processing equipment, field conversations from this study revealed otherwise because these women spend much time processing the catch. The fish processors reported that because of the decline in fish stocks, they sometimes get the fish to the shores very late. Due to the perishable nature of fish and lack of storage facilities, they are obliged to process them immediately irrespective of the time, which makes them lose their sleep and leisure time. This result is consistent with Alkire's et al. (2013) pilot

study on Uganda using the WEAI. Their findings show that time poverty is the highest contributor to Uganda's disempowerment of women in agriculture.

The next highest contributor to the disempowerment of women arises from lacking autonomy in their activities (19.5%), followed by a lack of access to training and information (18.9%). Again, lack of access to and decision over credit contributed (8.3%) to what influences their disempowerment. Thus, the disempowerment of women in fishing communities is constrained by these three dimensions: Time, production, and institutions. Over 90% own assets such as fish processing equipment, mobile phones, baskets and pans, and sometimes canoes. The result reflects the power women in fishing communities have in acquiring assets and the ability to make decisions regarding them. Unlike farming households with a higher incidence of disempowerment, women (51%) in asset ownership in the Northern region, as reported in (Alkire et al., 2013) pilot results for Ghana. This emphasizes the differences between these two communities, hence adapting their methodology to suit typical fishing communities.

Only 9% of women did not have the decision-making ability to purchase new assets, sell the existing ones, and transfer them as gifts to other women or households. In terms of their control over income from fish-related activities, most women are empowered, suggesting that they can decide on what they use the money they earn from their fish business. If they own the business with other women, they have a voice in what the money should be used for. However, 16% of women (see table 5) are engaged in other supplementary livelihoods. This result is consistent with the study by Appiah et al. (2020), who found that an estimated 76% of fish processors needed access to alternative livelihood

opportunities. Of this number, more than 80% have some input in the decision-making regarding using income sourced from alternative livelihoods. Thus, ownership of assets and control of revenue from fish and non-fish-related activities contributed less than 1%, respectively, to the disempowerment of women fishers in the communities where the WEFI was administered.

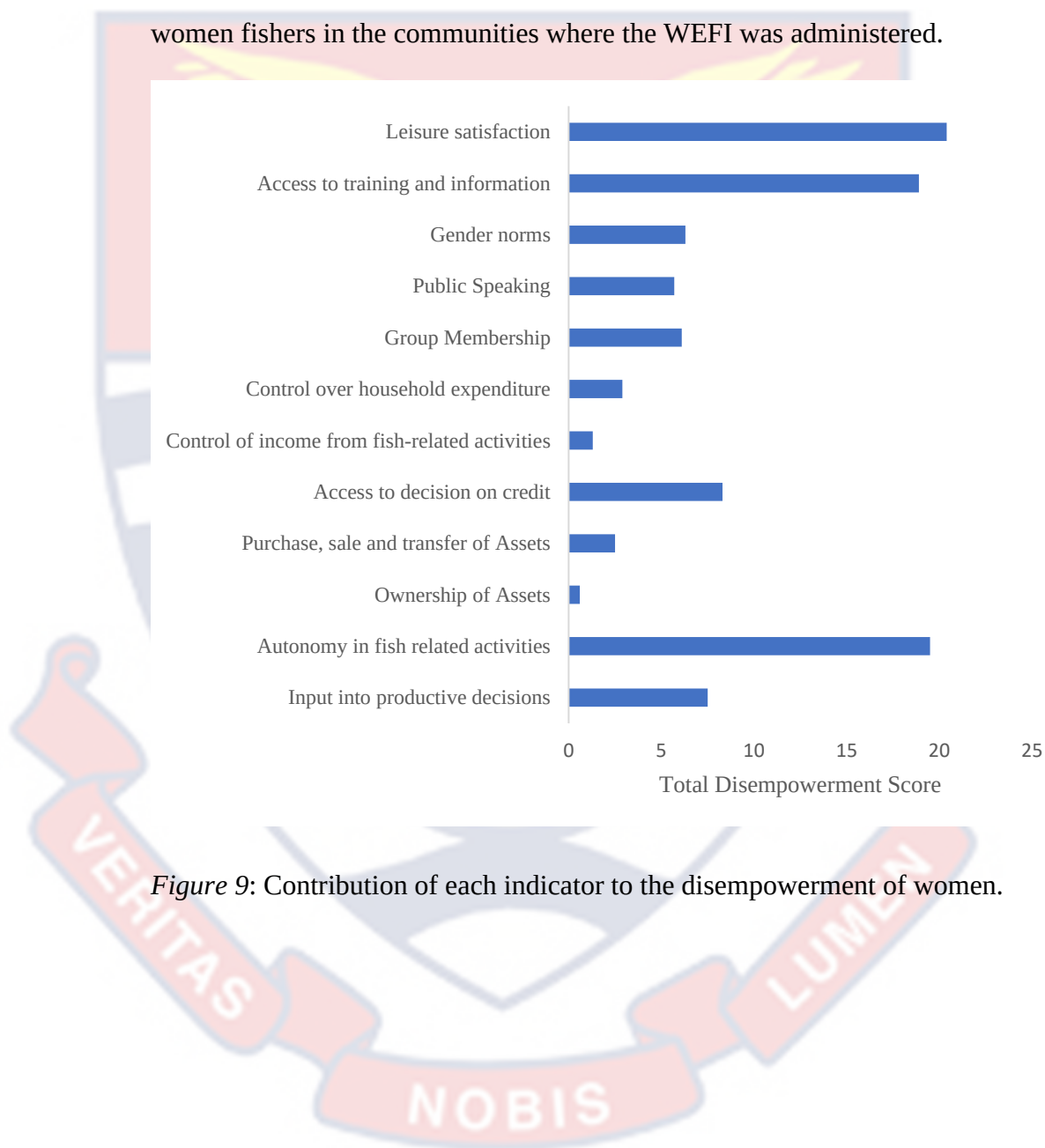


Figure 9: Contribution of each indicator to the disempowerment of women.

Table 8: Censored headcount and contribution of indicators to the disempowerment of women

Dimension/Indicator	Censored Headcount (%)	Contribution to disempowerment (%)
Production		
Input into productive decisions	24.2	7.5
Autonomy in fish related activities	99.4	19.5
Resources		
Ownership of Assets	1.9	0.6
Purchase, sale and transfer of Assets	9.13	2.5
Access to and decision on credit	54.9	8.3
Income		
Control of income from fish-related activities.	2.8	1.3
Control over household expenditure	7.2	2.9
Leadership		
Group Membership	19.4	6.1
Public Speaking	16.2	5.7
Institutions		
Gender norms	24.9	6.3
Access to training and information	95.7	18.9
Time Use		
Leisure satisfaction	22.0	20.4

Note: All indicators' contribution to disempowerment is 100percent. The Censored headcount shows the proportion of multidimensionally disempowered women in each indicator.

In Table 8, the results presented show the disparities in women's empowerment concerning the men in their households. The estimate for the multidimensional Women Empowerment in Fisheries Index (WEFI) for coastal

communities in Ghana is 0.838. This is the weighted mean of the 6DE index for women, 0.823, and the Gender Parity Index, 0.97. The results show that approximately 58.5% of women and 28.4% of men are empowered.

This implies that for the women and men living in the same household, there are more disempowered men relative to women. This study did not limit the analysis to only husbands and wives. It considered all primary adult males and females above 18 years living in the same household. The average magnitude of deprivation is approximately 43% for women and 46% for men. Thus, on average, women have more adequacy/achievement in the dimensions than their male counterparts in the same household. This finding corroborates the findings of the baseline study and application of the WEAI by Alkire et al. (2013) in Cambodia. They found that men fared worse than women in the dimensions of empowerment. Nine percent of dual-adult households experience gender disparities.

For households where women's censored inadequacy score is greater than men's, the empowerment gap is approximately 33.3%. Although inequality between women and men is reported in a few households (9%), the magnitude of the empowerment gap (33.3%) is quite alarming. More women than men are empowered, and disempowered women have fewer inadequacies than disempowered men. Therefore, men experience a higher intensity of disempowerment than women in the same household.

Table 9: 6DE, GPI in dual-adult household

Indexes	Women	Men
Number of observations	383	383
Disempowered Headcount (H)	41.5 %	72.6%
Empowered Headcount (1-H)	58.5%	28.4%
Average Inadequacy Score (A)	43.0%	46.2%
Average Adequacy Score (1-A)	57.0%	53.8%
Disempowered Index ($M_0 = H * A$)	0.178	0.335
6DE Score (1-M_0)	0.822	0.665
% not achieving gender parity (H_{GPI})	9.1%	
% achieving gender parity ($1-H_{GPI}$)	90.9%	
Average Empowerment Gap (I_{GPI})	33.3%	
Gender Parity Index ($GPI = 1 - (H_{GPI} \times I_{GPI})$)	0.970	
WEFI [$\alpha(6DE) + (1 - \alpha)(GPI)$]	0.838	

There was a further disaggregation of the disempowerment index to know what contributes most to the disempowerment of men and women living in the same household. The censored headcount, which is the proportion of both men and women that are multidimensionally disempowered and at the same time deprived in the individual indicators, is shown in Table 9. Findings reveal that, amongst the women that are disempowered, higher inadequacy is seen in autonomy in fish-related activities (99.5%), access to training and information (96.3%), and access to credit decisions (54.8%). The same trend is observed for men. About 99.5% were deprived of autonomy in fish-related activities; 73.5% did not have access to and decision on credit, while 96.3% did not have access

to training and information. 41.5% of men expressed having more workload measured via leisure satisfaction than their women (21.4%) counterparts. Also, about 34.5% of men did not believe in the egalitarianism principle that individuals are equal and should be accorded the same rights and privileges compared to the 28.7% of women in their households.

Approximately 22% of men did not have control over household expenditures than 10% of women. This means about 90% of women were making all major and minor household expenditure decisions. This is not surprising because, in most fishing communities, women are considered home managers by taking care of all household expenditures, especially in tough times (Torell et al., 2020). Again, 32 % of men did not belong to any fish or non-fish-related groups in their communities.

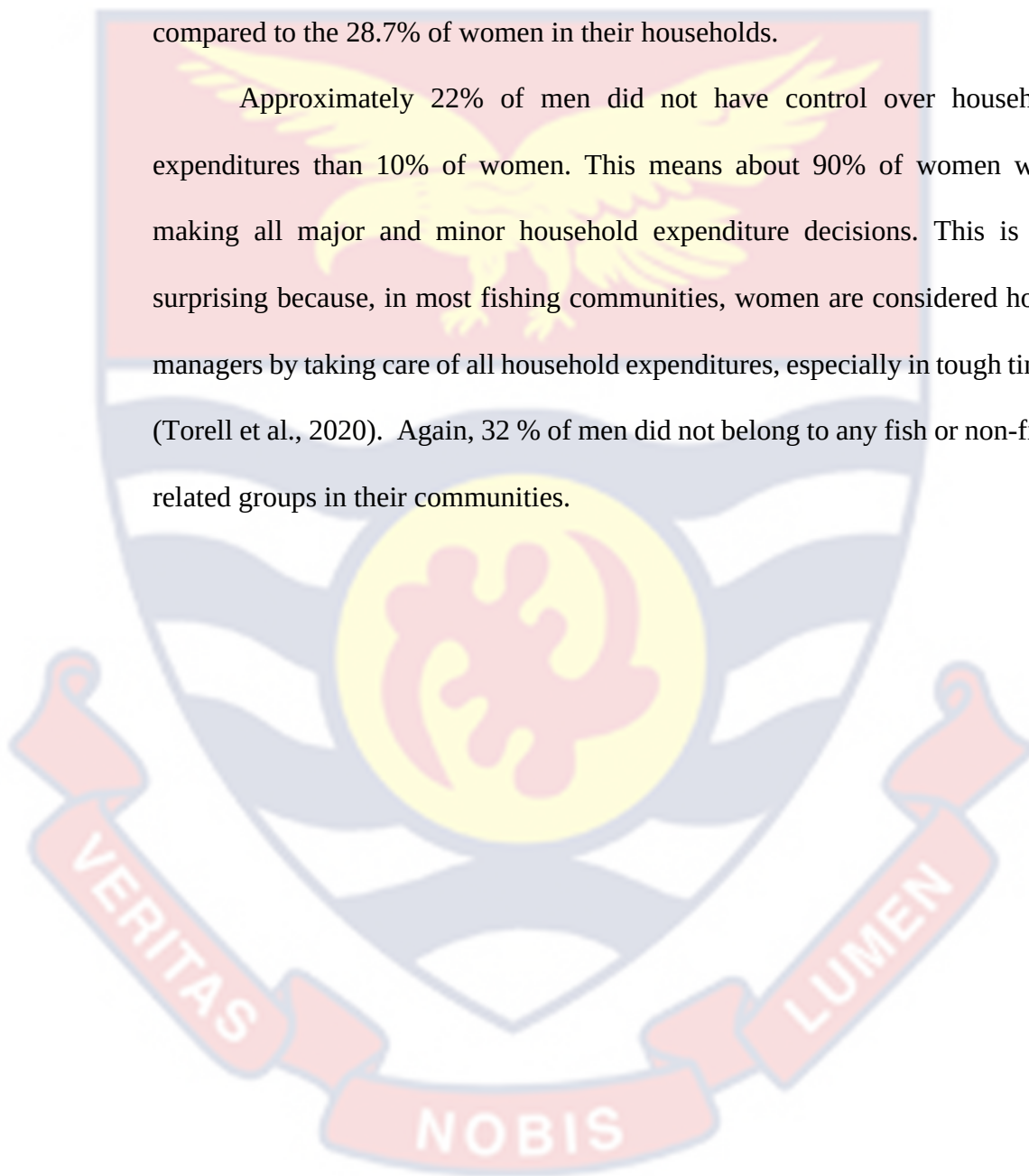


Table 10: Censored headcount and contribution of indicators to disempowerment by gender

