

**EFFECT OF ECONOMIC ACTIVITY DIVERSIFICATION ON
SUSTAINABLE LIVELIHOODS AMONG FISH FARMERS
IN KAKAMEGA COUNTY, KENYA**

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**A Thesis Submitted in Partial Fulfillment of the Requirements for the Award of
Master of Science in Economics in the School of Business and Economics, Masinde
Muliro University of Science and Technology**

DECLARATION

This research thesis is my original work and has not been presented for a degree or any other award in any other university.

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CERTIFICATION

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DEDICATION

I dedicate this thesis to my daughter, Denica Atieno and my parents, Dr. and Mrs. Mukoya for their constant encouragement towards pursuing this academic journey.

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The completion of this thesis was made possible through the contribution of many people from whom their efforts cannot be underscored as they made this work a success. I wish to express my sincere gratitude to them all. My sincere gratitude goes to my supervisors Dr. Consolata Ngala and Dr. Edwin Simiyu for their positive criticism and constant support during this academic journey. I also appreciate the entire Department of Economics of Masinde Muliro University of Science and Technology and my fellow students for the support and guidance accorded. Special gratitude goes to my family, friends and workmates for their support, encouragement and great understanding as I pursued this task. Lastly, I thank the Almighty God for without him I could not have been able to reach where I am.

ABSTRACT

This study investigates the effect of economic activity diversification on sustainable livelihoods among fish farmers in Kakamega County, Kenya. With the increasing demand for fish products and the challenges faced by traditional farming practices, exploring alternative economic activities has become imperative. This study aimed at establishing the effect of economic activity diversification on Sustainable livelihoods among fish farmers in Kakamega County. Specific objectives included to examine the effect of vertical diversification on Sustainable livelihoods among fish farmers in Kakamega County, To determine the effect of structural diversification on Sustainable livelihoods among fish farmers in Kakamega County, To examine the effect of Portfolio diversification on Sustainable livelihoods among fish farmers in Kakamega County and finally, to evaluate the moderating effect of entrepreneurship determinants on the relationship between economic activity diversification and sustainable livelihoods among fish farmers in Kakamega County. The study was guided by Sustainable Livelihoods Theory, economic diversification theory, entrepreneurial theory and the value chain theory. Descriptive and survey research designs were used in the study. The target population was 4500 fish farmers in Kakamega County from which a sample of 354 fish farmers was selected for the study using the Krejcie and Morgan Table 1970. Data was collected using closed-ended questionnaires. Data collected was analyzed using SPSS version 26. The researcher was cognizant of ethical principles of research. The study's findings revealed that 29.5% of variations in Sustainable Livelihood among fish farmers in Kakamega County was explained by structural diversification, 44.7% by Portfolio diversification and 30.1% was explained by Vertical Diversification. Generally, Economic Activity Diversification explained 50.2% changes on sustainable livelihoods. When moderated with Entrepreneurial determinants, the influence of economic diversification could explain 58.1% of the changes in sustainable livelihoods among fish farmers in Kakamega County. Vertical diversification positively influences the accumulation of physical assets among the fish farmers, while Portfolio diversification positively correlates with increased income levels among fish farmers in Kakamega County, whereas, engaging in diverse economic activities facilitates interactions with a wider range of individuals; these expanded social networks provide access to valuable information, resources, and support systems. However, challenges such as limited access to finance, inadequate market linkages, and technical knowledge gaps hindered the full realization of the potential benefits of economic diversification among fish farmers. The study concludes that economic activity diversification is a viable strategy for enhancing sustainable livelihoods among fish farmers in Kakamega County. Policy interventions and support services should focus on addressing the identified challenges while promoting inclusive and sustainable diversification initiatives to maximize the socio-economic benefits for farming households. By harnessing the potential of economic diversification, fish farmers can improve their resilience, accumulate more physical assets, improve their income levels, and overall well-being, contributing to poverty reduction and rural development in the region.

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LIST OF ABBREVIATIONS AND ACRONYMS

AAK	Aquaculture Association of Kenya
ADP	Agricultural Development Programme
CGK	County Government of Kakamega
EU	European Union
FAO	Food and Agriculture Organization
FGD	Focus Group Discussions
GDP	Gross Domestic Product
ILO	International Labour Organization
KSHS	Kenya Shillings
KNBS	Kenya National Bureau of statistics
MMUST	MMUST Masinde Muliro University of Science and Technology
NACOSTI	National Commission for Science Technology and Innovation
NGO	Non-Governmental Organizations
PNSP	Productive Safety Net Program
SLF	Sustainable Livelihoods Framework

SACCO Savings and Credit Cooperative

UN United Nations

SLT Sustainable livelihoods theory

OPERATIONAL DEFINITION OF TERMS

Economic Activity	A fish farmer's entrepreneurial activity can be defined as
Diversification	engaging in a wide range of activities, both for profit and for fun, in addition to their main activity of farming.
Entrepreneurship	The imaginative and inventive process of replacing entrenched practices with novel goods, services, and technologies that improve people's quality of life.
Structural Diversification	This refers to a strategic approach where a company expands its operations into new markets, industries, or product lines that are unrelated to its core business. This strategy aims to spread risk, capture new growth opportunities, and enhance the company's resilience to market fluctuations. Diverse crops and livestock, including fish, are the hallmarks of mixed farming.
Sustainable Livelihoods	The ability of individuals, households, and communities to secure the resources, assets, and capabilities necessary for a decent standard of living, both now and in the future, while preserving and enhancing the natural and social resources on which they depend. A way of making a living that makes use of one's skills, interests, and connections in order to sustain oneself.
Vertical Diversification	This represents a calculated approach to business growth, wherein an organization broadens its activities across various phases of the supply chain within a singular industry. The enhancement of primary agricultural products through methods such as processing, branding, or packaging.

Portfolio Diversification	This is a risk management strategy that involves spreading investments across different asset classes, industries, regions, or securities to reduce overall investment risk and enhance potential returns.
Off-farm Activities	The term encompasses the income generated by farm households from sources outside of farming, which includes non-farm wages and salaries, pensions, and interest income accrued by agricultural families.
Vulnerabilities	These are elements external to the pastoralists' household that render them susceptible to unfavorable livelihood outcomes.
Household Stability	This pertains to the enhancement of household income, the accessibility of education within the household, the improvement of dietary intake, and the augmentation of household assets. This was assessed by evaluating the changes in income, education, and dietary intake in relation to the diversification of livelihood strategies, determining whether they increased, remained constant, or diminished. .

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The theoretical framework for this study is grounded in the principles of rural economic diversification and sustainable livelihoods. The Sustainable Livelihoods Approach (SLA) posits that diverse economic activities can enhance resilience and improve living standards for rural households. This approach emphasizes the importance of assets natural, social, human, physical and financial available to households and how these can be leveraged to diversify livelihoods (Scoones, 1998). In the context of rural areas, especially in developing countries, diversification into non-agricultural activities is crucial for reducing vulnerability to economic shocks and improving food security (Ellis, 2000).

Globally, rural economic diversification encompassing both agricultural and non-agricultural activities holds significant potential for reducing poverty and enhancing food and livelihood security among rural households. According to the International Labour Organization (ILO, 2019), this diversification can bolster coping mechanisms against crop failures and price volatility, benefiting rural populations worldwide. While approximately 20 to 50 percent of the rural workforce in regions like Africa, Asia, and Latin America is engaged in non-farm work, many still rely heavily on agriculture for their livelihoods (Wahome, Kiema, & Mulaku, 2023). In the broader context of rural development strategies, a dynamic agricultural sector is essential. It not only creates better jobs within agriculture but also fosters the growth of non-farm activities. To harness the potential of economic diversification for poverty alleviation and decent work, three critical policy priorities are recommended: strengthening family farms, developing food product markets to mitigate producer risks, and implementing

territorial policies that enhance rural-urban linkages through the promotion of small cities and towns (ILO, 2019).

Regionally, rural economies in lower-income countries often remain characterized by subsistence-driven agriculture. A survey across 26 rural areas in seven developing countries including Kenya revealed that 93 percent of households' own farms (ILO, 2019). Poverty in these rural areas is pervasive, with the proportion of people living below the national poverty line reaching as high as 84 percent in Zimbabwe and averaging two to three times higher than urban poverty in many countries, except for Vietnam and Cameroon, where it is even more pronounced (U.N., 2021). In these circumstances, rural populations prioritize minimizing risks and achieving food security through self-consumption (U.N., 2021). To achieve rapid poverty reduction, developing a vibrant agricultural sector alongside diversifying into non-agricultural activities is crucial (Shonhe & Scoones, 2022). The emergence of non-farm economic activities often follows agricultural growth; for instance, in Southeast Asia, a prosperous agricultural sector has historically fueled investments in industrial enterprises. Thus, the prospects for economic diversification are most promising in well-connected rural areas with expanding agricultural productivity (ILO, 2019).

In Kenya, the fish farming sector has seen significant growth, positioning itself as a key contributor to food security and rural livelihoods. Fish production has been the fastest-growing food industry globally over the last four decades and is expected to continue its upward trajectory (Béné et al., 2020). In Africa, small-scale fish farming plays a vital role, with millions of families depending on it for their livelihoods (Gatonye, 2021). Kakamega County, in particular, benefits from diverse water sources such as rivers, springs, and dams, making it well-suited for fish farming (County Government of Kakamega, 2015). Fish farming households in this region primarily cultivate Nile

tilapia (*Oreochromis niloticus*) and African catfish (*Clarias gariepinus*) (Nguka et al., 2020). However, challenges such as land fragmentation and rugged terrain limit the size of fishponds, resulting in production levels that do not meet market demand despite the cumulative area of small ponds (Kiiru & Munguti, 2021). Thus, while the potential for fish farming in Kakamega County is substantial, addressing these limitations is essential for maximizing its contributions to rural economic diversification and sustainable livelihoods.

This study stems from the pressing need to explore how rural economic diversification, particularly through fish farming, can serve as a catalyst for improving livelihoods in Kakamega County. As rural communities grapple with challenges such as poverty, food insecurity, and market volatility, understanding the dynamics of diversifying into fish farming offers valuable insights for policy-makers and stakeholders. This research aims to identify the barriers and opportunities within the fish farming sector, providing evidence-based recommendations for enhancing its role in economic diversification. By focusing on this specific context, the study seeks to contribute to broader discussions on sustainable rural development and the importance of integrating agricultural and non-agricultural activities to promote resilience and economic stability among rural households.

1.1.1 Economic Activity Diversification

Markides et al. (2021) articulate that economic activity diversification constitutes an entrepreneurial behavior in which individuals partake in various commercial endeavors to sustain their livelihoods. According to Peng, Robinson, Zheng, Li, Wang, and Li (2022), livelihood activity diversification is conceptualized as the method through which households develop a varied array of activities and social support mechanisms to

enhance their quality of life. Rantamaki-Lahtinen (2018) recognizes that diversification has long been a practice among farmers, and the trend of integrating farms with additional profitable activities is increasingly prevalent within the European Union. She further asserts that farmers who have diversified their livelihoods are strategically positioned to effectively utilize resources in managing their farm-firm complexes. Carter (2019) notes that research on entrepreneurial behavior among small-scale farmers has primarily focused on the value addition chain of agricultural produce, while numerous non-agricultural entrepreneurial activities undertaken by these farmers remain overlooked. He further asserts that the diversification of farmers into non-agricultural activities significantly contributes to employment generation and the advancement of rural economies.

Furthermore, Karugia et al. (2016) noted that an increase in farm productivity by itself may not ensure that small-scale farmers achieve adequate incomes to break free from their circumstances. Nonetheless, expanding into non-agricultural enterprises could prove significantly more crucial in mitigating vulnerability. Agriculture in Africa, especially on small-scale farms, has not yet emerged as a lucrative investment. In contrast, in developed nations, agriculture proves to be a profitable endeavor as farmers exhibit entrepreneurial tendencies through methods such as processing their produce, engaging in mixed farming, or diversifying into non-agricultural enterprises (Makaya, 2017). According to Fouracre (2021), the engagement in entrepreneurial endeavors by small-scale farmers ought to result in heightened agricultural output, diversification into income-generating activities beyond farming, or seeking employment opportunities on other farms. Wasserman (2018) posits that the integration of

agricultural practices with non-agricultural business methodologies presents a highly promising avenue for enhancing livelihoods.

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1.1.2 Sustainable Livelihood

The Department for International Development (DFID) (2019) articulates livelihood as a synthesis of human capabilities, assets, and activities essential for sustaining a means of living. Moreover, a livelihood is considered sustainable when it possesses the capacity to withstand and recuperate from environmental stresses and shocks. A sustainable livelihood must be capable of preserving or enhancing its capabilities and assets while ensuring that natural resources are not compromised. The concept of rural livelihood diversification refers to the method by which households situated in rural regions develop a varied array of activities and social support mechanisms to enhance their quality of life (Peng et al, 2022). According to Chambers and Conway (2021), the concept of poverty reduction in rural areas is framed within the paradigm of sustainable rural livelihood, which is characterized by an ongoing process of change and the positive transformation of rural communities. The concept of sustainable livelihood must encompass the assurance of individuals' current well-being while also safeguarding the welfare of future generations. Fouracre (2021) elucidates the concept of livelihood through a sustainable livelihood framework that encompasses vulnerability context, capital assets, transforming structures and processes, as well as livelihood strategies and outcomes. The context of vulnerability pertains to the capacity of marginalized populations to endure the impacts of phenomena like globalization and various shocks, such as

drought, alongside the evolving nature of culture. The frameworks and mechanisms of transformation are established by the private and governmental entities that oversee the various livelihood opportunities available to individuals. It is essential to comprehend these elements, as they play a pivotal role in assessing the value of assets and delineating access to diverse resources. Ultimately, the strategies individuals employ to sustain their livelihoods significantly influence the outcomes they achieve, including increased income, enhanced living standards, and diminished vulnerability (Boli, 2022).