Dimension/Indicator	Censored Headcount (%)		Contribution to disempowerment (%)	
	Women	Men	Women	Men
Production				
Input into productive decisions	30.3	33.9	8.9	7.6
Autonomy in fish related activities	99.5	99.5	19.4	17.9
Resources				
Ownership of Assets	1.6	9.4	0.5	1.5
Purchase, sale and transfer of Assets	7.6	12.0	2.2	1.9
Access to and decision on credit	54.8	73.6	8.3	9.3
Income				
Control of income from fish-related activities	1.6	2.9	0.7	0.6
Control over household expenditure	9.7	21.7	4.0	4.9
Leadership				
Group Membership	16.2	32.1	5.6	6.8
Public Speaking	11.7	19.1	4.3	4.4
Institutions				
Gender norms	28.7	34.5	7.7	7.1
Access to training and information	96.3	96.3	18.9	17.7
Time Use				
Leisure satisfaction	21.4	41.5	19.5	20.4

Note: All indicators' contribution to disempowerment is 100%. The Censored headcount shows the proportion of women and men that are multidimensionally disempowered in each indicator.

To comprehend what is essential in assessing disempowerment, Fig. 10 displays the share of each indicator to the overall disempowerment of men and women living in the same household. A similar trend facilitated the disempowerment of both men and women living in the same household. The highest contribution is lack of leisure satisfaction, 19.5% for women versus 20.4% for men. This is because men spend, on average, 12 hours daily on fishing activities compared to women, who dedicate, on average, 7 hours per day. Like the women, the men complained of spending more hours at sea due to declining fish stocks and inefficient fishing gear. This situation eats into their leisure time. In lean seasons, they also migrate to neighboring fishing communities like Mauritania and Congo in search of fish (Overå, 2005). The next highest contributors to the disempowerment of women are autonomy in fish-related activities (19.4%) and lack of access to training and information (18.9%). Although the same pattern was observed for men, in the same indicators: autonomy in fish-related activities (17.3%) and access to training and information (17.0%), the magnitude of contribution is higher for women, except for leisure satisfaction. This shows that disempowerment in fishing households is more associated with time poverty, lack of training and market information, and lacking autonomy which means that the activities of fishers are influenced by society other than themselves. Even with more men expressing the view that women and men should not have equal opportunities, biased gender norms' contribution to the disempowerment of women is higher than men.

Just like the women, about 97% of men did have control over the income they make from fishing activities. Although they have control over the income

they earn from their primary activities, just 11% (see table 5) of them have businesses they manage outside the fishing activities. Interestingly, among these few, 85% can decide on earnings from their supplementary livelihoods without coercion.

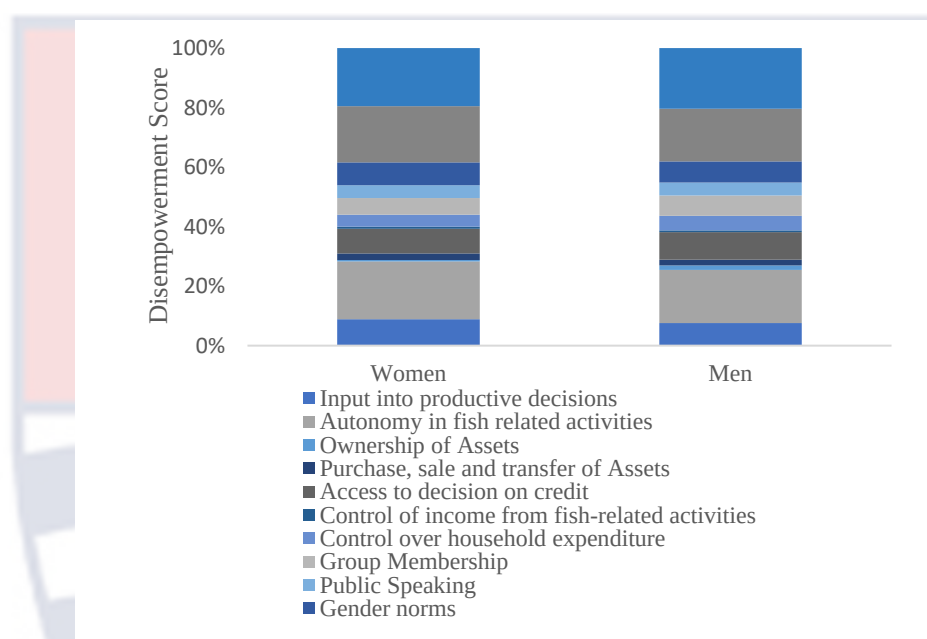


Figure 10: Contribution of each indicator to disempowerment.

Sensitivity analysis has been applied in many studies to check the viability and consistency of results (Nussbaumer et al., 2012; Lin and Okyere, 2021). In this study, sensitivity analysis (see table 10) was also conducted to demonstrate that the results for the incidence of deprivation, the intensity, and the disempowerment score for the women relative to the men in their households followed the same pattern across different disempowerment cut-offs. The different disempowerment cut-off (k) used in this study to test the sensitivity aligns with the literature (for example, Alkire et al., 2013; Narayanan et al., 2019). For the three different cut-offs (k) the study used, women are more empowered than the men in their households in this pilot. For instance, at $k=20\%$, 83.3% of women are disempowered, as against 95.8% of men. When k

was set at $k=50\%$ (3 or more dimensions), the incidence of disempowerment reduced significantly to 7% for women and 20.6% for men. It was also observed that as the disempowerment cut-off increases, while the incidence increases, the intensity of deprivation reduces. The disempowerment cut-off in this study was set at 33% to ensure that the cut-off used would not make all participants disempowered or empowered. At 33%, for an individual to be considered empowered, they must be adequate in at least four of the six dimensions.

Table 11: Sensitivity analysis using different disempowerment cut-offs (k)

Threshold	K=20%	K=33%	K=50%
Women			
Headcount Ratio (H)	0.833	0.415	0.070
Intensity of Disempowerment (A)	0.347	0.430	0.562
Disempowerment score (M_0)	0.289	0.178	0.040
Men			
Headcount Ratio (H)	0.958	0.726	0.206
Intensity of Disempowerment (A)	0.416	0.462	0.588
Disempowerment score (M_0)	0.398	0.335	0.121

The study further disaggregated the disempowerment score (M_0) of women by community (Table 11). This helps policymakers and sector stakeholders to know the disempowerment rate in each of the communities and also diagnose the weakest dimensions of empowerment. Findings show that 50% of women are disempowered in Moree and Biriwa. Although they have the

same percentage of incidence, disempowerment is more intense in the Biriwa (45.2%) than in Moree (42.0%), even with Moree having more than 14.5% in population share. Elmina (26.0%) recorded the lowest incidence or headcount of the disempowered, followed by Axim (31.3%).

Interestingly, Anomabo has the same population share as Elmina. However, the disempowered are almost twice the number in Elmina. In Anomabo, an estimated 43% of women are disempowered.

Table 12: Incidence, Intensity, and Index by community k=33%

Community	Incidence (%)	Intensity (%)	Disempowerment Index	Population Share (%)
	H	A	M ₀	
Axim	31.3	42.8	0.134	21.7
Elmina	26.0	41.5	0.108	14.5
Moree	50.0	42.0	0.210	31.9
Biriwa	50.0	45.2	0.226	17.4
Anomabo	43.0	42.3	0.182	14.5

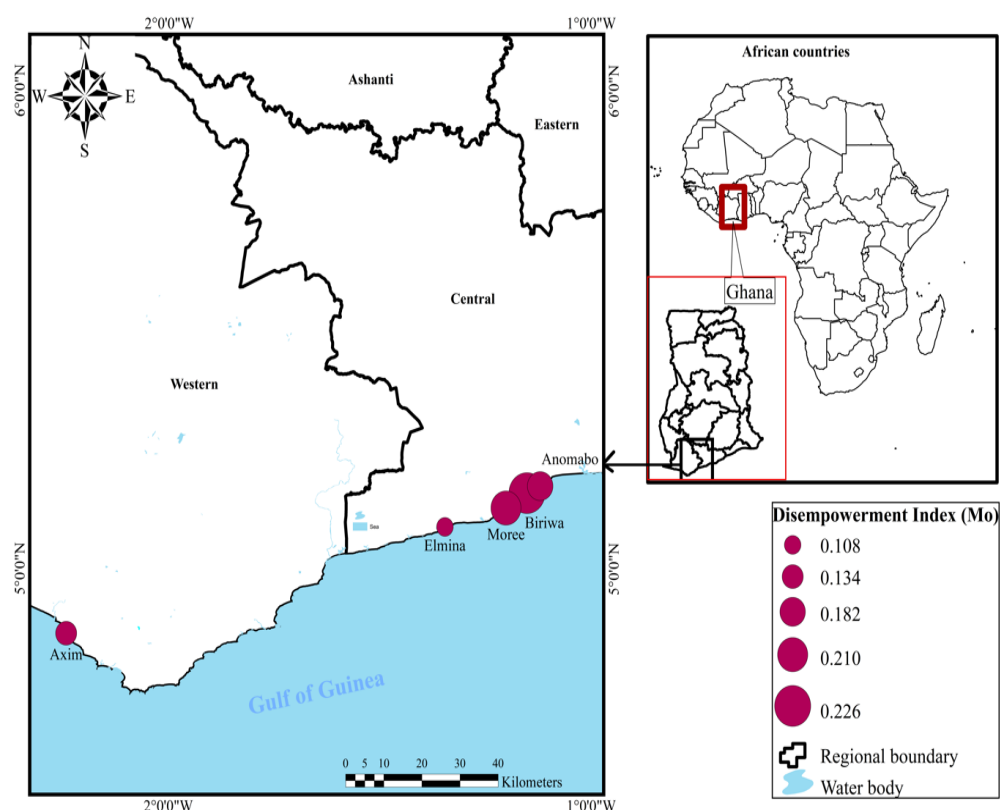


Figure 11: Map showing disempowerment score of women by community.

Table 13: Contribution to disempowerment of women at the community level

Dimension/Indicator	Contribution to disempowerment (%)				
	Axim	Elmina	Moree	Biriwa	Anomabo
Production					
Input into productive decisions	6.6	8.5	9.2	5.2	6.9
Autonomy in fish related activities	19.4	20.2	19.5	18.4	19.7
Resources					
Ownership of Assets	0.6	0.0	0.6	0.6	0.6
Purchase, sale, and transfer of Assets	0.0	1.0	2.5	3.1	1.2
Access to decision on credit	10.2	8.3	8.3	7.6	8.5

Income					
Control of income from fish and non-fish activities	2.1	1.6	1.3	1.5	0.9
Control over household expenditure	5.4	1.6	2.9	2.8	1.4
Leadership					
Group Membership	1.2	1.6	6.1	6.1	6.4
Public Speaking Institutions	0.8	3.9	5.7	8.6	5.9
Gender norms					
Access to training and information	10.3	8.5	6.3	5.5	5.5
Time Use	19.4	20.2	18.9	17.8	19.2
Leisure satisfaction	24.0	24.8	20.4	22.7	23.8

Note: All indicators' contribution to disempowerment is 100%. The Censored headcount shows the proportion of multidimensionally disempowered women in each indicator.