Nonetheless, Nee and Young (2021) proposed that the government ought to establish institutions aimed at promoting sustainable rural livelihoods for small-scale farmers. Minniti (2022) posits that the United States excels in entrepreneurship compared to other nations due to its liberal policies that create conducive conditions for entrepreneurial activities. These include financial support, education and training in entrepreneurship, and social norms that foster entrepreneurial behavior, ultimately enhancing livelihoods. The interplay among entrepreneurship, economic growth, poverty alleviation, and sustainable development is essential for the advancement of a nation. Consequently, sound policy and research outcomes ought to guide the economic initiatives. The European Union has deliberately embraced the entrepreneurship policy referred to as the Gothenburg Strategy, which is based on the cohesive advancement of economic, social, and environmental elements as the foundational pillars to elevate the European economy to new heights (CEC, 2023).

1.1.3 Fish Farming in Kakamega County

In 2021, the former Kakamega County Governor FCPA Wycliffe Oparanya and the Swedish Ambassador to Kenya H.E Madam Caroline Vicini officially commissioned the Kakamega County Fish Processing Plant at Lutonyi, in Lurambi Sub-County, (County Government of Kakamega Agriculture Report, 2021) to promote fish value addition and marketing. The County Government of Kakamega further invested approximately Kshs. 100 million to promote aquaculture and provide fish farmers with subsidized fish feeds and fingerlings (Kakamega County Agriculture Report, 2021). Despite these efforts, the fish production in Kakamega County is as low as 0.36 kilograms per square meter among smallholder producers compared to the potential of 0.50 - 0.70 kilograms/m² (KNBS,2023). The mostly practiced poly-culture (more than one species) of tilapia with African catfish and mixed sex culture system of farming resulted in low pond productivity. Other teething troubles noted included limited supply of fingerlings, limited value addition/processing, limited quality feeds and limited market access. These perennial fish farming problems prompted most farmers to venture into economic activity diversification with an aim of increasing farm incomes and profitability (County Government of Kakamega Agriculture Report, 2021).

1.2 Statement of the Problem

The challenge of achieving sustainable livelihoods in rural Africa is pressing, particularly in the context of ongoing debates about effective strategies for poverty alleviation. The controversy surrounding the World Bank's 2020/2021 report on poverty and the strategies proposed by other Bretton Woods Institutions indicates a lack of consensus on what truly enhances rural livelihoods (Tschirley & Benfica, 2022). The Food and Agriculture Organization (FAO, 2022) has called for investigations into what is urgently needed to revive the Kenyan economy, emphasizing economic activities that

have the potential to improve livelihoods sustainably. Scholars such as Barringer and Ireland (2021), Butter and Mazur (2022), and Fouracre (2022) suggest that entrepreneurship, particularly through economic activity diversification, could be pivotal for small-scale farmers to achieve better livelihoods.

However, despite the recognition of the importance of diversification, there is a notable gap in understanding how these activities impact sustainable livelihoods, especially within the context of fish farming. Peng et al. (2022) observed that while rural households often engage in multiple business occupations, few studies have linked economic activity diversification to specific livelihood outcomes, particularly for fish farmers. The complex interactions among poverty, income distribution, farm productivity, environmental conservation, and gender relations create a paradox that complicates straightforward interpretations of livelihood outcomes. This complexity has led to contradictory practices and policy recommendations, such as Kenya's Vision 2030, which advocates for value addition in agriculture, while Karugia et al. (2020) recommend diversification into non-agricultural activities to enhance living standards.

In Kakamega County, the potential of fish farming to contribute to sustainable livelihoods is hindered by challenges like underinvestment and poor management practices, resulting in low yields. Despite significant investments by the County Government in fish farming initiatives, such as the Aquaculture Business Development Programme (ADBP), the number of fish farmers remains below market demand (International Fund for Agricultural Development, 2021). Karugia et al. (2020) argue that an excessive focus on diversified economic activities has diverted attention from optimizing fish farming practices. Consequently, production levels do not meet local demand, and many farmers are reluctant to invest in fish farming, with some abandoning their efforts altogether (Nguka et al., 2020; Otieno, 2019).

This study aims to address the critical issue of sustainable livelihoods by investigating how economic activity diversification, specifically through fish farming, can enhance the resilience and well-being of households in Kakamega County. The limited understanding of the determinants and impacts of economic diversification on the livelihoods of fish farmers necessitates comprehensive research. Previous studies have not adequately explored how various forms of diversification—such as vertical, structural, and portfolio diversification—affect sustainable livelihoods in the fish farming sector.

1.3 Objectives of the Study

1.3.1 General Objectives of the Study

The general objective of the study was to establish the effect of economic activity diversification on Sustainable livelihoods among fish farmers in Kakamega County.

1.3.2 Specific Objectives

The study sought to address the following specific objectives;

- i. To examine the effect of vertical diversification on Sustainable livelihoods among fish farmers in Kakamega County.
- ii. To determine the effect of structural diversification on Sustainable livelihoods among fish farmers in Kakamega County.
- iii. To examine the effect of Portfolio diversification on Sustainable livelihoods among fish farmers in Kakamega County.
- iv. To evaluate the moderating effect of entrepreneurship determinants on the relationship between economic diversification and sustainable livelihoods among fish farmers in Kakamega County.

1.4 Research Hypothesis

This study sought to answer the following research hypotheses;

H₀₁: Vertical diversification has no statistically significant effect on Sustainable livelihoods among fish farmers in Kakamega County.

H₀₂: Structural diversification has no statistically significant effect on Sustainable livelihoods among fish farmers in Kakamega County.

H₀₃: Portfolio diversification has no statistically significant effect on Sustainable livelihoods among fish farmers in Kakamega County.

H₀₄: Entrepreneurship determinants have no statistically significant moderating effect on the relationship between economic diversification and Sustainable livelihoods among fish farmers in Kakamega County.

1.5 Significance of the Study

The significance of this study extends to the researcher, Kenyan Society, academic institutions universities among other stakeholders.

1.5.1 Researchers and Academics

Researchers and academics studying rural development, sustainable livelihoods, and agricultural economics benefit from the study findings by gaining new insights into the dynamics of economic diversification in rural communities. This leads to further research and knowledge dissemination in the field, contributing to the broader academic discourse on rural development strategies.

1.5.2 Government and Policymakers

The local government and policymakers can use this study's findings to design more effective policies and programs that support economic diversification initiatives among fish farmers. This includes providing access to training and capacity-building programs,

facilitating market linkages for alternative livelihood activities, and investing in infrastructure to support diversified economic development in rural areas.

1.5.3 Local Communities

The broader community in Kakamega County stands to benefit from the study findings. Economic activity diversification among fish farmers can lead to increased employment opportunities, improved food security through diversified food production, and enhanced local economic development. This contributes to poverty reduction and overall community well-being.

1.5.4 Fish Farmers

The primary beneficiaries are the fish farmers themselves. They gain insights into the potential benefits of diversifying their economic activities beyond fish farming. This knowledge helps them improve their livelihood resilience, increase their income streams, and reduce vulnerability to market fluctuations and environmental risks.

1.5.5 Development Organizations

NGOs, development agencies, and international organizations working in Kakamega County can utilize this study's findings to tailor their interventions and support services to better meet the needs of fish farmers and promote sustainable livelihoods. This involves providing technical assistance, financial support, and access to markets for alternative income-generating activities.

1.5.6 Private Sector:

Businesses and entrepreneurs in Kakamega County stand to identify new opportunities for collaboration or investment based on the findings of this study. This is not limited to

demand for inputs, equipment, or services related to alternative livelihood activities identified through economic diversification efforts among fish farmers.

1.6 Scope of the study

This study focused on the effect of economic activity diversification on Sustainable livelihoods among fish farmers in Kakamega County. Specifically, it studied the effect of vertical, structural and portfolio diversification on sustainable livelihoods among fish farmers in Kakamega County. The moderating effect of entrepreneurship determinants which covered farm, personal and social characteristics on sustainable livelihoods among fish farmers was also examined. The target population for the study was fish farmers in Kakamega County. The sample population of the study was 354 fish farmers across all the sub-counties in Kakamega County. The respondents for this study were fish farmers in the twelve sub-counties as well as officers in the Ministry of Agriculture working within the fisheries department. The time scope for data collection covered the period of August 2022 to November 2023 owing the initiation of Small-Scale Fish Farming Recovery Strategy of 2022 by the County Government of Kakamega in July, 2021.

1.7 Limitation of the study

This section presents the challenges and problems encountered during the research process and how the researcher overcame them; Language and cultural differences between researchers and study participants posed communication barriers and almost affected the quality of data collected. The researcher overcame this challenge through working with local translators and interpreters who were familiar with the cultural context and language spoken by the community. The researcher also built strong

relationships with local stakeholders to learn cultural sensitivity practices in order to navigate cultural nuances and ensure effective communication during the research process.

Ensuring the safety and security of researchers during fieldwork, particularly in areas prone to insecurity in Kakamega County was paramount for the successful completion of this research work. The researcher overcame this by conducting a comprehensive risk assessment prior to fieldwork. This necessary to identify potential security threats and vulnerabilities. This assessment considered factors such as the local socio-political context, crime rates, presence of armed groups, and recent incidents of violence or unrest in the area. The researcher later established contacts with trusted local individuals, community leaders, and organizations who provided valuable insights into the security situation and help if needed.

This study also predicted that some fish farmers may be busy and other reluctant to divulge private business information. This was addressed through assuring respondents that their responses are confidential and anonymized to protect their privacy. The researcher also emphasized the importance of honest and candid feedback for the success of the research project. Informed consent from respondents before administering the questionnaires hence maintaining transparency throughout the research process by providing clear explanations of research objectives, methods, and expected outcomes. The researcher adhered to ethical guidelines and principles of research conduct, including honesty, integrity, and respect for human dignity. The researcher would then explain to them the purpose of the investigation and that it would be useful for academic purpose only.

The vastness of Kakamega County presented a logistical challenge for the researcher. The researcher overcame this through utilizing Purposive sampling, cluster sampling methods and Simple random sampling during the data collection process. This implies that the researcher used the Sub county fisheries officer to gather the registered fish farmers where they may with the researcher there after selected them through simple random sampling. The researcher also collaborated with local organizations, institutions, and community leaders across different regions of Kakamega County who provided valuable insights that facilitated access to remote or hard-to-reach areas within the county.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This section also presents the theoretical literature review, conceptual literature review, empirical literature review and the conceptual framework of the study.

2.2 Theoretical Literature Review

The study was anchored on the main theory of Sustainable Livelihoods which was guided or assisted by theory of economic diversification, Value chain theory and

2.2.1 Sustainable Livelihoods Theory

Sustainable Livelihoods Theory (SLT) emerged as a significant framework within development discourse, particularly during the 1990s, following a series of cross disciplinary research efforts that began in the 1970s. Scholars such as Lipton and Moore (1972), Farmer (1977), and Moock (1986) contributed foundational insights that informed early household and village studies, ultimately shaping the discourse around livelihoods. The theory gained traction as concerns over poverty reduction and sustainable development intensified, leading to a paradigm shift towards people centered approaches (Chambers & Conway, 1992; Scoones, 2009). This theoretical evolution reflects a departure from top-down models that dominated earlier development efforts, emphasizing the importance of understanding livelihoods from the perspectives of those directly affected.

Chambers and Conway's (1992) definition of sustainable livelihoods highlights the integration of capabilities, assets and activities necessary for a means of living. They argue that a sustainable livelihood can withstand shocks, maintain its assets and capabilities and provide opportunities for future generations. This perspective aligns closely with the dynamics of economic activity diversification among fish farmers in Kakamega County, where understanding these components is essential for fostering resilience and sustainability.

Vertical diversification involves expanding existing fish farming operations, such as processing or marketing fish products. SLT emphasizes the enhancement of human and financial capital, suggesting that training in processing techniques can empower farmers to capture greater market value, thereby increasing income stability. This objective directly links to SLT's assertion that diversified income sources contribute to

the sustainability of livelihoods. Structural diversification forms of diversification entails engaging in alternative economic activities, such as crop farming or aquaculture-related services. By fostering community networks and collective action, structural diversification enhances social capital, which is crucial in supporting sustainable livelihoods. SLT underscores that such diversification not only provides new income streams but also promotes environmental sustainability through the responsible use of natural resources.

Portfolio diversification may engage fish farmers in various economic activities to mitigate risks associated with market fluctuations. SLT highlights the importance of financial capital in enabling such diversification. By spreading investments across different sectors, farmers can enhance their resilience to economic shocks, directly reflecting SLT's focus on adaptive capacity and long-term sustainability's posits that entrepreneurial skills enhance human capital and resource mobilization, enabling farmers to effectively pursue diversification strategies. This relationship illustrates how supporting entrepreneurship can significantly amplify the benefits of diversification efforts.

Despite its strengths, Sustainable Livelihoods Theory has faced critiques, particularly regarding its applicability and comprehensiveness. One major criticism is that SLT can be overly broad, potentially leading to a lack of focus on specific local contexts and dynamics (Bebbington, 1999). In the case of Kakamega County, unique challenges such as local governance issues, market access constraints and environmental vulnerabilities may not be fully addressed within the generalized SLT framework. Additionally, while SLT emphasizes the importance of assets and capabilities, it may downplay the complex interplay of power relations and socio-political factors that influence livelihood strategies. Understanding the influence of these external factors is essential

for comprehensively assessing the effectiveness of diversification strategies among fish farmers. Furthermore, the focus on asset accumulation might inadvertently reinforce existing inequalities, as those with more resources may benefit disproportionately from diversification opportunities. However, Sustainable Livelihoods Theory provides a valuable framework for exploring the effects of economic activity diversification on the livelihoods of fish farmers in Kakamega County. This nuanced understanding can inform both research and policy, guiding efforts to improve sustainable livelihoods in vulnerable communities.

2.2.2 Theory of Economic Diversification

The Theory of Economic Diversification is rooted in the understanding that diversifying income sources can enhance resilience and sustainability for individuals and communities. Economists such as Hirschman (1983) emphasized that diversification can lead to economic development by enabling households to reduce vulnerability to shocks and fluctuations in income. The theory posits that households and businesses that diversify their economic activities are better positioned to manage risks associated with market volatility and environmental changes. In this context, structural diversification expanding into entirely new sectors or types of economic activities plays a critical role in promoting sustainable livelihoods.

Structural diversification is particularly relevant for fish farmers in Kakamega County, where reliance on a single income source, such as fish farming, can expose them to significant economic and environmental risks. The theory suggests that by engaging in alternative livelihoods such as crop farming or aquaculture-related services, farmers can enhance their overall economic stability and improve their resilience to shocks. This approach aligns with the notion that diverse economic activities can create synergies, allowing households to leverage different forms of capital (natural, social, financial)

effectively.

The objective to determine the effect of structural diversification on sustainable livelihoods among fish farmers in Kakamega County can be examined through the lens of Economic Diversification Theory. Structural diversification enables fish farmers to access new markets, improve their income stability and foster innovation in their practices. By adopting new agricultural techniques or engaging in value added activities related to fish farming, farmers can enhance their social capital through community networks and collaborations.

For instance, a fish farmer who diversifies into vegetable farming can benefit from crop rotations, improve soil health and create a more balanced ecosystem. This not only increases food security but also provides an additional income stream that can be crucial during periods when fish prices are low or fish populations are affected by environmental changes. Structural diversification thus aligns with the principles of the Theory of Economic Diversification, highlighting how alternative economic activities can support sustainable livelihoods by reducing dependency on a single income source. Furthermore, structural diversification can enhance access to resources and knowledge. For example, farmers who engage in cooperative ventures can share tools, technology, and market access, fostering a sense of community and improving overall productivity. This collective approach underscores the link between structural diversification and enhanced social capital, a key component of sustainable livelihoods.

Despite its strengths, the Theory of Economic Diversification has limitations that must be acknowledged. One critique is that while diversification may reduce risk at the individual level, it does not always guarantee equitable benefits across communities. Some farmers, particularly those with limited resources or access to information, may struggle to diversify effectively, leading to disparities in income and livelihoods (Davis

et al., 2016). This issue highlights the importance of considering social and economic inequalities when assessing the impacts of structural diversification.

Moreover, the theory may oversimplify the complexities involved in diversification. Factors such as market access, local governance, and environmental conditions can significantly influence the success of diversification efforts. For instance, if farmers lack access to markets for their diversified products, the intended benefits may not materialize. Thus, while the Theory of Economic Diversification provides a valuable framework, it is essential to contextualize its application within the specific socio-economic dynamics of Kakamega County. By linking the principles of the theory to the research objective, we can explore how diversifying into new economic activities can enhance resilience, stability, and overall well-being. However, it is crucial to consider the limitations of the theory, particularly regarding equity and the complexities of local contexts.

2.2.3 Value Chain Theory

The central postulation of Porter's Value Chain theory is that a firm can gain a competitive advantage by understanding and optimizing the series of activities it engages in to deliver a product or service. Each activity ranging from inbound logistics to marketing and service contributes to the overall value created for customers (Porter, 1985). In the context of fish farming in Kakamega County, the theory posits that by diversifying activities (e.g., processing and distribution), fish farmers can increase the value of their products, capture higher prices, and improve their overall profitability and sustainability.

Despite its widespread application, the value chain theory has faced several critiques. One significant criticism is that it can oversimplify complex business environments by

focusing too narrowly on individual firm activities without considering broader systemic factors, such as market dynamics and environmental influences (Wheeler, 2002). Additionally, the model often assumes a linear progression of activities, which may not accurately reflect the interdependencies and fluidity present in modern supply chains. Critics argue that this can lead to a lack of attention to innovation and adaptability in a rapidly changing market (Kaplinsky, 2000). Furthermore, the emphasis on profit maximization may overlook important social and environmental impacts, potentially leading to unsustainable practices (Gereffi, 2005).

From a student's perspective, the value chain theory provides valuable insights into how businesses, including fish farms, can optimize their operations. However, it's essential to recognize the limitations of the model in today's complex and interconnected world. While understanding each activity's contribution to value creation is crucial, students might argue that there should be a greater emphasis on sustainability and ethical practices. For instance, fish farmers should not only focus on profitability through processing and distribution but also consider the ecological impacts of their practices and the well-being of their communities. This holistic approach could ensure that value creation aligns with long-term sustainability, balancing economic, social, and environmental considerations (Elkington, 1997). Embracing this perspective can help future entrepreneurs foster resilience and responsibility in their business practices.

2.2.4 Entrepreneurship Theory

Entrepreneurship Theory emphasizes the role of individuals and organizations in creating economic value through innovation, risk-taking and proactive decision making. Scholars such as Joseph Schumpeter (1934) highlighted the importance of entrepreneurship in driving economic growth and change through the introduction of

new products and processes. This theory posits that entrepreneurs are not only critical for economic development but also serve as catalysts for social change and community resilience.

In the context of fish farmers in Kakamega County, Entrepreneurship Theory underlines how entrepreneurial behaviors and characteristics can influence economic diversification and enhance sustainable livelihoods. The ability to identify opportunities, mobilize resources and adapt to changing market conditions is essential for farmers looking to diversify their income streams. As noted by Davidsson and Honig (2003), successful entrepreneurs are those who can effectively navigate uncertainty and leverage their skills to exploit new market opportunities, which is particularly relevant in the agricultural sector.

Entrepreneurship determinants on the relationship between economic diversification and sustainable livelihoods is crucial for understanding how entrepreneurial skills and resources affect farmers' capacity to diversify effectively. Entrepreneurship determinants such as access to capital, education, market information and networks can significantly influence the success of diversification efforts among fish farmers. For instance, access to microcredit or financial services can empower farmers to invest in new ventures, such as value-added processing of fish or alternative crops. This aligns with the postulation of Entrepreneurship Theory that emphasizes the importance of financial capital in enabling innovation and diversification (Gertner, 2014). Similarly, educational programs that enhance entrepreneurial skills can improve farmers' decision-making abilities, allowing them to better assess risks and opportunities in their diversification strategies.

Moreover, social networks play a crucial role in entrepreneurship. The ability to

connect with other farmers, market actors and support organizations can provide essential information and resources that facilitate successful diversification. By fostering strong networks, farmers can share knowledge, reduce transaction costs and enhance their collective bargaining power, thus supporting their livelihoods in the face of economic challenges (Davidsson & Honig, 2003).

While Entrepreneurship Theory offers valuable insights, it is not without its critiques. One significant limitation is that the theory may overemphasize individual agency at the expense of broader structural factors that influence entrepreneurial success. For example, systemic barriers such as inadequate infrastructure, poor access to markets and socio-political instability can severely limit the entrepreneurial potential of fish farmers in Kakamega County (Gertner, 2014). These external factors can create an uneven playing field, making it difficult for certain farmers to capitalize on diversification opportunities, regardless of their entrepreneurial mindset.

Additionally, the focus on individual entrepreneurship might neglect the importance of collective action and cooperative models in rural settings. In contexts where resources are limited, collective entrepreneurship where farmers work together to achieve common goals can be more effective than individual efforts. This aspect is particularly relevant for fish farmers, who may benefit from forming cooperatives to share resources, reduce risks, and improve access to markets (Davidsson & Honig, 2003).

2.3 Conceptual Review

2.3.1 Concept of Economic Activity Diversification

The World Bank Group (2021) defines economic activity diversification as the process of diversifying trade and domestic products to achieve enhanced economic returns.

Moreover, Esanov (2016) characterizes economic activity diversification as the process through which the economy of a specific polity or nation is evaluated in relation to the variety of goods and services produced, juxtaposed with the returns generated from those delivered goods and services. From these definitions, it is clear that the diversification of economic activities entails the variation of economic practices undertaken by various groups to achieve enhanced returns. This study leads us to conclude that the economic activities of numerous African communities are inextricably intertwined with the socio-cultural practices of their diverse populations. Nevertheless, the study concludes that the aspiration for enhanced economic yields has propelled the pursuit of diversification in economic activities (Musumba, Palm, Komarek, Mutuo & Kaya, 2022). In this study, economic activity diversification is characterized as the transition of an economy from reliance on a singular source of income to the establishment of multiple income streams.

Shifting from low-income sources to higher-value crops, livestock, and non-farm activities that produce better economic return per unit of labor is known as livelihood diversity (Adger, 2006). The reasons why households diversify their sources of income vary greatly within rural communities (Chavum et al., 2012; Joshi et al., 2021). Diversifying livelihoods is done to reduce risks, handle shock, or find a substitute for agricultural production. Residents of these communities have developed alternative sources of income as a result of the corresponding rise in poverty.

Crops, livestock production and fisheries are examples of on- farm while off-farm activities are market and non-market enterprises that are used as livelihood

diversification methods to reduce risks associated with erratic agro-climatic, political, and economic conditions (Bryceson, 2002; Peng et al, 2022; Hussien, 1998). As a result, the rural economy is not just dependent on agricultural production but rather on a wide range of economic activities. Farming is still significant, but the rural population continues to look for possibilities to diversify their sources of income and boost them (Aye, 2013). For rural households in developing nations, diversifying their sources of income is a strategy for survival (Peng et al, 2022). For their daily survival, rural households engage in a variety of income-generating activities. Farming and non-farming activities can be roughly characterized as forms of livelihood diversification (Barett et al., 2001).

For rural farm households, the importance of non-farm income has increased. Self-employment or paid job opportunities in manufacturing, crafts, artisan work, commerce, and services are examples of non-farm employment. These methods are now a crucial part of rural farm households' income-generating activities (Barett et al., 2001). The non-farm sector encourages inter-sectoral linkages and exchanges, reduces rural-urban migration, promotes equitable income distribution, broadens economic participation, and acts as a buffer during agricultural production's off-seasons in addition to offering strategic employment alternatives to agriculture (Bezu and Barrett, 2012; Oluwatayo, 2017).

Diversifying one's means of subsistence is also seen as another means of generating income; the different economic activities and assets combined influence the standard of living attained by an individual or a household. While a household in a specific context and economy is typically forced to choose between three main clusters of livelihood

options: intensive agriculture and having a wide variety of activities, livelihood diversification, and migration (Sati et al., 2015), livelihood strategies are the range and combination of activities and choices individuals make to achieve their livelihood goals. Changes in a rural household's access to resources and a variety of other external conditions are reflected in these approaches (Oni-Fashogbon, 2013). It should be mentioned that ensuring economic and social security is the primary objective of livelihood strategies (Koczberski et al., 2001).

Non-agricultural activities are more common than you might think in rural households. Studies conducted over a number of years have shown how important non-agricultural income is to rural households. The process of expanding income and livelihood strategies away from a mono-economy of agricultural (crop and animal) production to encompass both farm and non-farm activities is the focus of the livelihood diversification initiative. According to Bezu et al. (2012), the purpose is to earn additional income through the production of other agricultural and non-agricultural goods and services, by way of waged labor or self-employment, and other means.

Despite the fact that most of the literature defines 'diversification' in terms of profitable ventures or income generation, the concept of 'livelihoods' has extended the discussion to include the process by which rural households build a diverse portfolio of activities and social support capacities to raise their standards of living (Sati et al., 2015). The options available in terms of capacities, assets (including both material and social resources), and activities determine how a household responds to and endures economic shocks. It suggests that households should act differently in terms of generating money and maintaining living standards. Particularly, households from various socioeconomic

categories employ a variety of livelihood strategies, which in turn may result in varying degrees of resilience to food insecurity and welfare status. Therefore, homes from various socioeconomic groups such as agricultural households and households of public employees need a variety of interventions. Therefore, entrepreneurship and livelihood development initiatives should be customized to consider the various demands of the population.

The necessity to alleviate rising levels of poverty by raising living standards has led to a diversification of livelihoods, particularly in emerging economies (Bosc et al., 2006). Due to the economic and socio-political turmoil these nations have suffered over the past ten years, the poverty rate has increased in sub-Saharan countries. The problem is made worse by the dropping and erratic income, the slow pace of capital creation, and the decreasing agricultural output brought about by rapidly shifting climatic conditions.

Furthermore, it has been demonstrated that many rural communities cannot survive on agricultural production alone, therefore diversification into non-agricultural pursuits is viewed as a means of securing one's financial future (Oluwatayo, 2009). It is generally accepted that rural households at or below the poverty line benefit from diversification. Alternative sources of income can mean the difference between subsistence living and misery. The growing importance of non-farm incomes in reducing poverty has been noted in the emerging literature on livelihood diversification in the developing countries (Oluwatayo, 2009). Studies on livelihood diversification are therefore necessary due to the disparities in poverty levels that present in rural sub-Saharan Africa (Saha, 2010).

2.3.2 Portfolio Diversification

Portfolio diversification refers to the strategic allocation of assets to mitigate the risk associated with concentrating one's investments in a singular asset. Diversification is consistently regarded as a method for broadening and evaluating all potential economic alternatives available to populations, aimed at enhancing yields and returns (Koumou, 2020; Azar, 2017). This proposed study examines portfolio diversification as a means of expanding economic and income-generating activities to enhance yields and economic returns for a specific demographic, namely fish farmers in Kakamega County.

2.3.3 Structural Diversification

Structural diversification can be understood as the varying responses of distinct assets under different logical frameworks or seasonal contexts. The various seasons are classified according to inflation rates, production rates, and fluctuations in market prices of diverse commodities (Gu, Sheng & Lei, 2022). This study examines structural diversification through the lens of the factors influencing the varying returns associated with the diverse economic activities that fish farmers engage in alongside traditional fish farming within the same agricultural enterprise. The discussion encompassed various factors, including inflation, the overproduction of fish products, and the significant risks confronting fish farmers across diverse regions, with a particular focus on those in Kakamega County, Kenya.

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2.3.4 Vertical Diversification

Vertical diversification is an expansion strategy utilized by economies to join different entities to yield more returns. There are two types of vertical diversification strategies; backward and forward diversification strategies. Backward, vertical diversification strategies can be defined as the designing of raw materials needed to produce the goods. On the other hand, a forward, vertical diversification strategy can be defined as a diversification strategy used by companies to move up the supply chain to finish, distribute and supply the finished products (Mahmudjonovna, 2022). In this study, vertical diversification was explored in terms of the strategies that fish farmers employ to push the finished products up the supply chains to reach the consumers and earn them better returns.

2.4 Empirical Literature

This section reviews recent literature on the effect of economic activity diversification on sustainable livelihoods among fish farmers in Kakamega County. This review aims to identify key findings, methodological approaches, and gaps that justify the current research focus.