It was observed from Table 13 that, under the dimension production, comparing the five communities, Moree had the highest score when it comes to input into productive decisions, while Elmina recorded the highest for autonomy in fish-related activities. All communities showed adequate achievement in asset ownership and the ability to decide to purchase, sell or transfer assets. Time poverty, institutional lapses, and productive decisions remain the most contributing factors to women's disempowerment in coastal communities. The results show that the women in Axim are more vocal than those in the other four communities. Public speaking contributed less than 1% to the disempowerment of women in Axim. It was highest for the women in Biriwa (8.6%).

Similarly, the women in Axim have strong social networks by joining associations in fishing and non-fishing community organizations. Although the same can be said for the other four communities, compared to Axim, they had the highest contribution to disempowerment. From Fig. 12, findings suggest that asset ownership did not contribute to the disempowerment of women in Elmina, although it is a negligible percentage for the other communities. Also, it was observed that public speaking contributed less than 1% to the disempowerment of women in Axim. In contrast, the ability to acquire assets or sell and transfer to others did not influence their deprivation.

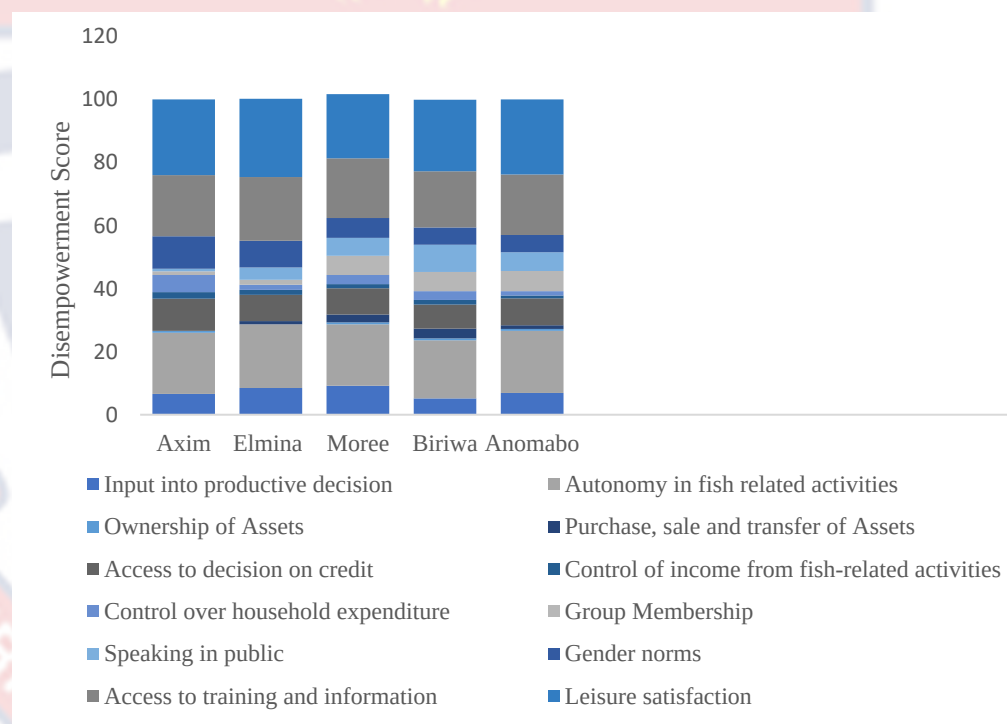


Figure 12: Contribution of each indicator to the disempowerment of women by the community.

Conclusion

It is evident that the role of women is crucial to sustainable fisheries management, and empowering women is critical to achieving food security and improving sustenance. Studies on the contribution of women in fisheries did not

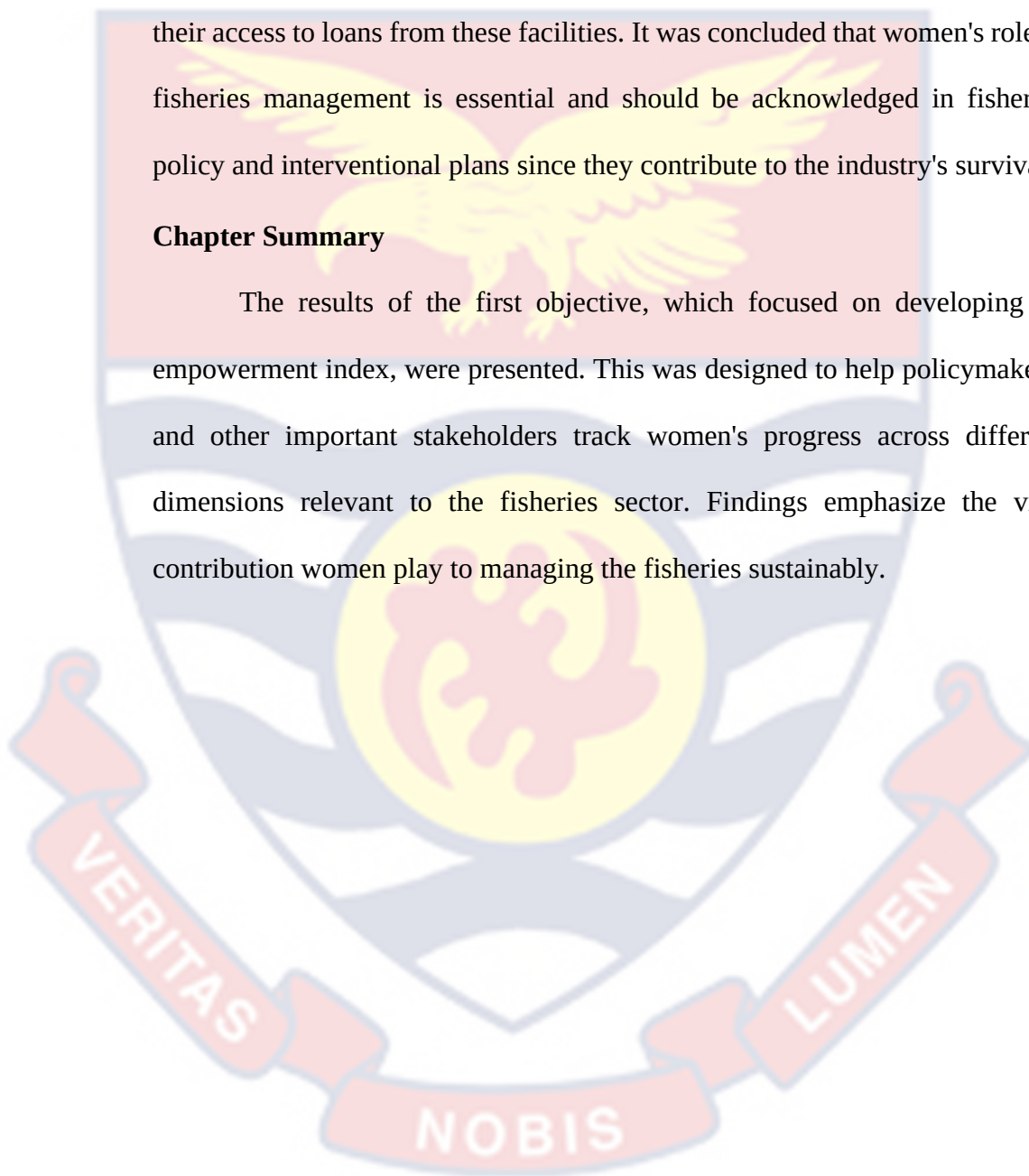
specifically assess the level of their empowerment. This study uses primary household data to estimate a multidimensional empowerment index in five coastal communities in Ghana. The study developed an empowerment index to evaluate and monitor women's progress across 12 indicators mapped to six dimensions. The results showed that about 41 % of women are disempowered. Comparing their empowerment to the men in their households, it was interesting to note that women were more empowered than men. A high incidence of deprivation was observed in autonomy in fish-related activities, access to training and information, time poverty, and access to and decision on credit for both women and men. However, what contributed most to their disempowerment were a lack of leisure satisfaction, poor autonomy, and limited access to training and information.

The disempowerment index was estimated at 0.17, indicating that women were inadequate in at least one dimension. This measurement tool will make it possible for policymakers, donor agencies, NGOs, and government agencies interested in empowering women to monitor their progress and to know the areas to focus on to attain complete empowerment. Given the positive relationship between leisure and well-being, the study encourages interventions to ensure women access and use efficient processing equipment to fasten their work. Also, the government can invest in storage facilities so that on days they don't get their fish early, they can store them rather than force them to process to avoid spoilage and losses. Additionally, the government should strengthen information dissemination in fishing communities and equip fisheries extension officers to offer more fisherfolk training. Empowering them to access the correct information and training in efficient fish processing and record keeping

will maximize their profit and alleviate poverty. They should receive training in areas where they are highly dominated-post harvesting activities. Since microfinance organizations and banks would instead give loans to a group than individuals, they should be encouraged to form associations that will facilitate their access to loans from these facilities. It was concluded that women's role in fisheries management is essential and should be acknowledged in fisheries policy and interventional plans since they contribute to the industry's survival.

Chapter Summary

The results of the first objective, which focused on developing an empowerment index, were presented. This was designed to help policymakers, and other important stakeholders track women's progress across different dimensions relevant to the fisheries sector. Findings emphasize the vital contribution women play to managing the fisheries sustainably.



CHAPTER FIVE

WOMEN EMPOWERMENT AND HOUSEHOLD FOOD SECURITY IN COASTAL GHANA

Introduction

This chapter presents the results of the relationship between women empowerment and household food security in coastal Ghana. The study uses the women empowerment index developed in objective one to measure empowerment. The household food insecurity access scale (HFIAS) is used for food security. This measure of food security uses the experiences of household members regarding certain conditions or problems to classify the household as food secure or food insecure directly. The HFIAS was selected above all other indicators because it is a direct measure of food security and relies on the behavioral conditions of individuals concerning hunger or food access. The study uses this measure because it directly measures the dimensions of food security rather than depending on proxy indicators such as dietary diversity, body mass index, and anthropometric measurements used in studies by Sraboni et al. (2014) and Banyen and Kotin (2015).

This approach to measuring food security relates to the access dimension of food security out of the four dimensions: access, affordability, utilization, and stability (Coates et al., 2007). Again, the study presents the results on food security using the two (HFIAS) indicators: Household Food Insecurity Access Scale (HFIAS) -related Domain and Household Food Insecurity Access Prevalence (HFIAP). The HFIA-related domain is created by dividing the number of households by the number of households that had encountered behavioral conditions such as anxiety and uncertainty regarding food access at any severity level in each domain (see appendix B). This was then converted

into a binary variable, with "0" denoting food security and "1" denoting food insecurity. The HFIAP, conversely, is a categorical variable that divides households into four levels of food insecurity (access): food secure, mildly food insecure, moderately food insecure, and severely food insecure (Coates et al., 2007). It is estimated by first calculating the HFIA category variable for each household by assigning a code for the food insecurity (access) category in which it falls. The four food security categories were created sequentially (see appendix A) to ensure that households are classified according to their most severe response.

Additionally, the Probit model was used to evaluate the effect of women's empowerment on food security. Anticipating endogeneity, the Lewbel two-staged least square (2SLS) estimation was used. The study also uses propensity score matching to test the robustness of the analyses further. The propensity score matching is an experimental model for estimating causal treatment effects by generating an artificial control group that matches treated and non-treated groups exhibiting the same characteristics (Caliendo & Sabine, 2005). Also, the study examines prosocial behavior, defined as any social action to benefit people or society as a potential channel through which empowerment can affect food security. To show if prosocial behavior mediates the relationship between women's empowerment and food security, the study adopts Baron and Kenny's (1986) stepwise regression method. This approach has been widely applied in the literature (Churchill et al., 2020; Lin & Okyere, 2021; Zhang et al., 2021). Primary household data in five fishing communities is used to investigate how women's empowerment impacts food security.

Baseline Analysis

Table 14 and Fig.13 present the results of the HFIA-related domain and HFAIP, respectively. For the HFIA-related domain, the conditions are categorized into three domains (Table 13). The households that answered “yes” to the conditions (see Appendix B) were asked a follow-up question to ascertain the frequency of occurrence. Results indicate that, out of the 688 households, 491(71.6%) are food insecure, while 197 (28.4%) are food-secure. Of the 491 food-insecure households, about 64% of them expressed anxiety and uncertainty about the household food supply due to a lack of resources. Approximately 69% of the households lack sufficient quality in their food regarding dietary diversity, nutritional adequacy, and preference. In comparison, 67% do not have sufficiency in the food they consume and its physical consequences.

Table 14: Household Food insecurity scale by domain

Domain	Response to HFIA Questions	Total Household %(N=688)
Anxiety and Uncertainty	Yes	63.77
	No	36.33
Insufficient Quality	Yes	68.70
	No	31.30
Insufficient food intake	Yes	66.81
	No	33.19

The HFIAP categorizes food security into food-secure, mildly food-insecure, moderately food-insecure, and severely food-insecure. Following Coates et al. (2007), the study used the information on the frequency of

occurrence to estimate the HFIAP (see Appendix B). The result is shown in Fig. 13, indicating that about 57% of the households are severely food-insecure, 11.2% are moderately food-insecure, 2.9% are mildly food-insecure, and approximately 29% are food-secure. For this study, the HFIA-related domain is used for further analysis because it detects aspects of food security beyond access to sufficient quantity and quality of food, such as the psychosocial manifestations of anxiety and uncertainty around food access or hunger (Coates et al., 2007).

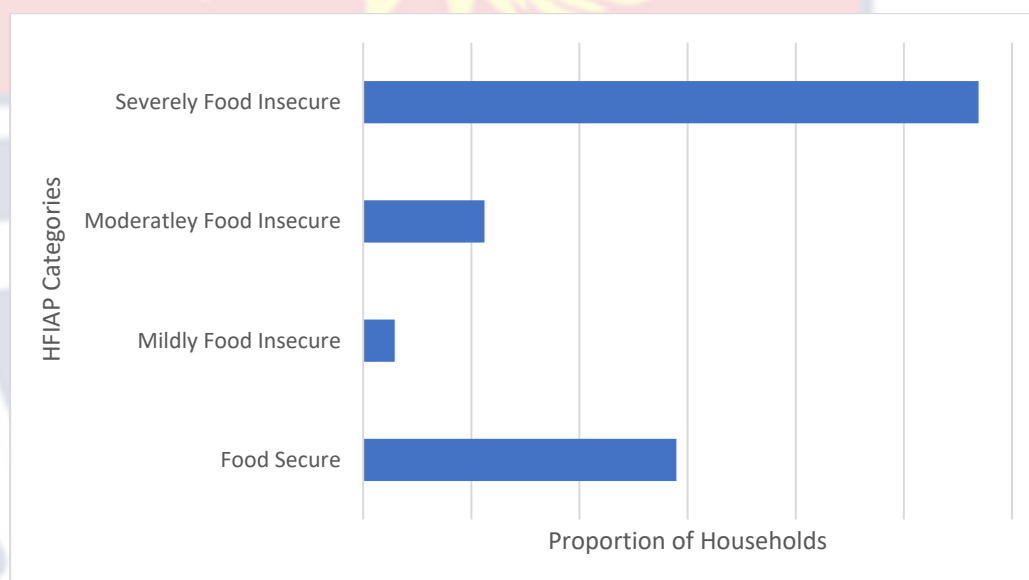


Figure 13: Prevalence of household food insecurity access (%).

Preliminary Analysis

The baseline estimates for the relationship between women empowerment and household food insecurity are presented in Table 15. The models' diagnostics find that the explanatory variables jointly explain food insecurity and account for about 17.3% to 10.1%, depending on the method adopted. The regression analysis examining the relationship between disempowerment and food insecurity yielded a highly significant result ($\text{Prob} > F/\chi^2 = 0.0000$). This finding strongly indicates that the model, with

disempowerment as the primary independent variable, has significant explanatory power in predicting food insecurity levels. The extremely low p-value ($p < 0.0001$) provides robust evidence against the null hypothesis, suggesting that disempowerment, in combination with the other explanatory variables in the model, is statistically significantly associated with food insecurity. Also, the high Wald chi²/F-statistic of 78.97 indicates that the model, with disempowerment as the primary independent variable, provides a substantially better fit for the data compared to a null model (a model with no predictors). These results strongly suggest that disempowerment, and all explanatory variables in the model, is significantly associated with food insecurity in the studied population. The magnitude of the test statistic underscores the potential strength of this relationship, indicating that variations in disempowerment levels are meaningfully linked to changes in food insecurity status.

It was observed that there exists a significant positive association between empowerment and household food insecurity using either the ordinary least square or probit regression technique. Specifically, the results show that food insecurity amongst disempowered women is 1.306 and 0.374 higher than empowered women, at a 1% significance level, using the OLS and probit regression technique, respectively. This implies that disempowered women have a higher likelihood of experiencing food insecurity than women who are empowered in the household. The marginal effect of 0.149 means that a one-unit increase in food insecurity is associated with an approximate 0.149 increase in the probability of experiencing disempowerment, holding other variables constant. Consistent with the literature, the study observed that income, food

expenditure, household size, marital status, and household location were significantly associated with food security.

To deal with endogeneity and also validate the baseline estimates in table 15, the study applies the Lewbel 2SLS and the propensity score matching technique. The results show a positive relationship between household size and food insecurity with a coefficient of 0.524 at a 1% significance level, meaning that households with a higher total number of people are more likely to experience a prevalence of food insecurity. The coefficients of the effect of food expenditure and income on food insecurity are -1.184 and -1.123, respectively. These results show that households that spend more on food or earn higher incomes will have a lower likelihood of experiencing hunger. The mean Variance Inflation factor (1.49) also showed that multicollinearity was not present in the estimated model.

Table 15: Baseline results for women empowerment and food insecurity

Variables	OLS		Probit	
	Coefficient	Robust Standard Errors	Coefficient	Robust Standard Errors
Women empowerment (disempowered)	1.306***	0.281	0.374***	0.115
Age (years)	-0.000	0.001	-0.000	0.000
Education (years)	-0.040	0.040	-0.017	0.016
Household size (continuous)	0.524***	0.110	0.184***	0.047
Children (below age 15, continuous)	-0.043	0.132	0.005	0.055
Sex (Female (1/0))	0.266	0.509	-0.142	0.214
Ln (Food expenditure)	-1.184***	0.267	-0.381***	0.113
Ln (Income)	-1.123***	0.213	-	0.081
			0.285***	

Table 15 continued

Marital Status				
(ref: Married)				
Consensual union	0.931**	0.399	0.294*	0.169
Separated	0.378	0.382	0.307*	0.157
Divorced	1.652***	0.539	0.682**	0.268
Widowed	0.554	0.506	0.209	0.193
Never married	1.030	1.003	0.343	0.404
Community				
(ref:Axim)				
Anomabo	-1.921***	0.430	-	0.181
			0.798***	
Biriwa	-1.750***	0.411	-	0.179
			0.723***	
Elmina	-0.682	0.439	-0.345*	0.184
Moree	-1.394***	0.381	-	0.166
			0.565***	
Constant	15.715***	1.716	3.861***	0.732
Regression				
Diagnostics				
Prob>F/chi2	0.0000		0.0000	
F-statistics/ Wald	10.13		78.97	
chi2				
R-	0.173		0.101	
squared/Pseudo				
R-squared				
VIF	1.49			
Observations	688		688	

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ represent 1%, 5% and 10% significance levels respectively

Robustness and Sensitivity Analysis

In validating the results in Table 15, the PSM is used. This method is often applied in authenticating robustness in the study by (Churchill & Smyth, 2020; Lin & Okyere, 2021). The matching algorithms in the PSM are consistent with the conventional approach that recommends using various matching procedures to confirm robustness. As reported in Table 16, the estimates agree with the results when the probit model was used. Thus, disempowered women in fishing communities in Ghana are more food-insecure than empowered

women. Depending on the PSM algorithm used, the likelihood of the disempowered being food insecure ranged between 1.064 and 1.119. The study presents the results of the Lewbel 2SLS, which was used to check for potential endogeneity in Table 15. To ascertain that the instrument does not weakly identify disempowerment at a 1% significance level, the Cragg-Donald Wald F statistics should be at least 10 (Stock & Yogo, 2002). The study's results show that at a 1% significance level, the likelihood of being food insecure is 1.176 higher for the disempowered compared to empowered women. The study also validated whether the results are sensitive to different cut-offs of disempowerment. The cut-offs used in this study and other thresholds are consistent with the literature (Alkire et al., 2013; Churchill & Smyth, 2020; Lin & Okyere, 2021). It was found that (see Table. 17) indeed, disempowered women are more food-insecure than their empowered counterparts. This confirms that the results are robust to different disempowerment cut-offs.

Table 16: Lewbel 2SLS and PSM results for women empowerment and food insecurity

Variable	Average Treatment Effect			
	Lewbel 2SLS	Regression adjustment	Augmented inverse-probability weighting	Nearest-neighbor matching
Disempowerment	1.73*** (0.664)	1.064*** (0.276)	1.064*** (0.276)	1.119*** (0.301)
Covariates included	Yes	Yes	Yes	Yes
Cragg-Donald	52.605			
Wald F statistic				
Observations	688	688	688	688

*Note: Standard errors are in brackets; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ are 1%, 5%, and 10% significance levels respectively. Covariates were included in the analysis.*

Table 2: Sensitivity analysis

Variable	Disempowerment Cut Off		
	0.5 Cut-off	0.30 Cut-off	0.7 Cut-off
Disempowerment	1.306*** (0.281)	0.836** (0.284)	2.944*** (0.421)
Covariates included	Yes	Yes	Yes
Prob>F	0.0000	0.0000	0.0000
F-statistics	10.31	8.05	9.36
R-squared	0.173	0.133	0.147
Observation	688	688	688

*Note: Standard errors are in brackets; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ are 1%, 5%, and 10% significance levels respectively. Covariates were included in the analysis.*

Potential Channel

In Table 18, the study examines prosocial behavior as a potential channel through which disempowerment affects food security. The first column presents the results of the relationship between disempowerment and prosocial behavior, while the second column shows the relationship between disempowerment and food insecurity when prosocial behavior is included in the model as an additional control variable. It was observed that disempowerment is negatively related to prosocial behavior. This implies that disempowered women are less likely to be prosocial. The results from column 2 reveal that prosocial behavior is positively associated with food security in that household that contribute to the well-being of the entire community are bound to receive contributions or food donations in times of distress, leaving them less food insecure. However, the results revealed that since disempowered women are

less likely to be prosocial, they are less likely to benefit from the benevolence of society in times of hunger or distress. Therefore, it can be seen in column 2 that when prosocial behavior was included as a covariate, the magnitude of disempowerment on food insecurity compared to the baseline results is maximized. The results validate prosocial behavior as a mediator, accounting for about 9% of the total effect of disempowerment on food security. The RIT in table 18 measures the ratio of the indirect impact on prosocial behavior to the total effect. The results show that about 9% of the impact of women empowerment on household food security is explained by prosocial behavior.

Table 18: A mediation analysis

	Column 1	Column 2
Variable	Prosocial	Food insecurity
Disempowerment	-373.998** (138.051)	6.110*** (1.203)
Prosocial		0.001*** (0.0003)
Covariates included	Yes	Yes
Delta test		-0.489**
Sobel test		-0.489**
Monte Carlo test		-0.492**
RIT		0.087

*Note: Standard errors are in brackets; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ are 1%, 5%, and 10% significance levels respectively. Covariates were included in the analysis.*

Moderation Analysis

The study employs the framework as specified below to test the role of water and energy poverty in moderating the influence disempowerment has on food security.

$$FS_i = \phi_0 + \phi_1 emp + \phi_2 emp * WP + \phi_3 emp * EP + \phi_4 emp * WP * EP + \sum_k \gamma_k X_{k,i} + \rho_c + \varepsilon_i \quad (33)$$

Where, FS_i is the food security of the i th household, emp is empowerment/disempowerment, WP is water poverty, EP represents energy poverty, WP_i and EP_i measures if the household faces water and energy deprivations or not respectively and they represent the moderating variables. $emp * WP$ and $emp * EP$ show if a household has a woman disempowered at the same time faces water and energy poverty while $emp * WP * EP$ represent if a household has a woman disempowered and at the same time faces both water and energy deprivations. Therefore, the study interacted with three other deprivations (disempowerment, water poverty and energy poverty) in the household and examined their effect on food security, as shown in Table 18. Results show that a household with a disempowered woman faced with energy or water deprivation worsens food insecurity by approximately 63% and 55% at 5% and 1% significance levels, respectively. These estimates are higher than the impact of only disempowerment on food security (37%).