2.4.1 Vertical Diversification and Sustainable Livelihoods

Recent studies emphasize the importance of economic diversification in enhancing sustainable livelihoods within agricultural communities. For example, Mwangi et al. (2021) explored diversification strategies among fish farmers in Western Kenya, demonstrating that integrating various income-generating activities significantly improved household resilience to economic shocks. Their quantitative analysis revealed a positive correlation between diversification and income stability, indicating that income growth is a crucial outcome of effective diversification. However, the study did

not specifically address the effects of vertical diversification, highlighting a gap in understanding its unique contributions to poverty reduction and food security status.

In contrast, Schlüter (2021) presents a differing viewpoint, arguing that while diversification can improve livelihoods, it may also lead to resource dilution, especially in areas with limited access to inputs. Their qualitative study found that some fish farmers experienced increased stress due to managing multiple activities, suggesting that the relationship between diversification and livelihood sustainability, including household asset accumulation, is not universally beneficial. This contradiction underscores the need for a nuanced investigation into the specific effects of vertical diversification on sustainable livelihoods.

Vertical diversification involves expanding the range of products or services offered along the value chain. A study by Mathia et al. (2024) specifically focused on vertical diversification in aquaculture, showing that fish farmers who engaged in processing or value addition significantly increased their income and improved food security. Their research utilized a mixed methods approach, combining surveys with case studies to provide comprehensive insights into the benefits of vertical diversification, particularly in enhancing profit margins. Nonetheless, the study did not adequately address the barriers farmers face in implementing such strategies, leaving a critical gap in understanding the challenges involved.

Conversely, Simelton et al. (2020) identified substantial barriers to vertical diversification among fish farmers, including inadequate access to technology, capital, and training. Their findings suggest that while vertical diversification holds promise for income growth and profit margin enhancement, its success depends on addressing these systemic challenges. This highlights a crucial area for further research, particularly in

Kakamega County, where socio-economic conditions may differ significantly from those in other studied regions.

Kariuki (2018) analyzed the challenges faced by fish farmers in Western Kenya and found that limited processing capacity was a major obstacle to maximizing the benefits of vertical diversification. The author suggested that developing processing infrastructure could greatly enhance income stability and food security for fish farmers in regions like Kakamega County, helping them capture more value and reduce vulnerability to market fluctuations.

The reviewed literature illustrates a complex relationship between economic diversification, particularly vertical diversification, and sustainable livelihoods. While several studies report positive outcomes associated with diversification such as increased income growth and improved food security others highlight potential pitfalls and challenges. This dichotomy indicates a pressing need for further empirical research focusing specifically on the effects of vertical diversification among fish farmers in Kakamega County.

Moreover, there is a notable lack of studies that integrate both qualitative and quantitative approaches to explore these dynamics comprehensively. Existing research predominantly relies on either method, limiting the depth of understanding regarding the nuanced effects of vertical diversification on sustainable livelihoods. Additionally, while studies have emphasized the importance of diversification, there is insufficient exploration of how social factors, such as community support and networks, influence diversification strategies and outcomes.

The empirical literature reviewed provides significant insights into the effects of economic activity diversification on sustainable livelihoods among fish farmers.

However, gaps remain, particularly regarding the specific effects of vertical diversification on income growth, household asset accumulation, and food security status, as well as the barriers faced by farmers in implementing such strategies. This study aims to address these gaps by focusing on the relationship between vertical diversification and sustainable livelihoods in Kakamega County, utilizing a mixed-methods approach to capture a holistic view of the challenges and opportunities present in this context.

2.4.2 Structural Diversification and Sustainable Livelihoods

Studies have underscored the importance of economic diversification in promoting sustainable livelihoods in agricultural communities. For instance, Adam et al. (2023) investigated the effect of diversification strategies among fish farmers in Kenya, revealing that those who engaged in multiple income generating activities reported improved financial stability and resilience against economic shocks. Their mixed-methods approach combined surveys and interviews, providing a comprehensive view of farmers' experiences. However, the study primarily focused on general diversification without delving into structural diversification's specific impacts, indicating a gap in understanding this particular dimension.

Contrastingly, Norton et al (2018), emphasized that while diversification can enhance income, it may also introduce complexities that can strain resources and time management for farmers. Their qualitative research pointed out that some fish farmers experienced diminished returns when spreading efforts too thin across diverse activities. This perspective underscores the necessity of further research on the optimal balance between diversification and resource allocation, particularly in the context of Kakamega County.

Structural diversification involves expanding activities along different tiers of the value chain, such as processing, marketing, or even engaging in aquaculture-related services. A study by Duarah & Mall, (2020), focused specifically on structural diversification among fish farmers, finding that those who diversified their operations by processing fish or selling aquaculture inputs significantly increased their incomes. Their research employed a quantitative methodology, analyzing income data across different farmer profiles. However, this study did not address the barriers to implementing structural diversification, such as lack of access to technology or market information, highlighting a critical gap.

In contrast, Jennings et al. (2017), provided insight into the challenges faced by fish farmers attempting structural diversification. Their study utilized case studies and interviews to reveal that many farmers were deterred from expanding their activities due to inadequate infrastructure and training. This finding points to a need for targeted interventions to support farmers in overcoming these barriers, which the current study aims to explore further.

Korda, Gray & Stead (2021), explored how small-scale fisheries can contribute to food security and poverty alleviation through structural diversification. They concluded that fish farmers who diversify into non-agricultural sectors are better able to withstand economic shocks, leading to more stable and sustainable livelihoods. This underscores the importance of structural diversification for fish farmers in Kakamega County, who face challenges such as market volatility and environmental risks.

Additionally, there is a notable lack of studies that adopt a holistic approach, integrating both qualitative and quantitative methodologies to examine the impacts of structural diversification comprehensively. Most existing research leans heavily toward one

methodology, limiting the depth of understanding regarding the challenges and opportunities that farmers face. Furthermore, many studies do not sufficiently address the socio-economic context of Kakamega County, which may differ significantly from other regions where research has been conducted. This gap indicates the necessity for localized studies that consider the unique circumstances affecting fish farmers in this area.

The empirical literature reviewed reveals significant insights into the effects of economic activity diversification, particularly structural diversification on sustainable livelihoods among fish farmers. However, critical gaps remain, particularly concerning the barriers to implementing structural diversification and the specific socio-economic factors influencing these dynamics. This study addressed these gaps by investigating the relationship between structural diversification and sustainable livelihoods in Kakamega County, utilizing a mixed-methods approach to provide a comprehensive understanding of the challenges and opportunities for fish farmers. By identifying these gaps, this research not only contributes to the existing body of knowledge but also informs policies and practices aimed at enhancing the livelihoods of fish farmers in the region.

2.4.3 Portfolio Diversification and Sustainable Livelihoods

The significance of economic diversification for enhancing sustainable livelihoods, particularly in rural agricultural settings. Sekaran, Lai, Ussiri, Kumar & Clay, (2021), conducted a study on livelihood diversification among rural households in Ethiopia, demonstrating that portfolio diversification engaging in multiple agricultural sectors such as fish farming, crop farming and livestock significantly reduced income variability and improved food security. Their findings support the notion that portfolio

diversification can enhance income stability for fish farmers in Kakamega County, emphasizing the benefits of engaging in multiple income-generating activities.

Conversely, Mwangi, (2020), focused on the challenges faced by fish farmers in Western Kenya. They noted that diversifying into livestock or crop farming mitigated the risk of income loss due to failures in any single activity. Their qualitative analysis highlighted the importance of balancing income across different sectors, particularly in regions vulnerable to environmental shocks. This perspective aligns with Clay et al (2021), findings but emphasizes the need for a strategic approach to diversification that considers local environmental conditions.

The concept of portfolio diversification extends beyond mere participation in various activities; it involves strategically combining different income-generating options to spread financial risks. Norton et al (2018), explored this concept among poultry farmers in Ghana, revealing that portfolio diversification significantly reduced income volatility by spreading financial risks across multiple sectors. They recommended a similar approach for other agricultural sectors, including fish farming, suggesting that integrating complementary activities can help reduce vulnerability to market and climate-related risks.

In a different context, Hauk et al. (2017) investigated the economic benefits of integrating short-rotation woody crops into farming systems in South Germany. Their findings indicated that portfolio diversification enhanced income stability and reduced overall risk exposure for farming households. Although the study did not focus on aquaculture, it suggests that fish farmers in Kakamega County could similarly benefit from diversifying their activities to include crop or livestock farming, thereby achieving more stable livelihoods.

While the reviewed studies collectively support the positive effects of portfolio diversification on sustainable livelihoods, they also reveal several important gaps and methodological issues. Notably, the existing literature often lacks a focused examination of how specific types of diversification such as vertical versus horizontal effect income stability and risk management among fish farmers. This is particularly relevant for Kakamega County, where socio-economic conditions may differ from those explored in other regions.

Additionally, while the qualitative studies by Mwangi and Clay et al. provide valuable insights, they may not capture the full economic dynamics due to their limited sample sizes or regional focus. A more comprehensive quantitative analysis could strengthen the understanding of how portfolio diversification affects income stability among fish farmers in Kakamega County.

Moreover, the existing research tends to overlook the social dimensions of diversification, such as community support networks and access to resources, which are crucial for the successful implementation of diversified income strategies. This gap suggests the need for future research to explore not only the economic benefits of diversification but also the socio-cultural factors that influence farmers' decisions and outcomes.

The empirical literature reviewed highlights the potential of portfolio diversification to enhance sustainable livelihoods among fish farmers. However, significant gaps remain, particularly regarding the specific mechanisms through which different forms of diversification affect income stability and the socio-economic contexts that shape these outcomes. This study filled these gaps by investigating the effects of portfolio

diversification on sustainable livelihoods in Kakamega County, employing a mixed-methods approach to capture both quantitative data and qualitative insights.

2.4.4 Entrepreneurship Determinants, Economic Diversification and Sustainable Livelihoods

Mwangi (2022) studied diversification strategies among fish farmers in Western Kenya, finding that those who diversified their activities such as integrating crop and livestock farming reported enhanced income stability and resilience to market fluctuations. Their mixed-methods approach combined surveys with qualitative interviews, providing a nuanced understanding of the benefits of diversification. However, the study did not specifically explore the role of entrepreneurship determinants, such as access to finance, market access, and entrepreneurship training, as moderating factors, indicating a gap for further investigation.

Similarly, a study by Purcell, Tagliafico, Cullis, and Gogel (2021) examined the effect of diversification on livelihoods in rural communities. They highlighted that diversified income sources reduced vulnerability to economic shocks, yet their research did not assess how entrepreneurial skills and attitudes influenced the effectiveness of these diversification strategies. This omission underscores the need for a focused exploration of entrepreneurship determinants as potential moderators in the relationship between economic diversification and sustainable livelihoods, particularly regarding profit reduction, income growth, food security status, and household asset accumulation.

Understanding the moderating effect of entrepreneurship determinants such as innovation, risk-taking, and managerial skills on the relationship between economic diversification and sustainable livelihoods is crucial. Holland et al. (2017) conducted a study in agricultural settings and found that entrepreneurial skills significantly

enhanced the positive impacts of diversification on income stability. Their quantitative analysis revealed that farmers with higher levels of entrepreneurial orientation were better able to leverage diverse activities for financial gain. However, the study was limited to a specific region and did not address the unique challenges faced by fish farmers in Kakamega County.

In contrast, Kimani and Mburu (2022) investigated the barriers to entrepreneurship among rural farmers, emphasizing that limited access to training and resources hindered effective diversification efforts. Their qualitative study revealed that while diversification had the potential to improve livelihoods, the lack of entrepreneurial support particularly in terms of access to finance and market access significantly diminished its effectiveness. This perspective highlights the critical role of entrepreneurship in facilitating successful diversification, reinforcing the need for comprehensive research in this area.

The reviewed literature collectively supports the notion that economic diversification positively influences sustainable livelihoods. However, the absence of studies specifically addressing the moderating role of entrepreneurship determinants presents a significant gap. For instance, while Mwangi emphasizes the benefits of diversification, they do not explore how entrepreneurial traits, such as access to finance and market access, might enhance these benefits.

Moreover, existing studies often rely on single-method approaches, which may limit the depth of understanding. For example, while Holland et al. (2017) provide valuable quantitative data, their findings could be complemented by qualitative insights to understand the contextual factors influencing entrepreneurship among fish farmers. Additionally, the socio-cultural factors affecting entrepreneurship in Kakamega County

remain underexplored, suggesting the need for localized research that considers these dimensions. This study aims to fill these gaps by investigating how entrepreneurship influences of economic diversification on sustainable livelihoods in Kakamega County. By utilizing a mixed-methods approach, this research seeks to provide a comprehensive understanding of the challenges and opportunities that fish farmers face, contributing valuable insights to the existing body of knowledge and informing policy interventions aimed at promoting sustainable livelihoods.

Table 2. 1: Summary of Empirical Literature Review and Gaps.

Authors (Year)	Study Topic	Findings	Methodology	Research Gap
Mwangi et al. (2021)	Open Science in Kenya: Where Are We?	The findings in this study highlight the state of open science in Kenya and challenges facing its adoption and practice while bringing forth possible areas for primary consideration in the campaign toward open science i.e. fishing	Online survey design	While offering insights into vertical diversification and performance in the fish farming sector, this research conceptualizes vertical diversification differently and focuses on Kakamega County, Kenya.
Schlüter, (2021)	Fish provision in a changing environment: The buffering effect of regional trade networks	Proportion of different trader types and their spatial connectivity have the potential to increase fish provision.	Agent based model (ABM)	overlooks other factors influencing farmers' livelihoods beyond income levels.
Mathia et al (2024),	Aquaculture: A hidden	The research findings indicated	A descriptive	this study focused on fish

	goldmine for the rural poor—A cost–benefit analysis of fish farming for sustainable development and food security in Vihiga County, Kenya	that the size and type of pond do not have a significant correlation and differences in production (p -value $>.05$). There is a strong positive correlation between the size of the pond and the stocking density	research design	farmers in Kakamega County, Kenya, and explore the effects on sustainable livelihoods.
Simelton et al (2020),	Adaptation and development pathways for different types of farmers	The most viable pathway for some farmers may be to exit agriculture altogether, which itself requires careful management and planning	census	This study further explores the effect of vertical integration on the sustainability of livelihoods, focusing on fish farmers, thereby bridging the gap in research on vertical diversification in different agricultural sectors
Kariuki, (2018),	Upgrading Strategies and Food Security Implications on Smallholder Farmers in Sub-Saharan Africa: A Value Chain Review	This paper proposes targeted agricultural interventions based on context specific integrated strategic innovations using tacit knowledge that aims at empowering smallholder farmers to add value to their farm produce using innovative models they participated in developing, while incorporating climate smart agricultural practices, to reduce	utilizing surveys and qualitative interviews.	While emphasizing interconnectedness of diversification strategies, this study focuses on Kakamega County, Kenya, exploring how fish farmers adopt structural diversification strategies and their effect on livelihoods.

		poverty and achieve sustainable food security and nutrition in Sub-Saharan Africa		
Adam et al. (2023)	Climate change, Gender and Livelihoods Among Fisher communities in the Lake Victoria Zone Region in Kenya: Report of Proceedings of the Multi-stakeholder Technical Workshop	The purpose of the workshop was to share and validate the findings of the scoping study carried out by WorldFish from March to July, 2023.	employing quantitative analysis methods.	While focusing on crop diversification, this study expands on the understanding of structural diversification, examining its impact on farmer livelihoods in Kakamega County, Kenya.
Norton et al (2018)	Precision fish farming: A new framework to improve production in aquaculture	By adapting several core principles from Precision Livestock Farming (PLF), and accounting for the boundary conditions and possibilities that are particular to farming operations in the aquatic environment, PFF will contribute to moving commercial aquaculture from the traditional experience-based to a knowledge-based production regime.	Primary data were collected using a self-administered digitized questionnaire to 331 randomly selected farmers in Kenya.	This study conceptualizes structural diversification differently, focusing on core competencies, market analysis, and integration strategy, providing insights into their impact on livelihoods in Kakamega County, Kenya, specifically for fish farmers.
Duarah & Mall, (2020),	Diversified fish farming for sustainable livelihood: A case-based study on small and marginal fish	Through a case-based research method an economic analysis has been made on species diversification strategy of fish farming. It is found that, by adopting an	a case-based research method	While demonstrating risk management's effects on agricultural systems in India, this study examined its

	farmers in Cachar district of Assam, India	effective and most economical diversification strategy consisting of the culture of <i>Gudusia chapra</i> along with Carps in small-scale composite culture ponds will resulted in more than 100% return on investment.		effects on sustainable livelihoods among fish farmers in Kakamega County, Kenya, operationalizing portfolio diversification differently.
Jennings et al. (2017),	Linked sustainability challenges and trade-offs among fisheries, aquaculture and agriculture	Countries with low adaptive capacity but increasing demand for food require greater support and capacity building to transition towards reconciling trade-offs.	Descriptive research design	While exploring livelihood diversification in Ethiopia, this study extends to portfolio diversification strategies, examining their impact on sustainable livelihoods among fish farmers in Kakamega County, Kenya.
Korda, Gray & Stead (2021)	Resilience in the English Small-Scale Fishery	Diversification significantly reduces poverty compared to specialization among Ghanaian farm households, indicating its role as a poverty reduction strategy.	Utilizing survey research design and quantitative analysis methods.	this study investigated its effect on sustainable livelihoods among small scale fish farmers in Kakamega County, Kenya, operationalizing portfolio diversification differently.
Sekaran, Lai, Ussiri, Kumar & Clay, (2021),	Role of integrated crop-livestock systems in improving agriculture	agricultural scientists are challenged to provide fundamental and credible information to integrate crop	mixed methodology approach.	exploring their effects on sustainable livelihoods among fish farmers in Kakamega

	production and addressing food security – A review	and livestock production systems so that worldwide adoption of ICLS can be used to increase the agricultural production compatible with food and nutrition security.		County, Kenya, operationalizing portfolio diversification differently.
Mwangi, (2020),	Technical efficiency, profitability and market Diversity among smallholder tomato farmers in Kirinyaga county	This implied presence of an opportunity to improve diversity scores by more than 50 percent if the quantities sold in each market outlet are improved	Descriptive research design	This study will investigate entrepreneurship determinants as a moderator between economic diversification and sustainable livelihoods among fish farmers in Kakamega County, Kenya.
Hauk et al. (2017)	Ecological diversification is risk reducing and economically profitable – The case of biomass production with short rotation woody crops in south German land-use portfolios	diversifying cash crop rotations with SRWC is an effective risk-management instrument that can furthermore provide positive external effects.	Quantitative data collected through interviews with 267 women, qualitative data from key informants, focus group discussions, and observations, analyzed thematically.	This study explored economic diversification and sustainability of farmer livelihoods.
Purcell, Tagliafico, Cullis, & Gogel, (2021),	Socioeconomic impacts of resource diversification from small-scale fishery development	The study reveals that certain coastal artisanal fisheries can be gender equitable and that benefits are likely underestimated because of	Utilized farmers using purposive and stratified random sampling	While providing insights into smallholder farming entrepreneurship in Kenya, this study focused on fish farmers

		subsistence consumption and informal distribution networks. Diversifying the marine resources accessible to small-scale fishers offers a promising strategy to support coastal livelihoods and strengthen resilience of social-ecological systems	techniques.	in Kakamega county, exploring entrepreneurial determinants as mediating variables in the relationship between economic diversification and sustainability of farmer livelihoods
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Source: The Researcher, 2024

2.5 Conceptual Framework

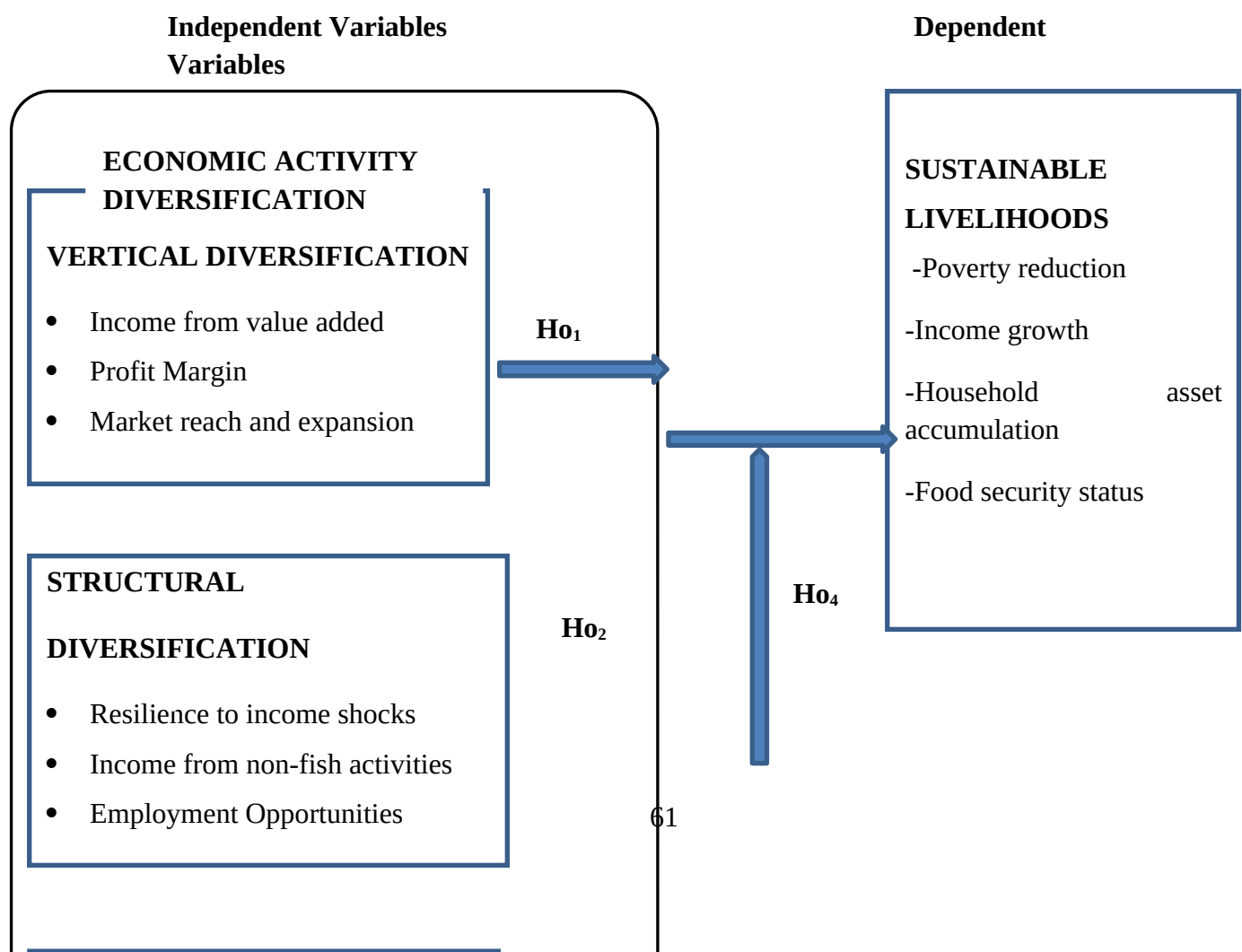




Figure 2.3: Conceptualizing the relationship between Economic Activity Diversification and Sustainable Livelihoods

Source: Adopted from Ntale 2012

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. Introduction

This chapter outlines the approach that was used to determine the effect of economic activity diversification on sustainable livelihoods among fish farmers in Kakamega County. It offered a detailed description of the study's geographic scope and target population. The research design, research population, sample size, sampling procedures, research tools, data processing, and data analysis were described and discussed. It also displayed ethical consideration and study constraints the study encountered.

3.2 Study area

The study was carried out in Kakamega County, Kenya which has twelve (12) sub-counties namely: Lurambi, Shinyalu, Ikolomani, Navakholo, Lugari, Butere, Malava, Matungu, Mumias East, Mumias West, Khwisero and Likuyani Sub-counties, (Wahome, Kiema, and Mulaku, 2023). Kakamega County covers 3,051 km² and borders Busia County to the Northwest, Bungoma County to the North, Siaya County to the South West, Vihiga County to the South and Uasin Gishu County to the North East. The study area lies within latitude 00 15' and 00 1' N and longitude 340 20' and 350 00' E (refer to Appendix VII). It is located between 1,250 and 2,000 meters above sea level, with an annual rainfall range of 1250 to 1750 mm. The average temperature in the county is 22.50C almost all year. Large-scale sugarcane farming, mixed farming, commercial enterprises, and boda-boda transport (motorcycle taxi) industries are among the county's major economic activities. The selection of Kakamega County for this research study is predicated on its remarkable aquaculture suitability rating of 95.86%, coupled with the presence of numerous fish farmers who have endeavored to diversify their economic activities. The county is home to roughly 4,500 registered fish farmers who manage around 9,988 fish ponds, as noted in the County Government of Kakamega Agriculture Report from 2021. Moreover, Kakamega County achieved the top rank in fish farming nationally, as recognized by Lattice Aquaculture Academy, due to the diligent efforts and dedication of its farmers, alongside governmental backing through extension services and subsidized fish feeds, (County Government of Kakamega Agriculture Report, 2021). The Kakamega County Government has allocated more than Sh120 million towards the advancement of aquaculture and smart farming initiatives, collaborating with farmers by offering subsidized fish feeds and fingerlings, as noted in the KCIDP report of 2023.

3.3. Research design

A research design is essentially a plan that directs the researcher in data collection, processing, and interpretation procedures (Lichtman, 2023). In essence, it serves as a logical proof model and allows for inferences to be made about relationships between the variables under inquiry. It also serves as the foundation for generalizing about circumstances (Amazon, 2008). Descriptive and survey research designs were used in this study. These designs generated quantitative data, (Köhler, Rummyantseva, & Welch, 2023). This study adopted descriptive and survey research designs as they are particularly useful for exploring the characteristics of a population or phenomenon. They allow researchers to describe and summarize data, identifying key features, trends, or distributions within the study sample as in the case of Kakamega fish farmers.

3.4. Research Population

The study population refers to the group of people who meet the researcher's operational definition of the target population (Köhler, Rummyantseva, & Welch, 2023). The population of this study comprised of 4,500 registered fish farmers from 12 sub-counties in Kakamega County (Kakamega County Agriculture Report, 2023). Refer to table 3.1 showing distribution of fish farmers in Kakamega County.

Table 3. 1: Distribution of Target population and Sampling technique in the sub-counties

Sub-County	Number of fish farmers in the sub-county	Percentage of the total number of farmers	Participants' Distribution in the Study
Lurambi	624	13.87%.	49

Khwisero	370	8.22%	29
Mumias East	455	10.11%	36
Mumias West	412	9.16%	32
Shinyalu	333	7.40%	26
Ikolomani	397	8.82%	31
Butere	342	7.60%	27
Malava	320	7.11%	25
Matungu	306	6.80%	24
Navakholo	301	6.69%	24
Lugari	331	7.36%	26
Likuyani	309	6.87%	25
Total	4,500	100	354

Source: County Government of Kakamega, 2023

3.5 Sampling and Sample size

The sample population refers to the entire population from which the researcher wishes to draw conclusions from (Lichtman, 2023). In this study, a total of 4500 fish famers in Kakamega county were targeted from which a total of 354 fish farmers drawn using the Krejcie and Morgan table (1970) were involved as shown below:

Krejcie and Morgan Table for Determining Sample Size for a Finite Population

<i>N</i>	<i>S</i>	<i>N</i>	<i>S</i>	<i>N</i>	<i>S</i>
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note.—*N* is population size. *S* is sample size.

Source: Krejcie & Morgan, 1970

The Table is constructed using the following formula for determining sample size:

Formula for determining sample size

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

s = required sample size.

X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841).

N = the population size.

P = the population proportion (assumed to be .50 since this would provide the maximum sample size).

d = the degree of accuracy expressed as a proportion (.05).

Source: Krejcie & Morgan, 1970

Source: Krejcie and Morgan, 1970.

Cluster sampling was used to group them according to sub-counties and further into wards within the sub-counties. Finally, the farmers were grouped according to their villages. Simple random sampling using lottery was used to identify fish farmers to be involved in the study.

3.6 Data Collection Instruments and Procedure

The study used data collection instruments, namely structured and semi-structured questionnaires.