On the other hand, if a household faces all three deprivations simultaneously, the impact on food insecurity is about 91% at a 5% significance level. This supports the study's hypothesis that water and energy deprivations in the household may moderate the relationship between women's empowerment and household food insecurity. Thus, households where women are disempowered while facing water and energy deprivations are more likely to be food insecure at a rate higher than the baseline results.

Table 19: Moderation analysis

Variables	Model 1	Model 2	Model 3	Model 4
Disempowerment	0.374*** (0.115)			
Disempowerment*water poverty		0.550*** (0.173)		
Disempowerment*energy poverty			0.629** (0.200)	
Disempowerment*water poverty*energy poverty				0.905** (0.302)
Covariates	Yes	Yes	Yes	Yes
Regression Diagnostics				
Observations	688	688	688	688
Wald chi2	78.97	65.58	63.33	62.35
Prob>chi2	0.000	0.000	0.000	0.000
Pseudo R2	0.101	0.084	0.085	0.084

*Note: Standard errors are in brackets; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ are 1%, 5%, and 10% significance levels respectively. Covariates were included in the analysis.*

Discussion

The study's findings revealed that the disempowerment of women affects food security negatively. The Probit regression estimates suggest that the likelihood of disempowered women being food insecure is 37% higher than

empowered women. For instance, Asitik and Abu (2020) observed in Ghana that women empowerment using three indicators- decisions over crops to grow, livestock to rear, and who owns agricultural lands impact food security positively. Similarly, a study conducted in Bangladesh by Sraboni et al. (2014) found that women's empowerment is positively associated with household calorie availability, a key indicator of food security. This supports the results of previous research that have also shown that women empowerment is linked to better nutritional outcomes (Sraboni & Quisumbing, 2018; Malapit & Quisumbing, 2015; Tsiboe et al., 2018) and improved health outcomes (Ross et al., 2015; Tsiboe et al., 2018; Zereyesus et al., 2017).

Empowering women is a vital strategy in achieving food security as it promotes productivity, increases food availability, and generates income, ultimately contributing to eradicating hunger and malnutrition. Furthermore, Ragsdale et al. (2018) highlighted that global food security would remain elusive until gender equality and women empowerment are achieved, as cited in (Asitik & Abu, 2020). Therefore, these results imply that if a woman is empowered in any sector, be it agriculture, fisheries, and livestock, nutritional outcomes and food security will be positively affected. This may not only be limited to the woman but will spill over to the entire household.

The study suggested that food security prevalence is worsened in a household with a disempowered woman who relies on poor energy services and cannot afford or do not have access to improved drinking water. The intuition is that households that rely on biomass fuel and fetch water from long distances will spend more time on these activities. This will directly disempower women concerning time allocation, which is one of the disempowerment dimensions

used in the study. This indirectly affects women's income-generating activities and may ultimately negatively impact household food security. In addition, if women are empowered concerning time allocation, they may spend some of the saved time preparing more nutritious meals. Again, poor access to cooking fuels and water may force households to reallocate household resources from food production and preparation to secure fuel and water (Sola et al., 2016). These conclusions corroborate the findings of Jada and Berg (2022), Sola et al. (2016), and Fleifel et al. (2019) and suggest that time spent on collecting fuelwood and improved water by women will affect their empowerment which, in turn, affect household food security. Similarly, Essilfie et al. (2021) also found that households with available cooking fuel and also has access to water are more food secure compared to households with no access. Hanjra and Qureshi (2010) also asserted that water is vital to food security.

Furthermore, the study observed a positive relationship between prosocial behavior and food security. This means that the more a household or a woman engages in prosocial behavior by contributing to the community's raising of social capital, the less food insecure they will be. This implies that in times of distress, the household can rely on social networks for resources likely to reduce household food insecurity. However, if disempowered women cannot contribute to the benefit of others due to limited resources, they are less likely to receive help when in need. These findings are consistent with the results of (Niles et al., 2019; Nosratabadi et al., 2020; Rusmawati, 2021) that observed social capital raised due to the prosocial behavior of households or the community has a positive association with food security and that households that do not have any social networks are likely to suffer.

Conclusions

Studies on the relationship between women empowerment and household food security have focused on agrarian households and have neglected the dynamics in fishing households. Even for those who studied this relationship in the agriculture sector, other household deprivations that may have a policy impact on food security and disempowerment are ignored. Ignoring these may hinder the full attainment of sustainable development goals. Using primary household data in five coastal communities in Ghana, the impact of women empowerment on household food security was examined while considering the role of water and energy poverty. The study also accounted for prosocial behavior's role in mediating the relationship between women's empowerment and household food security. The results showed that disempowered women experienced food insecurity more than their empowered counterparts. The study also observed that prosocial behavior indirectly accounts for about 9% of the impact disempowerment has on food insecurity in the household, while poor energy and water services worsen food security prevalence in a household where a woman is disempowered.

Chapter Summary

This chapter presented the results of the second and third objectives, which focused on women's empowerment and household food security. The results suggest that women empowerment measured using a multidimensional approach and other household variables such as water and energy were significant indicators for improving household food security in coastal communities. It was also observed that the ability to contribute in kind or cash towards community well-being will also indirectly affect the total effect women

empowerment has on food security. The next chapter presents the results of women's empowerment and environmental poverty.



CHAPTER SIX

WOMEN EMPOWERMENT AND ENVIRONMENTAL POVERTY

Introduction

This chapter examines women's empowerment and environmental poverty in Ghana. The study uses the women empowerment index developed in objective one to measure empowerment. For environmental poverty, the study creates a multidimensional environmental poverty index following Nawaz and Iqbal (2021). The results of the hypothesis-women empowerment have a significant effect on environmental poverty are presented.

Environmental Poverty Index

Table 20 reports results for the multidimensional environmental poverty index. The table explicitly displays the effects on incidence, intensity, index (EPI), and the severity of environmental poverty. The results for the incidence, also known as the multidimensional headcount ratio (H), is the proportion of multidimensionally environmentally poor people in the population. The results show that approximately 93% of coastal households are multidimensionally environmentally poor. The effects on the intensity of environmental poverty (A) show the severity of the situation. It refers to the proportion of the poorest among the environmentally poor people. Results show that approximately 61% of those considered environmentally poor face environmental poverty. The multidimensional environmental poverty index (M_0) findings refer to the proportion of the population who are deprived in one or more dimensions on average. The index is calculated by multiplying the incidence by the intensity of environmental poverty. The results suggest that, at the cut-off of 33%, the multidimensional environmental poverty index stands at 0.562. Before a

household is considered multidimensionally environmentally poor, it is crucial to establish that it may have concurrently faced multiple deprivations in the four dimensions (dwellings, water, sanitation, and energy).

Table 20: Estimate for Environmental Poverty Index (EPI)

	Index
Number of observations	690
Headcount (H)	92.8%
Average intensity (A)	60.6%
EPI (H*A)	0.562

Table 21 presents the results for the censored headcount ratio, which is the proportion of the population that is multidimensionally environmentally poor and deprived in specific indicators simultaneously (Alkire et al., 2013) and the contribution of each indicator to the environmental poverty index. Results indicate that within the population of the multidimensionally environmentally poor, high deprivation is observed in cooking fuel (95%) under the energy dimension, toilet (67%), and refuse (93%) both under the sanitation dimension and water access (88%) under the water dimension. To understand what matters more in environmental poverty assessment, Table 21 shows the contribution of each indicator to the overall Multidimensional Environmental Poverty Index (EPI). Results show that, overall, the highest contribution rises from water (39.9%), followed by cooking fuel (19.9%), refuse (19.1%), and toilet (14.7%). These results imply that the EPI is more associated with water, cooking fuel, and sanitation. This finding aligns with other studies (Dehury & Mohanty, 2017; Crentsil et al., 2019; Nawaz & Iqbal, 2021; Essel-Gaisey & Chiang, 2022). The findings of these studies show that cooking fuel, water, and sanitation are key

components contributing to energy poverty and environmental poverty in most developing countries.

Table 21: Censored headcount and contribution of each indicator to environmental poverty.

Dimension/Indicator	Censored Headcount (%)	Contribution to EPI (%)
Dwellings		
Roof	5.94	0.7
Floor	4.64	0.9
Wall	12.61	1.8
Water		
Water access	87.83	39.1
Sanitation		
Toilet	66.52	14.7
Refuse	92.61	19.1
Energy		
Cooking fuel	94.93	19.9
Electricity	17.25	3.8

Note: The contribution to EPI adds up to 100%. The censored headcount is the proportion of households that are multidimensionally environmental poor.

Baseline Estimates

In Table 22, the results of the relationship between women empowerment and the multidimensional environmental poverty index (EPI) are presented. The results show that the variables jointly explain environmental poverty at 1% significance level. OLS and fractional regression estimates indicate a positive and statistically significant relationship between disempowerment and environmental poverty. Specifically, the results show that environmental poverty is about 5.2% and 13.6% higher for disempowered women than empowered women, at a 1% significance level, using the OLS and fractional regression technique, respectively. This implies that disempowered

women are more likely to have an unhealthy environment than empowered women. In other words, empowerment of women can provide resources to women to afford basic environmental services to reduce the likelihood of experiencing environmental poverty. The study also observed that income, marital status, and household location were significantly associated with environmental poverty. The results showing a negative relationship between income and environmental poverty, implies that an increase in the household's income will reduce environmental poverty by 10.4% at 1% significance level using the fractional regression. The mean Variance Inflation factor (1.46) also showed that multicollinearity was not present in the estimated model. The study applies robust methods like the propensity score matching (PSM) to validate the estimates in Table 22. It also uses the Lewbel 2SLS to solve the issue of endogeneity.