3.6.1 Questionnaire

The primary research tool employed was a meticulously designed questionnaire incorporating both nominal and scaled items. The majority of the inquiries were formulated along an agreement continuum, employing five-point Likert scales to assess the extent of agreement and disagreement among the respondents. The questionnaire consisted of five principal sections pertaining to the dependent, moderating, and independent variables. The initial section of the questionnaire elicited demographic

information pertaining to the respondents. Sections B, C, D, E, and F produced data concerning vertical diversification, structural diversification, and port fold diversification, as well as the determinants of entrepreneurship and sustainable livelihoods, respectively. The questionnaire serves as the fundamental framework of any survey, and its effectiveness is contingent upon the meticulous design of the questionnaire itself. The primary method employed for the collection of quantitative primary data was a questionnaire. A questionnaire facilitates the collection of quantitative data in a standardized manner, ensuring that the data remains internally consistent and coherent for subsequent analysis. Akhavan, 2013 Open-ended inquiries were employed to collect insights regarding the potential perceptions of livelihoods.

3.6.2 Data Collection Procedure

According to (Abraham, 2018) Data Collection is a process in research where raw information is gathered and processed to a meaningful Information. The data collected was primary. Questionnaires were used to collect primary data. The questionnaire was having open ended and closed questions. To increase the response, rate the questionnaires were administered to the respondents by trained research assistants through a drop and pick method. A letter of introduction from MMUST and NACOSTI were provided to the respondents explaining the purpose of the exercise and assure respondents of confidentiality of the data collected. Upon completion, the research assistants gathered the questionnaires. The assessment of validity and reliability for the questionnaires was conducted through the application of the Cronbach's Alpha Coefficient. The duration of data collection spanned one month, as all respondents were situated in close proximity to one another, a consequence of their shared livelihoods.

3.7 Reliability and Validity

Following a thorough examination of the research objectives, hypotheses, and pertinent literature, a research instrument in the form of a questionnaire was meticulously developed. The researcher employed the content validity index to assess the validity of the research instruments through careful examination. To ensure content validity, it is imperative that the questionnaire encompasses a comprehensive array of items that address the entirety of the concept (Mohajan, 2017). Consequently, the supervisors and experts evaluated the content validity of the instrument. Construct Validity pertains to the theoretical relationship between a variable, such as a score on a specific scale, and other variables. It examines the degree to which a measure operates as expected in relation to established measures of other constructs.

A pilot study was conducted in Vihiga County to assess the reliability and clarity of the research instruments. The SPSS statistical program was employed to analyze the data generated during the pilot study, with the aim of assessing the reliability of the instrument. Historically, scholars have regarded a reliability coefficient of 0.7 or above as acceptable (Singh, 2017). However, researchers have now established the threshold at 0.7.

3.8 Data Analysis and Presentation Techniques

The process of data analysis involves the systematic collection, modeling, and examination of data to extract insights that facilitate informed decision-making. (Bernardita Calzon, 2022). The process of data analysis allows researchers to meticulously assess the information, guaranteeing that no critical elements are overlooked that might hinder their ability to derive meaningful conclusions. The

computation of mean scores and standard deviation was integral to the descriptive statistics, elucidating the demographic characteristics of the respondents. A statistical measure of dispersion, specifically the standard deviation, was employed to assess the normality of the data set. In order to ascertain the statistical significance of the respective hypotheses, both ANOVA and multiple linear regression analyses were performed, adhering to a 95 percent confidence level ($\alpha=0.05$). The questionnaires returned from the field underwent a process of coding, editing, and entry into the computer to enable statistical analysis. The analysis was facilitated using version 23 of the Statistical Package for the Social Sciences (SPSS). The coefficient of determination (R^2) serves as a metric for assessing the goodness of fit across various models, elucidating whether the proportion of sustainable livelihoods can be accounted for by the aggregate of predictor variables, in comparison to the population of each individual predictor variable. A hierarchical regression was employed to ascertain the impact of moderating influence on the model.

3.8.1 Model specification

For the purposes of this study, the following linear regression model were used

Model 1

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \epsilon$$

Where;

Y = Aggregate mean score of Sustainable live hoods

β_0 = y-intercept/constant

β_1 =Regression coefficient for vertical diversification

X_1 = Aggregate mean score of vertical diversifications

β_2 = Regression coefficient for structural diversification

X_2 = Aggregate mean score of structural diversifications

β_3 = Regression coefficient for port fold diversification

X_3 = Aggregate mean score of port fold diversification

Model 2: Moderating effect of entrepreneurship determinants on the relationship between economic diversification factors and sustainable livelihoods.

$$Y = \beta_0 + \beta_1 X_1 * M + \beta_2 X_2 * M + \beta_3 X_3 * M + \varepsilon$$

Y = Aggregate mean score of Sustainable live hoods

β_0 = y-intercept/constant

β_1 = Least squares estimate of the population regression coefficient for X

X = Degree of the individual independent variable

Z = A hypothesized grouping moderator entrepreneurship determinants

β_2 = Least squares estimate of the regression coefficient for Z

$X * Z$ = the product between the predictors (Independent variable * Moderator)

β_3 = the sample base least squares estimate of the population regression coefficient for the product term

ε = error term-random variation due to other unmeasured factors

3.9 Diagnostic Tests

Prior to conducting the regression analysis, a series of diagnostic tests were executed to mitigate the potential bias that could arise from the collected data. The investigation utilized the subsequent assessments:

3.9.1 Multicollinearity

Multicollinearity, characterized by a significant correlation among two or more independent variables, can negatively influence the results of multiple regression analyses. The inter-correlation among independent variables exceeding 0.8 (Garson, 2013) or 0.7 (Sekaran and Bougie, 2010) indicates a pronounced level of multicollinearity. This is further evidenced by a high R-squared value coupled with significant F tests for the model, while the t-tests for the coefficients remain non-significant.

Regrettably, the presence of multicollinearity can negatively impact analysis, thereby constraining the conclusions drawn from research. This study aims to identify instances where the t-tests for individual slopes yield non-significant results ($P > 0.05$), while the overall F-test assessing the simultaneous significance of all slopes is significant ($P < 0.05$). Consequently, the reliance on the variance inflation factor (VIF) serves to quantify the extent of variance inflation, indicating that the variances of the estimated coefficients are indeed inflated in the presence of multicollinearity.

3.9.2 Normality

Hair et al. (2015) suggested that the true extent of deviation from normality can be assessed through the use of graphical representations as well as various statistical tests. Moreover, parametric tests presuppose that the sample data originate from populations

that exhibit a normal distribution. In SPSS Version 23, the Kolmogorov-Smirnov and Shapiro-Wilk tests were employed to assess the data for normality.

3.9.3 Homoscedasticity

One can most effectively evaluate the homoscedasticity of two measured variables through graphical representation or by employing a statistical test. The test for homogeneity of variances, established by Bartlett in 1983 and noted by Jones in 2019, serves to ascertain whether the variances remain consistent across all samples. Prior to conducting certain statistical tests, including the One-Way ANOVA, it is essential to ascertain the validity of the assumption regarding equal variances.

3.10 Ethical Consideration

This study did abide by the research ethics and principles. The researcher never put subjects in a position where their participation could put them at danger of injury. In order to protect the privacy of research participants, the principles of voluntary participation, secrecy, and freedom was used in this study. The participant's secrecy was assured by the researcher. The researcher did not divulge the data to outside parties. This study considered ethical concerns such confidentiality permission and anonymity. The Masinde Muliro University ethics committee and National Commission for Science, Technology and Innovation (NACOSTI) first authorized the study before it begun. The participants were also given formal consent by the study's location's authorities hence the researchers worked closely with the local authority to assure the respondents of the legality of the research work (Barrow, Brannan, & Khandhar, 2022).

All participants' identities and best interests were safeguarded, their anonymity was guaranteed, and data confidentiality was also upheld throughout the research process. This study made sure that all data sources used were cited in the report properly. In the

analysis and reporting of the research, pseudonyms was utilized. This research work also ensured that the respondents gave informed consent before taking part in the study. The researcher also presented the study's relevance and purpose to participants before delivering the questionnaire where they received assurances of confidentiality and anonymity from the researcher (Isbell, Brown, Chen, Derrick, Ghanem, Arvizu, & Plonsky, 2022).

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents findings from the study conducted on “the effect of economic activity diversification on sustainable livelihoods among fish farmers in Kakamega County”. The entrepreneurship determinants of the respondents in this study are presented. The chapter also presents inferential analysis, interpretation and discussion of findings of the study.

4.2 Response Rate

This research aimed to distribute 354 questionnaires to registered fish farmers, utilizing the list provided by the Kakamega County Fisheries Department from August 2022. A total of three hundred and fifty (350) respondents engaged in the study by completing and submitting the questionnaires. A mere four respondents failed to submit their questionnaires. The data regarding the return rate of the questionnaire is presented in Table 4.1 below.

Table 4. 1 Questionnaire Return Rate

		Frequency	Percent
Valid	Returned	350	98.9
	Not Returned	4	1.1
	Total	354	100.0

Source: Researcher, 2024

This indicates that 350 of the questionnaires were accurately completed and utilized for the analysis in this study. This indicates a questionnaire return rate of 98.9% of the sample size, which aligns with the parameters of a substantial sample size, as noted by Kanazawa (2023).

4.3 Demographic information of the Respondents

The study sought to establish general information regarding the following aspects of the respondents: Gender, Age, marital status, level of education, and household size.

4.3.1 Gender of the Respondents

The findings indicated that the majority of fish farmers in Kakamega County were male, accounting for 66.5% of the respondents, whereas female farmers comprised 33.5% of the total. This indicates that men engaged in fish farming endeavors to enhance their family's sustenance.

Table 4.2 Gender of the respondents

Gender	Frequency	Percentage (%)
Male	233	66.5

Female	117	33.5
Total	350	100

Source: Author, 2024

These statistics in table 4.2 suggests a male dominated population and engagements in livelihood activities. It can be attributable to the fact that men have more access to productive assets as argued in the KNBS 2022 House hold survey report. This implies that more men engage in more economic activities than their female counterparts. It corroborates with the Onuwa et al. (2022) who reported similar results arguing that the unequal participation of men and women in livelihood activities has been attributed to various factors, including historical gender roles, cultural norms, social expectations, and even legal barriers in some cases. These factors can influence the opportunities available to women, leading to disparities in their participation in economic activities as in the case of Kakamega County.

4.3.2 Age of the respondents

Table 4. 3: Age of the respondents

Age in years	Frequency	Percentage (%)
1-20 years	23	6.6
21-40 years	165	47.1
41-60 years	103	29.4
61-80	59	16.9
Total	350	100

Source: Researcher, 2024

Table 4.3 above revealed that most (47.1%) of the respondents are between the age bracket of 21-40, 6.6% were between 1-20 years, 29.4% were between 41-60 years

whereas 16.9 % were between 61-80 years. Also the estimated mean age of the respondents was 34.8 years. It implies that most of the farmers are still at their productive age brackets and have the energy and ability to engage in multiple income generating activities. Age also significantly influences economic and technical efficiency as argued by Martin and Lorenzen, 2022). These findings also agree with Adem, Tadele, Mossie, & Ayenalem, (2021) who maintained that younger individuals who are just starting their careers may be more open to exploring different economic activities and diversifying their livelihoods as they seek to gain experience and find their professional path. On the other hand, older individuals with more experience may be more inclined to stick to their established livelihoods due to factors such as job stability and financial commitments.

4.3.3 Marital status of the respondents

Table 4. 4: Marital status of the respondents

Marital status	Frequency	Percentage (%)
Single	43	12.3
Married	190	54.3
Divorced	31	8.9
Widowed	86	24.5
Total	350	100

Source: Researcher, 2024

Table 4.4 reveals that most (54.3%) of the respondents are married. It implies that married farmers have higher demand for income due to family needs. The married

farmers need money to cater for the welfare needs of their families; therefore, multiple income streams are required, hence they engage in multiple livelihood activities. It corroborates with Onuwa et al. (2022) who reported that married individuals may have the advantage of resource pooling. Combining financial resources with a spouse can provide more significant capital for investment, which could enable them to explore a wider range of economic activities or take on larger business ventures.

4.3.4 Level of Education

The highest levels of education attained by the farmers were categorized in the following categories; primary level, secondary level and tertiary level. From the findings, majority (50.18%) of the respondents had attained secondary level of education. Those who had attained primary level of education were 24.21%, and tertiary levels of education were 25.61%.

Table 4. 5: Level of education of the respondents

Level of Education	Frequency	Percentage (%)
Primary	85	24.21
Secondary	175	50.18
Tertiary	90	25.61
Total	350	100

Source: Researcher, 2024

Table 4.5 revealed that most (50.1%) of the respondents attained secondary education; an indication of high literacy level among the farmers in the study area. Education is important in the diffusion of knowledge on modern innovations and livelihood activities. The level of education tends to determine the livelihood strategies and opportunities available to farmers.

Alobo-Loison, 2019 and Joshi et al., 2021 argue that higher levels of education provide individuals with a broader knowledge base and specialized skills. This enhanced expertise can enable them to explore a wider range of economic activities and industries,

leading to more diversified career paths, entrepreneurial ventures, innovation and access to information.

4.3.5 Household size

The researcher discovered that most of the respondents (182) representing 52.0% of the respondents were in households consisting of 6 to 10 family members, 36.6% had 5 members and below, whereas 11.4 % had more than 11 members. The distribution of the household sizes of the respondents is shown in the Table 4.6.

Table 4. 6: Household size of the respondents

Household size	Frequency	Percentage (%)
≤ 5	128	36.6
6-10	182	52.0
≥11	40	11.4
Total	350	100

Source: Researcher, 2024

It denotes that the respondents have relatively populated households. Family size may enhance the chances of livelihood diversification within households as argued by Babatunde and Martin, (2020) who contends that larger households typically have more combined financial resources. This increases the pool of resources which provide more opportunities for economic diversification. It may allow members of the household to invest in different ventures or start multiple income-generating activities. Larger households may be better equipped to handle financial risks associated with economic diversification. If one income source faces challenges, other family members' earnings can provide a buffer, reducing the overall vulnerability of the household which may apply to Kakamega.