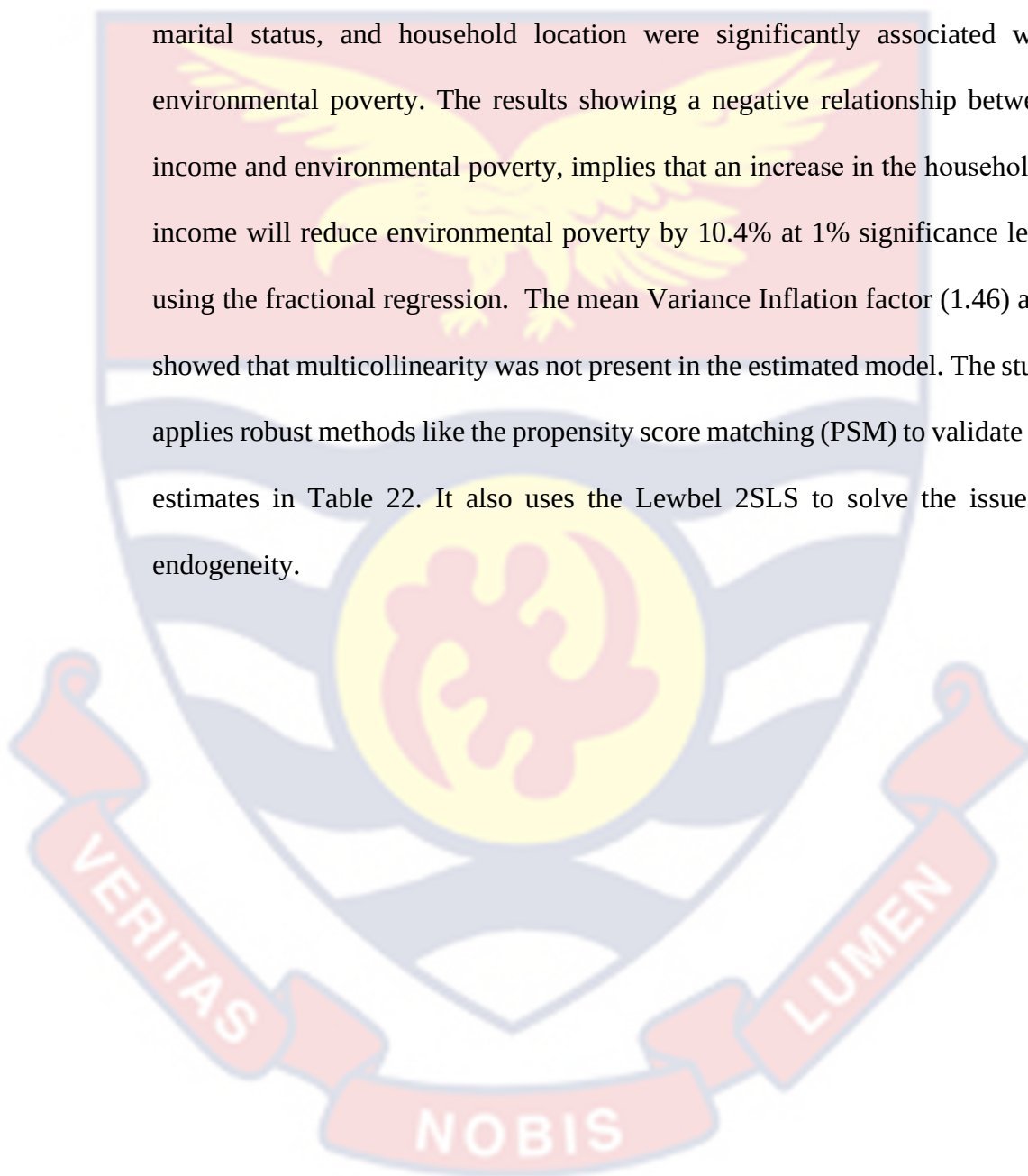


Table 22: Baseline results for women empowerment and environmental poverty

Variables	OLS		Fractional regression	
	Coefficient	Robust Standard Errors	Coefficient	Robust Standard Errors
Women empowerment (disempowered)	0.052***	0.011	0.136***	0.027
Age (years)	-0.000	0.000	0.000	0.000
Education (years)	-0.002	0.002	-0.006	0.004
Household size (continuous)	0.005	0.004	0.012	0.102
Children (below age 15, continuous)	0.007	0.005	0.019	0.014
Sex (Female) (1/0)	0.032	0.017	0.083*	0.044
Ln (Income)	-0.041***	0.008	-	0.019
Marital Status (ref: Married)			0.104***	
Consensual union	0.048**	0.016	0.124**	0.041
Separated	0.021	0.015	0.054	0.038
Divorced	0.030	0.027	0.075	0.069
Widowed	0.018	0.020	0.046	0.052
Never married	0.023	0.528	0.060	0.135
Community (ref: Axim)				
Anomabo	0.037**	0.017	0.096**	0.044
Biriwa	0.009	0.018	0.024	0.045
Elmina	-0.052**	0.020	-	0.051
Moree	-0.007	0.381	0.131**	
Constant	0.725***	0.059	-0.020	0.042
Regression Diagnostics			0.576***	0.150
Prob>F/chi2	0.0000		0.0000	
F-statistics/ Wald chi2	7.000		112.04	
R-squared/Pseudo R-squared	0.158		0.011	
VIF	1.46			
Observations	688		688	

Note: Standard errors are in brackets; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ are 1%, 5%, and 10% significance levels respectively.

Robustness and Sensitivity Analysis

In validating the results in Table 22, the study adopts the propensity score matching (PSM) technique. This method is often applied in authenticating endogeneity in the energy poverty literature (Churchill & Smyth, 2020; Lin & Okyere, 2021; Essel-Gaisey & Chiang, 2022). These matching algorithms are consistent with the conventional approach in the existing literature that recommends using the manifold matching procedures to confirm robustness. As seen in Table 23, the estimates are consistent with the baseline results in Table 22. Thus, disempowered women in fishing communities in Ghana have a higher likelihood of being environmentally poor since they cannot afford environmental services than empowered women. The impact of women empowerment on environmental poverty ranged between 4.6% to 5.4% depending on the algorithm used. Results from the PSM validates the baseline results indicating since women are defined as primarily responsible for decision-making regarding environmental services such as collecting fuel and water, their disempowerment will greatly affect environmental poverty. Table 23 also shows the results from the Lewbel 2SLS indicating that the variables do not weakly identify the outcome variable.

Table 23: Lewbel 2SLS and PSM results for women empowerment and environmental poverty

Variable	Average Treatment Effect			
	Lewbel 2SLS	Regression adjustment	Augmented inverse- probability weighting	Nearest- neighbor matching
Disempowerment	0.127* (0.664)	0.054*** (0.011)	0.053*** (0.011)	0.046*** (0.012)
Covariates included	Yes	Yes	Yes	Yes
Cragg-Donald Wald F statistic	52.605			
Observations	688	688	688	688

*Note: Standard errors are in brackets; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ are 1%, 5%, and 10% significance levels respectively. Covariates were included in the analysis.*

Discussion

It is observed from the study that disempowerment of women increases the likelihood of a household to be environmentally poor. The fractional regression estimates suggest that disempowered women have about 13.6% environmental poverty prevalence compared to their empowered counterparts. This implies that there is always a decreased use of environmental services when women are disempowered. This finding is consistent the study by Dehury and Mohanty (2017) who found that multidimensionally poor households headed by a female have a higher deprivation in healthy environment. Similarly, Crentsil et al. (2019) found that a household being headed by a female is more likely to be energy poor than a household headed by a male.

The significant negative relationship between income and environmental poverty suggest that when a household is financially handicapped, it will not be able to afford basic environmental services. It can be maintained that income affords the households or women the ability to afford services that leaves the environment healthy thereby reducing environmental poverty and facilitating the SDGs. This result is consistent with the study by Essel-Gaisey and Chiang (2022) who observed that lack of financial inclusion or access to financial services worsens the environmental poverty situation in Ghanaian households.

Conclusions

Environmental degradation affects human livelihoods in various ways, leading to households experiencing environmental poverty. Environmental poverty is when households face inadequate and unsafe housing, poor water and sanitation facilities, and a lack of modern energy services. However, households may face difficulties accessing and investing in environmental services due to a lack of income and the disempowerment of women who are often expected to manage the environment efficiently. As a result, this study aims to address this issue by adopting a multifaceted perspective on women's empowerment and environmental poverty, which goes beyond one-dimensional measures. The study used primary household data from five fishing communities and employed robust estimation techniques, including fractional regression models, to investigate the relationship between women's empowerment and environmental poverty. Findings revealed that disempowered women are more likely to face environmental poverty, and households with a low-income

struggle to afford environmental services, leading to them living in an unhealthy environment.

Chapter Summary

Findings of women empowerment and environmental poverty were presented. The results suggest that women's empowerment and increased household income are significant indicators for ensuring a healthy and quality environment in coastal communities. This chapter's objective was achieved using fractional regression and propensity score matching to validate results. The next chapter presents the summary, conclusion, and policy recommendation.



CHAPTER SEVEN

SUMMARY, CONCLUSION, AND RECOMMENDATION

Introduction

Food security and environmental sustainability remain an issue despite various initiatives undertaken by both development agencies and the government of Ghana. Despite the significant strides made by Ghana in multiple aspects, such as economic development and social progress, there remain regional differences in food insecurity and environmental sustainability in the coastal communities. In light of this, the primary aim of the research is to explore the topics of women's empowerment, household food security, and environmental poverty in Ghana.

Summary

This study examined women's empowerment in household food security and environmental poverty in coastal Ghana. The thesis developed an empowerment index to measure women's empowerment in fishing households and to diagnose the gap between men and women living in the same household. It also contributed to the knowledge of how women's empowerment can be used to end hunger and improve the environmental conditions of households in the country.

In the first empirical chapter, an empowerment index was developed using the Alkire Foster methodology. Primary household data with a sample size of 690 households from five fishing communities- Axim, Elmina, Moree, Biriwa and Anomabo was used to pilot the women empowerment in fisheries index. Twelve indicators mapped to six dimensions (production, resources, income, leadership, institution, and time) were used to develop the

empowerment index to evaluate and monitor women's progress in fishing communities. The results showed that about 41 % of women are disempowered. Comparing their empowerment to the men in their households, it was interesting to note that women were more empowered than men in their households. A high incidence of deprivation was observed in autonomy in fish-related activities, access to training and information, time poverty, and access to and decision on credit for both women and men. However, what contributed most to their disempowerment were a lack of leisure satisfaction, poor autonomy, and limited access to training and information. The disempowerment index was estimated at 0.17, indicating inadequacy in at least one dimension.

The second empirical chapter tested three hypotheses: (a) women empowerment has a significant effect on food security (b) The combined effect of women empowerment, water, and energy poverty has a significant effect on food security (c) prosocial behavior mediates the relationship between women empowerment and food security. Primary household data with a sample size of 690 households was used. The Ordinary Least Square, the Probit model, propensity score matching, and Lewbel Two Stage Least Square were used to evaluate the effect of women empowerment on household food security. The findings from the study showed that the disempowerment of women would increase food security prevalence in households. The food security variable is binary so that the OLS may lead to biased estimates. Hence the study ran a probit model to examine the relationship. It was found that food security prevalence is about 37% higher if a woman is disempowered than an empowered woman. Findings also revealed that when a household does not have access to improved water and energy services, food security will worsen

if the household has a disempowered woman in it. While prosocial behavior was negatively related to women empowerment, results show a positive relationship to food security, implying that when prosocial behavior is included as a covariate, the impact of disempowerment on food security reduces.

The third empirical analysis focused on women empowerment's effect on Ghana's environmental poverty. The purpose was to show that women's empowerment significantly impacts environmental poverty. Using the same household data and sample size, the study applied fractional regression to evaluate this relationship. The results from this empirical chapter suggested that women's empowerment allows households to access quality environmental services. In other words, a household with a disempowered woman is more likely to be environmentally poor than a household with an empowered woman. Also, the findings showed a negative relationship between income and environmental poverty. The results show that increased household income or earnings will reduce environmental poverty. Results from the propensity score matching validated the results from the fractional regression.

Conclusions

Women empowerment, food security, and a quality environment are significant to achieving sustainable development goals. This study advanced the knowledge of women's empowerment and investigated the impact of empowerment on household food security and environmental poverty using data from five fishing communities in 699 households. The study's findings sharpen the understanding of women's empowerment in fishing communities and which dimensions of empowerment will be necessary for policymakers. The results from all three empirical chapters emphasize the importance of

women's empowerment in ensuring sustainable food systems and protecting the environment due to women's vital roles in food production, fuel, water collection, childcare, and sanitation. It is agreed that when equality is achieved and discrimination against women is eradicated, there will be an improvement in household welfare which will drive economic development.

Recommendations

To promote the empowerment of women and improve household food security and environmental sustainability, the following recommendations are put forward:

Based on the findings from the first empirical chapter, this study recommends a comprehensive approach to enhance empowerment for both men and women in the fishing communities of Axim, Elmina, Moree, Biriwa, and Anomabo. The recommendations address the six dimensions of empowerment: production, resources, income, leadership, institution, and time.

To enhance autonomy in fish-related activities, the study proposes establishing gender-specific cooperative groups and associations that allow for more democratic decision-making in fishing operations and fish processing. This should be complemented by business management and decision-making skills training for both genders.

Addressing the high incidence of deprivation in access to training and information, the study recommends developing comprehensive, accessible training programs and information dissemination systems. This includes organizing gender-specific workshops on relevant topics such as modern fish processing techniques, sustainable fishing practices, and financial management.

Establishing community information centers with resources on fisheries, market prices, and regulations will ensure accessibility for both genders.

To combat time poverty, the study suggests introducing labor-saving technologies in fish processing and fishing operations, promoting shared household responsibilities, and implementing community childcare programs. These measures aim to free up time for both productive activities and leisure.

Enhancing access to and decision-making on credit is crucial. The study recommends developing tailored microfinance programs for women's fish processing and trading activities and creating specific loan products for men's fishing equipment and boat maintenance. Financial literacy training and support for savings and loan associations should be provided for both genders.

To increase leisure satisfaction, the study proposes organizing gender-specific social groups and recreational activities, as well as creating community spaces for relaxation and social interaction. This aims to promote work-life balance and community engagement.

Strengthening institutional participation is important for both genders. The study suggests establishing quotas for women's participation in fisheries management committees and encouraging men's involvement in community development initiatives beyond fishing. Leadership training and platforms for community members to voice concerns should be provided for both genders.

To improve production capabilities, the study recommends providing training on value addition in fish processing for women and introducing sustainable fishing techniques for men. Access to improved technologies should be facilitated through subsidies or cooperative purchasing schemes for both genders.

Enhancing resource management involves supporting women's ownership of processing equipment and storage facilities, facilitating co-ownership of fishing boats and gear among crew members, and implementing community-based resource management programs with equal participation.

For income management, the study suggests promoting direct market access for women fish processors and traders, encouraging transparent income sharing systems among fishing crew members, and providing training on household budgeting and financial planning for both genders.

Finally, to develop leadership skills, the study recommends implementing mentorship programs, encouraging men to take on leadership roles in community development projects beyond the fishing sector, and providing leadership and public speaking training for both genders.

Also, regular monitoring using the developed empowerment index will be crucial to assess the effectiveness of these interventions and make necessary adjustments over time. By implementing these strategies, the goal is to reduce the disempowerment index for both men and women, ultimately contributing to improved livelihoods and community development in these coastal fishing communities.

The empowerment measurement will make it possible for donor agencies, NGOs, and government agencies interested in empowering women to know areas to focus on to achieve their goals instead of generalizing. icy and interventional plans since they contribute to the industry's survival. Since empowering women, will improve food security, the study also recommends that the ministry in charge of women's affairs should promote initiatives that emphasize the importance of women in decision-making at the household level.

The study recommends that the government facilitate the campaign towards adopting alternative livelihoods that allows them to generate income to supplement livelihood and well-being or promote financial inclusion strategies such as access to credits among vulnerable households. Implementing initiatives to increase women's earnings enhances a household's well-being by reducing food insecurity and environmental poverty, which is essential in meeting SDGs 2, 3, 6, and 7. Also, investment in environmental products and services initiatives help achieve SDGs 3, 7, 11, 13, and 15. Such initiatives would ensure inclusiveness toward achieving the SDGs and UN-Habitat's core vision of leaving no one and place behind.

Suggestion for Further Research

The limitation of this study is that it does not assess the trends in empowerment over time due to the cross-sectional data used for the analysis. It did not also look at the relationship between disempowerment of men and household food security and environmental poverty. Using panel data for empowerment analysis is an excellent opportunity for future research. Notwithstanding the limitation, this study provides an empirical contribution to the literature on women's empowerment and its impact on food security and environmental poverty in an emerging economy.

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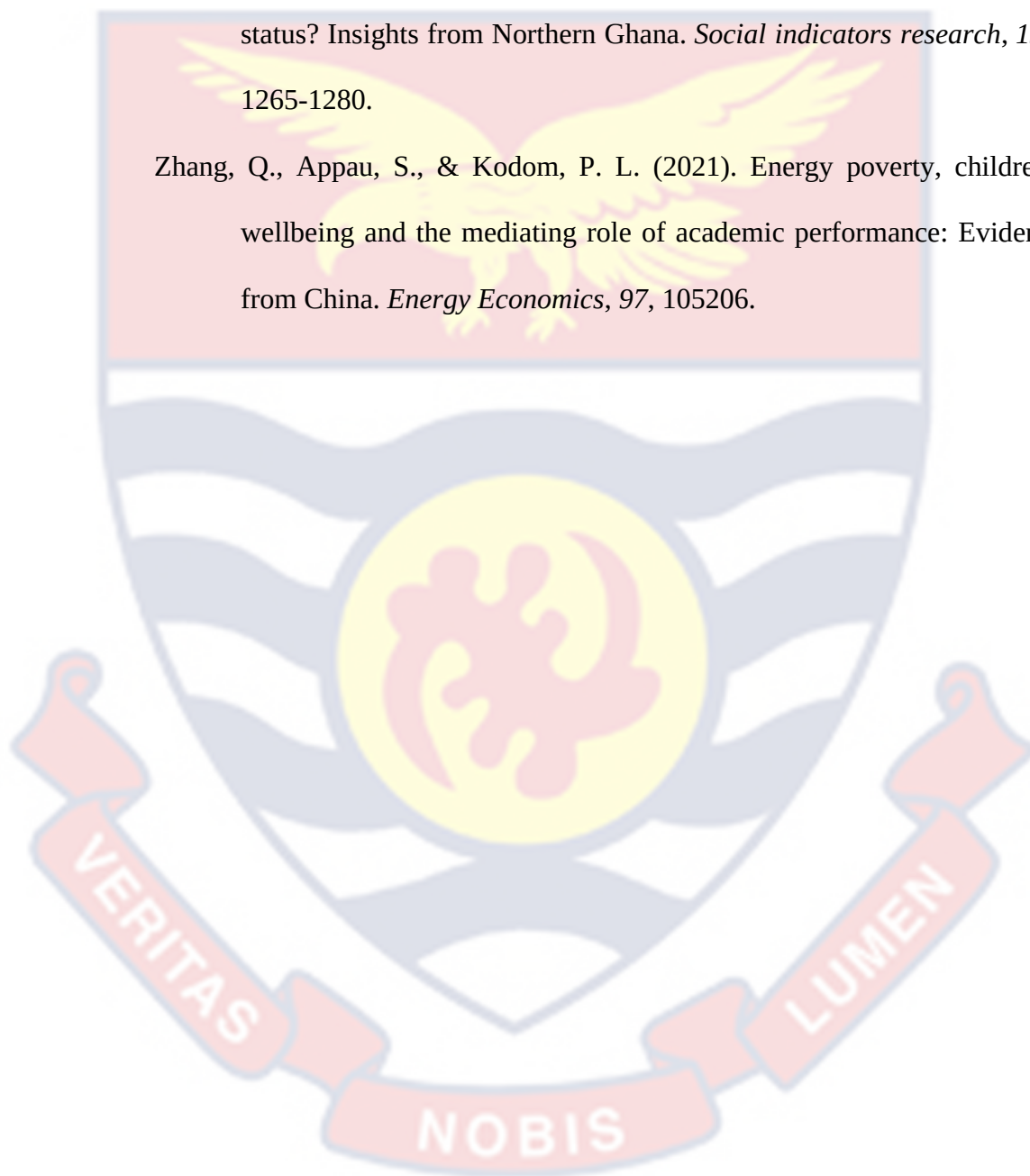
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APPENDICES

APPENDIX A: HOUSEHOLD FOOD INSECURITY PREVALENCE SCALE

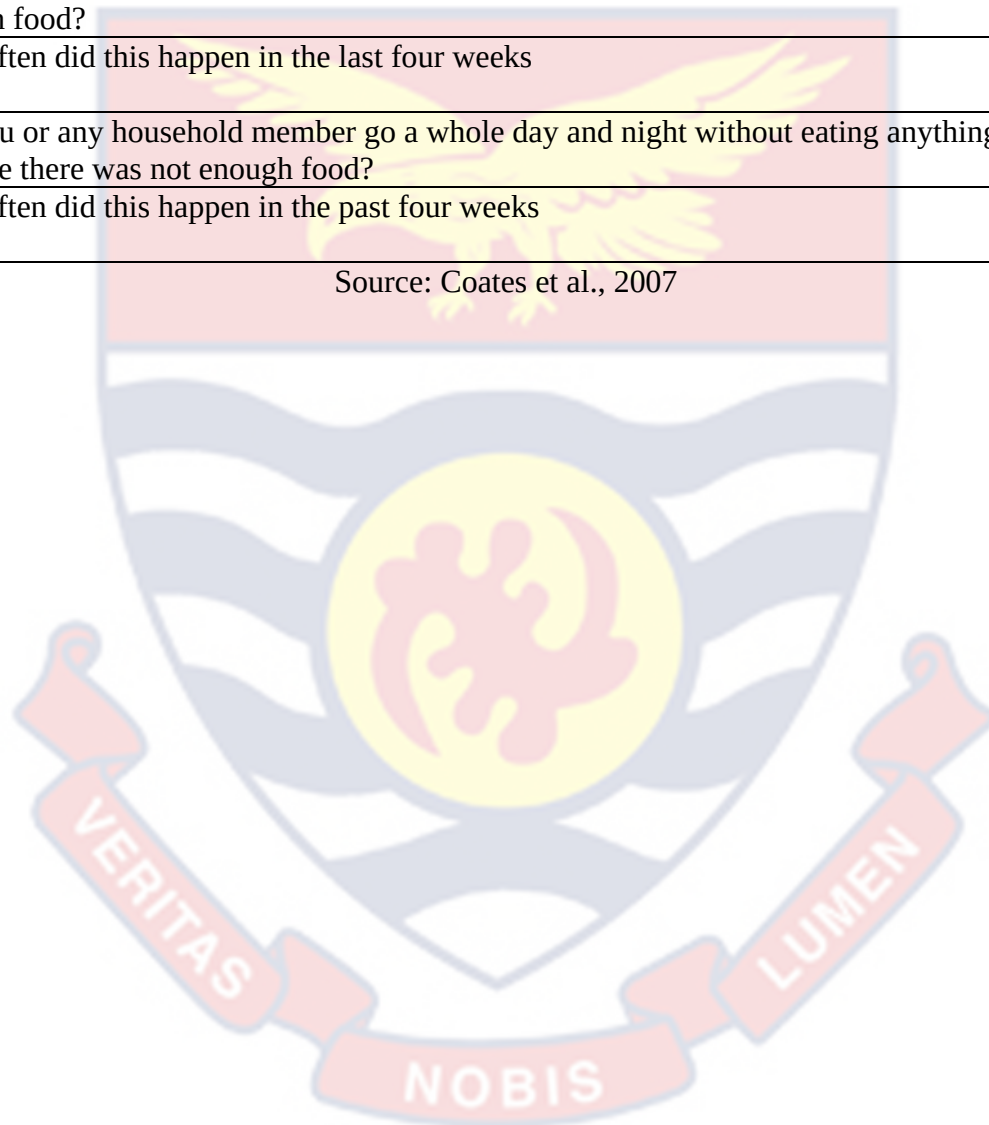
HFIA category	HFIA category “food secure”= 1 if [(Q1a=0 or Q1a=1) and Q2=0 and Q3=0 and Q4=0 and Q5=0 and Q6=0 and Q7=0 and Q8=0 and Q9=0] HFIA category “mildly food insecure”= 2 if [(Q1a=2 or Q1a=3 or Q2a=1 or Q2a=2 or Q2a=3 or Q3a=1 or Q4a=1) and Q5=0 and Q6=0 and Q7=0 and Q8=0 and Q9=0] HFIA category “moderately food insecure”= 3 if [(Q3a=2 or Q3a=3 or Q4a=2 or Q4a=3 or Q5a=1 or Q5a=2 or Q6a=1 or Q6a=2) and Q7=0 and Q8=0 and Q9=0] HFIA category “severely food insecure”= 4 if [Q5a=3 or Q6a=3 or Q7a=1 or Q7a=2 or Q7a=3 or Q8a=1 or Q8a=2 or Q8a=3 or Q9a=1 or Q9a=2 or Q9a=3]
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APPENDIX B: HOUSEHOLD FOOD INSECURITY ACCESS SCALE MEASUREMENT TOOL

Q	Questions	Response Code
1	Did you or any household member worry about not having enough food to eat because of a lack of money or resources?	Yes=1 No=0
1a	How often did this happen in the last four weeks	1=Rarely 2=sometimes 3=often
2	Were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?	Yes=1 No=0
2a	How often did this happen in the last four weeks	1=Rarely 2=sometimes 3=often
3	Did you or any household member have to eat a limited variety of foods due to a lack of resources?	Yes=1 No=0
3a	How often did this happen in the last four weeks	1=Rarely 2=sometimes 3=often
4	Did your household have to eat some foods that you did not want to eat because of a lack of resources to obtain other types of food?	Yes=1 No=0
4a	How often did this happen in the last four weeks	1=Rarely 2=sometimes 3=often
5	Did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?	Yes=1 No=0
5a	How often did this happen in the last four weeks	1=Rarely 2=sometimes 3=often
6	Did your household have to eat fewer meals in a day because there was not enough food? 7	Yes=1 No=0
6a	How often did this happen in the last four weeks	1=Rarely 2=sometimes 3=often
7	Was there ever no food to eat of any kind in your household because of a lack of resources to get food?	Yes=1 No=0
7a	How often did this happen in the last four weeks	1=Rarely 2=sometimes 3=often

8	Did you or any household member go to sleep at night hungry because there was not enough food?	Yes=1 No=0
8a	How often did this happen in the last four weeks	1=Rarely 2=sometimes 3=often
9	Did you or any household member go a whole day and night without eating anything because there was not enough food?	Yes=1 No=0
9a	How often did this happen in the past four weeks	1=Rarely 2=sometimes 3=often

Source: Coates et al., 2007



APPENDIX C: ETHICAL CLEARANCE

UNIVERSITY OF CAPE COAST



COLLEGE OF AGRICULTURAL & NATURAL SCIENCES
SCHOOL OF BIOLOGICAL SCIENCES
DEPARTMENT OF FISHERIES AND AQUATIC SCIENCES

Tel: 0332096806
E-mail: dfas@ucc.edu.gh

Cape Coast
Ghana – West Africa

Our Ref: SBS/DFA/24/V.4/2
Your Ref:

17th September, 2020

The Chair
Institutional Review Board
University of Cape Coast

Dear Sir,

ETHICAL CLEARANCE

Ms. Fawzia Muhammed Zuka, is a PhD (Integrated Coastal Zone Management) student in the Department of Fisheries and Aquatic Sciences.