4.3.6 Farm size

The researcher discovered that most of the respondents (132) representing 37.7% of the respondents were in farm size of 1to 3 acres, 35.1% had 1 acre and below, whereas 27.2% had more than 4 acres.

The distribution of the firm size of the respondents is shown in the Table 4.7.

Table 4. 7: Farm size of the respondents

Farm size	Frequency	Percentage (%)
≤ 1 acres	123	35.1
1-3 acres	132	37.7
≥4 acres	95	27.2
Total	350	100

4.3.7 Member of cooperative society

The researcher discovered that most of the respondents (180) representing 51.4% of the respondents were members of the cooperative society. The distribution of the respondents is shown in the Table 4.8.

Table 4. 8: Member of a cooperative society

Cooperative Society Membership	Frequency	Percentage (%)
Yes	180	51.4
No	170	48.6
Total	350	100

Source: Researcher, 2024

4.3.8 Access to Microcredit

The researcher discovered that most of the respondents (234) representing (66.86%) of the farmers in the study area do not have access to microcredit. It indicates that most

farmers were excluded from credit support from formal financial institutions in the study area. The distribution of the respondents is shown in the Table 4.9.

Table 4. 9: Access to Microcredit

Access to Microcredit	Frequency	Percentage (%)
Yes	116	33.14
No	234	66.86
Total	350	100

Source: Researcher, 2024

4.3.9 Ownership of Productive Assets

The researcher discovered that most of the respondents (190) representing (54.29%) of the farmers in the study area possess productive assets. The distribution of the respondents is shown in the Table 4.10.

Table 4. 10: Ownership of Productive Assets

	Frequency	Percentage (%)
Yes	190	54.29
No	160	45.71
Total	350	100

Source: Researcher, 2024

4.4 Descriptive Analysis of the Variables in the Study

Descriptive analysis included an assessment of Vertical diversification, Structural diversification, Portfolio diversification, Entrepreneurial determinants and Sustainable livelihoods. The statements were anchored on a five - point Likert - type scale ranging from 1=Strongly Disagree to 5= Strongly Agree and respondents were asked to indicate the extent to which they agreed to the statements.

Table 4.11 Descriptive statistics for Vertical Diversification

	N	SD (%)	D (%)	N (%)	A (%)	SA (%)	Me an	Std. Dev.
The introduction of value-	35	80	73	26	86	85	3.07	1.53

added products has significantly increased our overall income.	0	(22.9 %)	(20.9 %)	(7.4 %)	(24.6 %)	(24.3 %)	0	
Our investment in vertical diversification has led to a noticeable enhancement in the income generated from our products	35 0	94 (26.9 %)	105 (30%)	39 (11.1 %)	43 (14%)	63 (18%)	2.66	1.45 8
The value-added services we provide contribute positively to our revenue streams	35 0	48 (13.7 %)	82 (23.4 %)	13 (3.7 %)	114 (32.6 %)	93 (26.6 %)	3.35	1.43 4
Vertical diversification has improved our profit margins compared to previous periods	35 0	44 (12.6 %)	74 (21.1 %)	68 (19.4 %)	90 (25.7 %)	74 (21.1 %)	3.22	1.33 2
The profit margins on our diversified products are higher than those on our core products	35 0	44 (12.6 %)	74 (21.1 %)	73 (20.9 %)	137 (39.1 %)	22 (6.3 %)	3.05	1.16 5
Implementing vertical diversification strategies has led to a reduction in costs, thereby increasing our profit margins	35 0	32 (9.1 %)	63 (18%)	109 (31.1 %)	126 (36%)	20 (5.6 %)	3.11	1.06 1
Our vertical diversification efforts have expanded our market reach significantly	35 0	20 (5.7 %)	54 (15.4 %)	138 (39.4 %)	99 (28.3 %)	39 (11.1 %)	3.24	1.02 9
We have successfully entered new markets as a result of our vertical diversification strategy	35 0	17 (4.9 %)	42 (12.0 %)	157 (44.9 %)	66 (18.9 %)	68 (19.4 %)	3.36	1.07 4

Source: Researcher, 2024

From the table above, introduction of value-added products significantly increasing overall income showed a majority of respondents agreeing, as indicated by a mean of 3.07 and a standard deviation of 1.530. This suggests that on average, respondents believed that value-added products have positively effect sustainable livelihood, though with considerable variability in individual opinions. On regarding investment in vertical diversification leading to enhanced income, a majority of respondents were undecided or disagreed, as shown by a mean of 2.66 and a standard deviation of 1.458. This indicates that vertical diversification has not been universally seen as a significant driver of sustainable livelihood, with a notable portion of respondents remaining neutral.

On the other hand, value-added services contributing positively to revenue streams, a majority of respondents agreed, as indicated by a mean of 3.35 and a standard deviation of 1.434. This shows a general consensus that value-added services have a positive financial effect, although some variability in responses is still present. Vertical diversification has improved profit margins compared to previous periods, a majority of respondents agreed, as reflected in the mean of 3.22 and a standard deviation of 1.332, profit margins on sustainable livelihood being higher than those on core products, a majority were neutral or disagreed, as indicated by a mean of 3.05 and a standard deviation of 1.165. Cost reduction and increased profit margins from implementing vertical diversification strategies, a majority of respondents were neutral or disagreed, as shown by a mean of 3.11 and a standard deviation of 1.061. This indicates that while some companies perceive cost reduction, the effect is not consistent across all businesses, as many respondents did not share this view.

On expanding market reach, a majority of respondents agreed, as indicated by a mean of 3.24 and a standard deviation of 1.029. This reflects a positive outlook on the ability of vertical diversification to extend market reach, though some respondents remained neutral and lastly, successfully entering new markets due to vertical diversification, a majority of respondents agreed, as shown by a mean of 3.36 and a standard deviation of 1.074. This suggests that a significant portion of respondents felt that diversification had enabled them to enter new markets, although some were neutral on the matter.

Table 4.12 Descriptive statistics for Structural Diversification

	N	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mea n	Std. Dev
Our business has shown improved resilience to income shocks due to structural diversification	350	48 (13.7%)	76 (21.7%)	40 (11.4%)	110 (31.4%)	76 (21.7%)	3.26	1.374
The income generated from non-fish activities contributes significantly to our overall revenue.	350	49 (14%)	66 (18.9%)	26 (7.4%)	136 (38.9%)	73 (20.9%)	3.34	1.365
Structural diversification has created additional employment opportunities in our organization.	350	68 (19.4%)	107 (30.6%)	47 (13.4%)	92 (26.3%)	36 (10.3%)	2.77	1.308
Structural diversification has led to the development of profitable non-fish activities within our business	350	15 (4.3%)	69 (19.7%)	67 (19.1%)	125 (35.7%)	74 (21.1%)	3.50	1.152
Structural diversification has helped us maintain stable income levels during economic downturns.	350	12 (3.4%)	80 (22.9%)	68 (19.4%)	162 (46.3%)	28 (8%)	3.33	1.022

Source: Researcher, 2024

The findings on improved resilience to income shocks, a majority of the respondents agreed as indicated by a mean of 3.26 and a standard deviation of 1.374. This suggests that most respondents believe structural diversification has helped their business become more resilient to income fluctuations, although there is some variation in the responses. Income generated from non-fish activities contributes significantly to overall sustainable livelihood, a majority of respondents were again in agreement, as shown by a mean of 3.34 and a standard deviation of 1.365. Creation of additional employment opportunities in the organization, the responses were more mixed. The mean score of 2.77 and a standard deviation of 1.308 suggest that respondents were generally neutral to slightly agreeing that diversification has led to sustainable livelihood. Lastly, structural diversification led to development of profitable non-fish activities, a majority of the

respondents agreed, as indicated by a mean of 3.50 and a standard deviation of 1.152. This shows a strong consensus that diversification has indeed helped many sustainable livelihoods that develop profitable non-fish activities, with about 56.8% agreeing or strongly agreeing, while 24% were neutral or disagreed.

Table 4.13 Descriptive statistics for Portfolio Diversification

	N	SD (%)	D (%)	N (%)	A (%)	SA (%)	Me an	Std. Dev.
Diversifying our portfolio has significantly reduced our overall risk exposure	350	29 (8.3 %)	41 (11.7 %)	34 (9.7 %)	114 (32.6 %)	132 (37.7 %)	3.80	1.28 5
We have increased the number of income-generating activities as a result of our diversification strategy.	350	9 (2.6 %)	16 (4.6 %)	85 (24.3 %)	115 (32.9 %)	125 (35.7 %)	3.95	1.00 7
Our diversified portfolio helps protect us from downturns in specific markets or sectors	350	0(0 %)	29 (8.3 %)	80 (22.9 %)	156 (44.6 %)	85 (24.3 %)	3.85	0.88 4
We experience fewer fluctuations in income due to our diversified portfolio of activities	350	6 (1.7 %)	68 (22.3 %)	54 (15.4 %)	154 (44%)	58 (16.6 %)	3.51	1.06 4

Source: Researcher, 2024

A majority of the respondents agreed that portfolio diversification has reduced financial risks with a mean of 3.80 and a standard deviation of 1.285. This suggests that diversification has been effective in reducing financial risks for most respondents, though there is some variability in the extent to which it has mitigated risks across different livelihoods. Diversified strategy has helped increase the number of income-generating activities with majority of the respondents agreeing with a mean of 3.95 and a standard deviation of 1.007. Again, diversified portfolio helps protect sustainable livelihood from downturns in specific markets or sectors with a majority of respondents agreement, as shown by a mean of 3.85 and a standard deviation of 0.884. The results indicate that most respondents believe their diversified portfolios offer protection against

sector-specific downturns, with relatively consistent responses across livelihoods. Finally, in terms of whether diversification has led to fewer income fluctuations, a majority of the respondents agreed as reflected by a mean of 3.51 and a standard deviation of 1.064.

Table 4.14 Descriptive statistics for Entrepreneurial Determinants

	N	SD (%)	D (%)	N (%)	A (%)	SA (%)	Me an	Std. Dev.
I have sufficient access to financial resources to start and grow my business.	35 0	58 (16.6 %)	98 (28.0 %)	55 (15.7 %)	73 (20.9 %)	66 (18.9 %)	2.97	1.382
The availability of loans and grants has positively impacted my entrepreneurial activities.	35 0	72 (20.6 %)	38 (10.9 %)	117 (33.4 %)	67 (19.1 %)	56 (16.0 %)	2.99	1.330
I have adequate opportunities to access markets for my products or services.	35 0	36 (10.3 %)	86 (24.6 %)	60 (17.1 %)	104 (29.7 %)	64 (18.3 %)	3.21	1.283
My business benefits from strong connections with suppliers and customers, facilitating market access	35 0	8 (2.3 %)	49 (14.0 %)	85 (24.3 %)	122 (34.9 %)	86 (24.6 %)	3.65	1.067
Access to entrepreneurial training has significantly enhanced my ability to manage and grow my business	35 0	36 (10.3 %)	27 (7.7 %)	94 (26.9 %)	124 (35.4 %)	69 (19.7 %)	3.47	1.191
I have participated in training programs that have improved my entrepreneurial skills and knowledge	35 0	11 (3.1 %)	54 (15.4 %)	57 (16.3 %)	180 (51.4 %)	48 (13.7 %)	3.57	1.010

Source: Researcher, 2024

The table above presents the descriptive results for various entrepreneurial determinants. In terms of knowledge of seasonal patterns, the respondents showed a relatively positive response with a mean of 3.53 and a standard deviation of 1.174. This suggests that most entrepreneurs are aware of seasonal trends in their sustainable livelihoods. When venturing into fish farming based on prior information, the mean score was 3.64 with a standard deviation of 1.031, indicating that many entrepreneurs were influenced by

existing knowledge when deciding to enter fish farming. Regarding their approach to business thinking, the majority of respondents preferred experimenting rather than following a structured, systematic method. This is reflected in a mean of 3.50 and a standard deviation of 1.094.

When it comes to social and business networks, the results were more neutral, with a mean of 3.05 and a standard deviation of 0.976, suggesting that while some entrepreneurs find their networks helpful in accessing resources, others may not rely as heavily on them. Their ability to notice changes in customer needs, the mean score was 3.32 with a standard deviation of 1.115, indicating that most entrepreneurs are attentive to market shifts, though the degree of awareness differs. Lastly, in terms of relying on instincts when generating business ideas, the respondents were generally in agreement, with a mean of 3.44 and a standard deviation of 1.019.

Table 4.15 Descriptive statistics for Sustainable Livelihoods

	N	SD (%)	D (%)	N (%)	A (%)	SA (%)	Me an	Std. Dev.
Our participation in sustainable livelihood programs has significantly reduced our poverty levels	3 5 0	0 (0)	33 (9.4 %)	37 (10.6 %)	182 (52%)	98 (28%)	3.99	0.875
I believe that sustainable livelihood programs contribute positively to income growth in my community.	3 5 0	10 (2.9 %)	49 (14%)	59 (16.9 %)	162 (46.3 %)	70 (20%)	3.67	1.038
I feel that our ability to accumulate assets has improved due to support from sustainable livelihood programs	3 5 0	27 (7.7 %)	61 (17.4 %)	75 (21.4 %)	125 (35.7 %)	62 (17.7 %)	3.38	1.186
My household experiences greater food security as a result of participating in sustainable livelihood activities	3 5 0	6 (1.7 %)	40 (11.4 %)	32 (9.1 %)	180 (51.4 %)	92 (26.3 %)	3.89	0.978
I feel that our community has benefited from initiatives aimed at	3 5 0	54 (15.4 %)	27 (7.7 %)	91 (26%)	136 (38.9 %)	42 (12%)	3.24	1.228

poverty reduction.

Source: Researcher, 2024

The findings for sustainable livelihood programs had significantly reduced their poverty levels, a majority of the respondents agreed, with a mean of 3.99 and a standard deviation of 0.875. In regards to livelihood programs contribute positively to income growth in the community a majority of respondents agreed as indicated by a mean of 3.67 and a standard deviation of 1.038. Similarly, when asked about whether asset accumulation had improved due to participation in sustainable livelihood programs, a majority agreed as reflected in a mean of 3.38 and a standard deviation of 1.186. This suggests that while many respondents felt their ability to accumulate assets had been enhanced, there was a noticeable variation in the extent of this improvement. Regarding food security, a majority of respondents agreed that their households experienced greater food security as a result of participating in sustainable livelihood activities, with a mean of 3.89 and a standard deviation of 0.978 and finally, when asked about whether their community had benefited from initiatives aimed at poverty reduction, a majority of respondents agreed, with a mean of 3.24 and a standard deviation of 1.228.