We wish to submit this letter to you in support of the conduct of her Research titled “(Women in Fisheries: Contribution to Food Security, Dietary Diversity and Fish Pricing in Coastal Ghana)” led by Ms. **Fawzia Muhammed Zuka**

Thank you.

Yours faithfully,

Dr. Noble Asare
Head of Department

APPENDIX D: SURVEY INSTRUMENT**Questionnaire**

Women empowerment and Household Welfare

Household ID:

Name of Interviewer:

Date of Interview :..... Time of start:.

Good morning/afternoon/evening. I am Fawzia Muhammed Zuka, a student from the University of Cape Coast and I am here to administer a questionnaire for my thesis on gender and fisheries management in Ghana. Your household has been randomly selected to participate in this survey. We promise that the responses you give us will be treated with strict confidentiality. Your response will be added to those of other respondents for a general analysis so there will be no way of figuring out your specific responses after the analysis is done. Throughout this interview you must not talk to anyone. We also prefer to talk to you alone to avoid interruption and to save your time and ours.

DO YOU AGREE TO PARTICIPATE?

A. YES

B. NO

If you do not understand any of the questions, please tell me and I will explain it again.

EA CODE	RESPONDENT CONTACT	GPS XYZ Coordinates	
		Latitude	X
		Longitude	Y
		Altitude	Z

Supervisor's Remarks

Module 1: Household Roster and Socio-Demographic Characteristics

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	1.10	1.11	1.12
ID	SEX	What is the relationship of [NAME] to the head of the household?	How old is	What is	how many	In what Region/	What is	To which ethnic	How long	Household Fishing	How many hours per
	Male.....1	Head.....1	[NAME]	[NAME'S]	years of	country was	[NAME'S]	group does	has [NAME]	labour contribution	day are dedicated to
	Female.....2	Spouse(wife/husband).....2	(COMPLETED	present marital	formal	[NAME] born?	occupation	[NAME] belong?	stayed in this	(≥16)	fishing
		Child(son/daughter).....3	IN YEARS	status?	education	Western.....1		Akan.....1	community	Part-time.....1	(COMPLETE IN HRS)
		parent/parent in-law.....4		(≥12yrs)	has	Central.....2		Ewe.....2	(COMPLETED	Full-time.....2	
		son/daughter in-law.....5		Married.....1	[NAME]	Gt. Accra.....3		Ga/Adangbe.....3	IN YEARS	Does not.....3	
		other relatives.....6		Consensual Union.....2	attained?	Volta.....4		Mole-Dagbani.....4	ONLY)		
		adopted/foster/step child.....7		Separated.....3		Eastern.....5		Gurma.....5			
		grandchild.....8		Divorced.....4		Ashanti.....6		Grusi.....6			
		househelp.....9		Widowed.....5		Brong Ahafo.....7		Guan.....7			
		Non-relative.....10		Never married.....6		Northern.....8		Mande.....8			
		Great Grand children.....11				Upper East.....9		other.....9			
		Living together.....12				Upper West.....10					
						Savannah.....11					
						North East.....12					
						Oti.....13					
						Ahafo.....14					
					Western North.....15						
					Bono East.....16						
					Non-Ghanain.....17						
		CODE	YEARS	CODE	YEARS	CODE		CODE	YEARS	CODE	
1											
2											
3											
4											
5											
6											
7											
8											
9											

1. What is your religion?
- a. Christian
- b. Muslim

- c. Traditional
 - d. Any other (Please Specify)
2. If you compare yourself to the most religious person in your religion, how religious are you (on the scale of 0 to 100 %)?
3. Is fishing your only source of income?
- a. Yes
 - b. No
4. How long have you been into fishing/fish related activities?
5. Where have you born to parents primarily engaging in fishing activities?
- a. Yes
 - b. No
6. What is the total number of people in your household?
7. How is your family structured?
- a. Male-centred
 - b. Female-centred
 - c. Nuclear
 - d. Extended
 - f. polygynous
- NB: a. Female-centred (no husband or make partner in the household) b. Male-centred (No wife or female partner in household) c. Nuclear (Male partner and wife with or without children) d. Extended (Both partners, children and other relatives) f. Polygynous (Husband with more than one wife).*
8. how many children does he have aside yours?
9. How many males are in your household?
10. How many females are in your household?
11. How many of your household members are 15 years and below?
12. How many of your household members are aged between 15 and 65 years?
13. How many of your household members are aged above 65 years?
14. If you are married, cohabiting, divorced or widowed what is the ethnicity of your spouse?

15. Which of the two political parties do you believe won the election?

- a. NDC
- b. NPP
- c. Don't know

16. Which of the following two political parties do you associate yourself with?

- d. NDC
- e. NPP
- f. Don't know

17. Are you from a fishing community or have you ever lived in a fishing community?

- a. Yes
- b. No

18. How would you rate your willingness to take risks in your occupational career (0-10)?

19. Please indicate whether or not your household owns any of the following items.

Item	Yes=1; No=0
A radio	
A computer	
A television set	
A smart Telephone	
An analogue Telephone	
A Refrigerator	
A washing machine	
A freezer	
A microwave	
An Air conditioner	
A fan	
An Electric generator/Invertor(s)?	
A Video deck/DVD player	
A Sewing machine	
A Bed	
A Table	
A Cabinet/Cupboard	
A bicycle	
A motorbike	
A motor vehicle	

Women's Empowerment in Fisheries Index**An adapted Women Empowerment in Agriculture Index Questionnaire****Module 7A: Role in household decision making around fish related activities and Income generation**

Enumerator: The purpose of this section is to get an idea about men's and women's relative roles in decision making around production and income-generating activities.

Activity		Did you (singular) participate in [ACTIVITY] in the past 12 months? Yes 1 No 0 >> next activity	How much input did you have in making decisions about [ACTIVITY]? Use CODE 1	How much input did you have in decisions on the use of income generated from [ACTIVITY]? Use CODE 1
Activity No	Activity description	B01	B02	B03
B1	Fish processing			
B2	Fish storage			
B3	Fish transportation			
B4	Fish marketing			
B5	Other income generating activities (e.g., small business such as grocery, making/selling mats, agricultural production (crops), livestock rearing, etc.)			
			Code 1 No input.....1 input into very few decisions.....2 Input into some decision.....3 Input into most decisions.....4 Input into all decisions.....5 No decision made.....6	

Access to productive assets

Enumerator: The purpose of this section is to get an idea about women's and men's access to specific assets and their ability to control use of specific resources.

Productive assets	Does anyone in your household currently have any [ITEM]? Yes 1 No 0 >> next item	How was the [ITEM] acquired? Indicate below how the item was obtained	How many of [ITEM] does your household currently have?	Who would you say owns most of the [ITEM]? Use CODE 1	Who would you say can decide whether to sell [ITEM] most of the time? Use CODE 1	Who would you say can decide whether to give away or rent [ITEM] most of the time? Use CODE 1	Who contributes most to decisions regarding a new purchase of [ITEM]? Use CODE 1
No Asset Description	C01a	C01b	C01c	C02	C03	C04	C05
C1	Locally produced fishing equipment (e.g., baskets)						
C2	Externally produced fishing equipment (e.g., synthetic nets, line and hooks)						
C3	Canoe (or boat) for fishing						
C4	Canoe (or boat) for transportation						
C5	Fish processing						

	equipment (e.g., drying mats, knives, etc.)							
C6	Fish storage equipment (e.g., sacks, bundles							
C7	Means of communicating (e.g., cell phone)							

CODE 1 (for C02 – C05): Decision-making and control over assets	
Self 1	Spouse and other HH member 6
Spouse 2	Spouse with someone outside home ... 7
Jointly with spouse 3	Other HH member 8
Jointly with other HH member 4	Someone outside the home..... 9
Jointly with someone outside home 5	Not applicable.....10

Access to fisheries extension services

Enumerator: The purpose of this section is to gain a better understanding of women's and men's access to fisheries extension services.

#	Question	Response option	Response
D1	Have you ever met with a fisheries extension service officer in the past 12 months?	Yes.....1 No.....0 >> Move to D4	
D2	How many times did you meet with a fisheries extension service officer in the past 12 months?	Enter number of visit	
D3	The last time you met with a fisheries extension service officer, were they a woman or a man?	Man 1 Woman..... 2 More than one (woman and man) 3	
D4	Have you received any training on fishing practices in the past 12 months?	Yes 1 No 0	
D5	Have you ever received training on storage methods in the past 12 months?	Yes 1	

		No 0	
D6	Have you ever received training on fish trading and marketing in the past 12 months?	Yes 1 No 0	
D7	Have you ever received training on food safety in the past 12 months?	Yes 1 No 0	
D8	Have you ever received training on fish processing in the past 12 months?	Yes 1 No 0	
D9	Who provided the training?	specify	

Individual leadership and influence in the fishing camp

Enumerator: The purpose of this section is to get an idea about men's and women's potential for leadership and influence in [name of fishing camp] where they reside.

#	Question	Response options	Response
E1	Do you feel comfortable speaking up in public to help decide on projects and issues affecting this [name of fishing camp] (e.g., canal clearing, fishing ban)?	No, not at all comfortable 1 Yes, but with a great deal of difficulty 2 Yes, but with a little difficulty..... 3	
E2	Do you feel comfortable speaking up in public to protest the use of illegal mesh and other illegal fishing activities?	Yes, fairly comfortable 4 Yes, very comfortable 5	

Gender attitudes

Enumerator: The purpose of this section is to get information about existing gender attitudes relevant within the fishery value chain.

#	Attitude	Agree 1 Partially agree 2 Disagree 3
F1	Women should not get involved in fishing fulltime, this is a man's responsibility	
F2	Women should not own canoes, fishing nets, and other means to fish	
F3	Women should primarily be the ones who clean and process fish	
F4	Women should primarily be the ones who trade or market fish, not men	

F5	Men should primarily be the ones who transport fish to a market for sale	
F6	Men should primarily be the ones who control the earnings obtained from the sale of fish	
F7	Women should primarily be the ones who prepare meals (including fish) for the family or if guests come to visit	
F8	Men should mostly be the ones who belong to fisheries clubs, organizations, or associations, not women	

Time allocation

Enumerator: The purpose of this section is to get an idea about women's and men's time use.

#	Activity	Hours	Minutes	Total (the TOTAL time is key here, need to get the amount of time each day people on average do the following)
G1	Sleeping and resting			
G2	Eating			
G3	Fishing			
G4	Fish processing (drying, smoking fish)			
G5	Fish trading (buying and selling of fish)			
G6	Transporting fish to market			
G7	Gardening, farming, and/or livestock rearing			
G8	Doing other types of business (enterprise) other than fishing, processing fish, etc. such as selling groceries			
G9	Purchasing household items, etc.			
G10	Utilizing public services (e.g., seeking health care)			
G11	Cooking			
G12	Domestic work (collecting firewood, water, sweeping)			
G13	Care for children, adults, elderly			
G14	Daily traveling (to and from the home)			
G15	Leisure activities (e.g., reading, listening to radio, watching TV)			

G16	Sports (e.g., playing football, netball)			
G17	Religious activities			
G18	Drinking alcohol			
G19	Other (specify)			
G20	Do you feel you have enough time for leisure activities? Yes.....1 No.....0			
G21	Who makes the final decision on how your leisure time is spent? Self 1 Spouse 2 Jointly with spouse.....3 Jointly with other HH member 4 Jointly with someone outside home 5 Spouse and other HH member 6 Spouse with someone outside home 7 Other HH member 8 Someone outside the home.....9	