4.5 Diagnostic tests

4.5.1 Normality tests

The Kolmogorov-Smirnov output below was used to test for normality of distribution of data for the variables. At 95% confidence level, for any data to be considered normal, the P values should be greater or equal to 0.05 ($P \geq 0.05$). From the table above, none of the variables attained P values since all are 0.00. However, the sample for this research was 350 respondents drawn from different fish farmers in Kakamega County. Large samples

greater than 50 usually violate this assumption hence the data was considered normal (Pallant, 2005).

Table 4.16 Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Vertical Diversification	.117	348	.000	.958	348	.000
Structural Diversification	.256	348	.000	.852	348	.000
Portfolio Diversification	.145	348	.000	.909	348	.000
Entrepreneurial Determinant	.165	348	.000	.923	348	.000
Sustainable Livelihood	.156	348	.000	.945	348	.000

a. Lilliefors Significance Correction

The Kolmogorov-Smirnov output above was used to test for normality of distribution of data for the variables. At 95% confidence level, for any data to be considered normal, the P values should be greater or equal to 0.05 ($P \geq 0.05$). From the table above, none of the variables attained P values since all are 0.00. However, the sample for this research was 350 respondents drawn from different fish farmers in Kakamega County. Large samples greater than 50 usually violate this assumption hence the data was considered normal (Pallant, 2005).

4.5.2 Test for Multi-collinearity

The collinearity statistics of the regression model indicate that there is a moderate level of multicollinearity among the predictors: Vertical Diversification, Structural Diversification, Portfolio Diversification, and Entrepreneurial Determinants. The tolerance values for these variables range from 0.266 to 0.448, all of which are above the critical threshold of 0.1, suggesting that multicollinearity is not severe. Correspondingly, the Variance Inflation Factor (VIF) values range from 2.231 to 3.758, which are below the commonly accepted upper limit of 10. These VIF values confirm that the

multicollinearity present is moderate but not substantial enough to significantly distort the regression estimates (Shieh,2010) Thus, while the predictors are somewhat correlated, the model should still yield reliable coefficients for analyzing their effects on the dependent variable, Sustainable Live (likely referring to sustainable livelihoods or outcomes). Overall, the model appears robust, though researchers should remain mindful of the moderate multicollinearity when interpreting the results.

Table 4. 17: Multicollinearity

Coefficients^a

		Collinearity Statistics	
Model		Tolerance	VIF
1	Vertical Diversification	.297	3.365
	Structural Diversification	.266	3.758
	Portfolio Diversification	.448	2.231
	Entrepreneurial Determinants	.362	2.762

a. Dependent Variable: SustainableLive
Source: Researcher, 2024

Table 4.18 Correlation test for multicollinearity

Correlations

		Vertical Div	Structural Div	Portfolio Div	Entrepreneurial Determinants	Sustainable Livelihood
Vertical Div	Pearson Correlation	1	.829**	.523**	.649**	.549**
	Sig. (2-tailed)		.000	.000	.000	.000
	N	350	350	350	350	350
Structural Div	Pearson Correlation	.829**	1	.601**	.680**	.543**

	Sig. (2-tailed)	.000		.000	.000	.000
	N	350	350	350	350	350
Portfolio Div	Pearson Correlation	.523**	.601**	1	.727**	.669**
	Sig. (2-tailed)	.000	.000		.000	.000
	N	350	350	350	350	350
Entrepreneurial Det	Pearson Correlation	.649**	.680**	.727**	1	.751**
	Sig. (2-tailed)	.000	.000	.000		.000
	N	350	350	350	350	350
Sustainable Livelihood	Pearson Correlation	.549**	.543**	.669**	.751**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	350	350	350	350	350

** . Correlation is significant at the 0.05 level (2-tailed).

Source: Researcher, 2024

The correlation matrix reveals significant relationships among Vertical Diversification, Structural Diversification, Portfolio Diversification, Entrepreneurial Determinants, and Sustainable Livelihood. Vertical Diversification has a moderate positive correlation with Sustainable Livelihood ($r = 0.549$, $p < 0.001$), suggesting that as vertical diversification increases, there is a corresponding improvement in sustainable livelihood outcomes (Field, 2013).

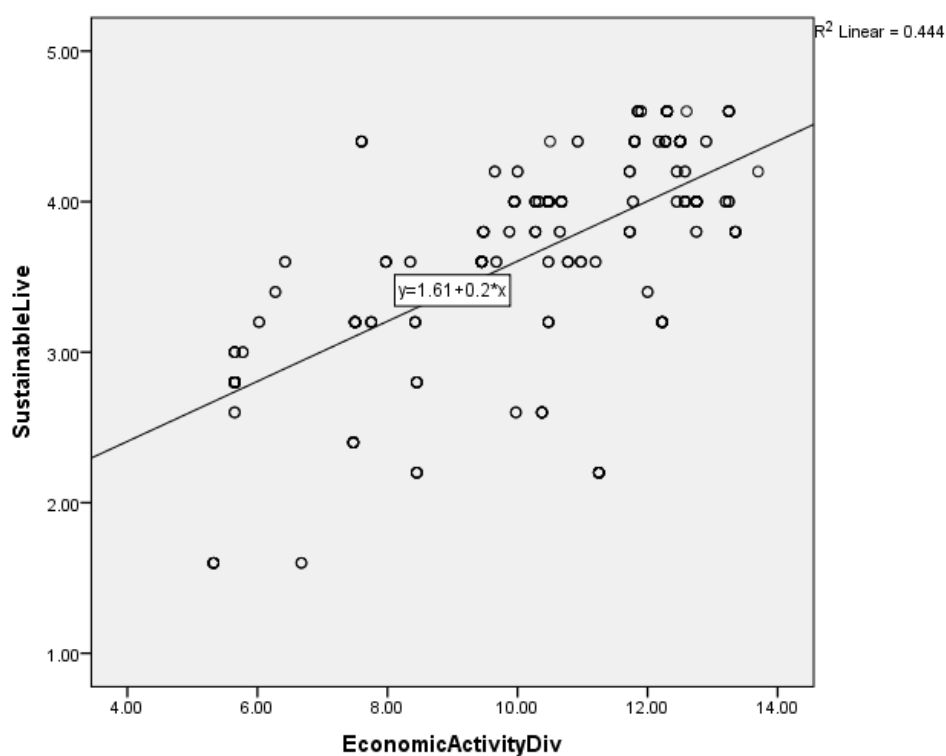
Structural Diversification shows a moderate positive correlation with Sustainable Livelihood ($r = 0.543$, $p < 0.001$), implying that structural diversification contributes positively, though moderately, to sustainable livelihood outcomes (Asare, 2018). Furthermore, Portfolio Diversification has a strong positive correlation with Sustainable Livelihood ($r = 0.669$, $p < 0.001$), indicating that higher levels of

portfolio diversification are associated with improved livelihood outcomes (Loison,2019).

Entrepreneurial Determinants demonstrate the strongest positive correlation with Sustainable Livelihood ($r = 0.751$, $p < 0.001$). This suggests that entrepreneurial factors play a significant role in enhancing sustainable livelihood outcomes (Muñoz & Cohen,2018). Additionally, Entrepreneurial Determinants are strongly correlated with all other diversification strategies, especially Portfolio Diversification ($r = 0.727$, $p < 0.001$), emphasizing the interconnectedness of these variables.

4.5.3 Homoscedasticity test

Homoscedasticity was tested through the use of a scatterplot. The above scatter plot indicates that Economic activity diversification is homoscedastic and linearly related to sustainable livelihoods among fish farmers in Kakamega County. This is supported by the possibility of fitting goodness of fit line in the scatter plot. The slope of the line is $0.2 \cdot X$ while the intercept constant is 1.61 based on the sum of scores for the variables. The points are also concentrated towards the fit line indicating presence of homoscedasticity. This indicates that the assumption has not been violated and hence the data can be subjected to regression analysis.



4.6 Simple linear regression of each independent variables against dependent variable

4.6.1 Effect of Vertical Diversification on Sustainable Livelihoods among fish farmers in Kakamega County

H₀₁: Vertical Diversification have no statistically significant effect on Sustainable livelihood among fish farmers in Kakamega County.

Table 4. 19: Model Summary

Model Summary									
Model	R		Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statistics			
	R	Square				F Change	df1	df2	Sig. F Change
1	.549 ^a	.301	.299	.58572	.301	149.988	1	348	.000

a. Predictors: (Constant), Vertical Diversification

Source: Researcher, 2024

From the study findings in Table 4.19, the value of R-square is 0.301. This implies that, 30.1% variation of sustainable livelihoods of fish farmers in Kakamega County was explained by the effect of Vertical Diversification on sustainable livelihoods.

Table 4. 20: ANOVA test

ANOVA ^a					
Model		Sum of Squares	df	Mean Square	F
1	Regression	51.456	1	51.456	149.988
	Residual	119.387	348	.343	
	Total	170.842	349		

a. Dependent Variable: SustainableLive

b. Predictors: (Constant), Vertical Diversification

Source: Researcher, 2024

The results presented in Table 4.20 reveal that at a significance level of 0.05, the ANOVA test demonstrates the critical role of the independent variable, Vertical diversification, in forecasting the livelihoods of fish farmers in Kakamega County. This is evidenced by a significance value of 0.000, which is notably less than the 0.05 threshold ($p=0.000 < 0.05$).

Table 4. 21: Coefficients of the Model

Coefficients ^a					
Model		Unstandardized Coefficients		Standardized Coefficients	
		B	Std. Error	Beta	t
1	(Constant)	2.296	.114		20.216
	Vertical Diversification	.427	.035	.549	12.247

a. Dependent Variable: SustainableLive

Source: Researcher, 2024

From Table 4.21, the study findings revealed that vertical diversification had significant influence on livelihoods of fish farmers in Kakamega County (t-statistic=12.247, p-value=0.000< 0.05). Therefore, at 5% level of significance the null hypothesis was rejected, indicating that Vertical diversification significantly influenced Sustainable livelihoods among fish farmers in Kakamega County.

Letting Y be Sustainable livelihood of fish farmers, X_1 be Vertical diversification, using the regression coefficients in Table 4.21, we have;

$$\text{Sustainable Livelihoods} = 2.296 + .427\text{VD}$$

Thus, for every unit increase in vertical diversification there was a corresponding increase on sustainable livelihoods of fish farmers in Kakamega County by 0.427.

4.6.2 Effect of Structural Diversification on sustainable livelihoods among fish farmers in Kakamega County.

***H₀₂:** Structural Diversification has no statistically significant effect on sustainable livelihoods among fish farmers in Kakamega County*

Table 4. 22: Model Summary

Model Summary									
Model	R	Change Statistics							
		R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.543 ^a	.295	.293	.58823	.295	145.741	1	348	.000

a. Predictors: (Constant), Structural Diversification

Source: Researcher, 2024

From the table above, the value of R-Square is 0.295. This implies that, 29.5% of variation of Sustainable Livelihood among fish farmers in Kakamega County was explained by structural diversification.

Table 4. 23: ANOVA test

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	50.429	1	50.429	145.741	.000 ^b
	Residual	120.413	348	.346		
	Total	170.842	349			

a. Dependent Variable: SustainableLive

b. Predictors: (Constant), Structural Diversification

Source: Researcher, 2024

The data presented in the table above reveals that at a significance level of 0.05, the ANOVA test demonstrates that the independent variable, structural diversification, plays a crucial role in predicting Sustainable Livelihood among fish farmers in Kakamega County. This is evidenced by a significance value of 0.000, which is notably less than the 0.05 threshold ($p=0.000<0.05$).

Table 4. 24: Coefficients

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.290	.116		19.804	.000
	Structural Diversification	.415	.034	.543	12.072	.000

a. Dependent Variable: SustainableLive

Source: Researcher, 2024

The data presented in the table indicates that structural diversification exerts a considerable impact on Sustainable Livelihood among fish farmers in Kakamega County (t statistic=12.072, p-value=0.000 < 0.05). Consequently, at a 5% level of significance, the null hypothesis was dismissed, suggesting that structural diversification exerted a notable influence on Sustainable Livelihood among fish farmers in Kakamega County.

Once more, for each unit increase in economic diversification, there was a proportional increase in Sustainable Livelihood among fish farmers by 0.415.

Using the regression coefficients in the table above, the study has the model below.

$$\text{Sustainable Livelihoods} = 2.290 + .415\text{SD}$$

4.6.3 Effect of Portfolio Diversification on Sustainable Livelihood among fish farmers in Kakamega County.

H₀₃: Portfolio diversification has no statistically significant effect on Sustainable Livelihoods among fish farmers in Kakamega County

Table 4. 25: Model Summary

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statistics			Sig. F Change
						F Change	df1	df2	
1	.669 ^a	.447	.445	.52100	.447	281.386	1	348	.000

a. Predictors: (Constant), Portfolio Diversification

Source: Researcher, 2024

The analysis presented in the preceding table indicates that the R-Square value is 0.447. This indicates that 44.7% of the variation in Sustainable Livelihood among fish farmers can be attributed to Portfolio diversification in Kakamega County.

Table 4. 26: ANOVA

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	76.380	1	76.380	281.386	.000 ^b
	Residual	94.462	348	.271		
	Total	170.842	349			

a. Dependent Variable: SustainableLive

b. Predictors: (Constant), Portfolio Diversification
Source: Researcher, 2024

The results presented in the table above demonstrate that at a significance level of 0.05, the ANOVA test reveals the independent variable, Portfolio diversification, plays a crucial role in predicting Sustainable Livelihoods among fish farmers. This is evidenced by a significance value of 0.000, which is notably less than the 0.05 threshold ($p=0.000<0.05$).

Table 4. 27: Coefficients

Coefficients ^a					
		Unstandardized Coefficients		Standardized Coefficients	
Model		B	Std. Error	Beta	t
1	(Constant)	1.547	.127		12.137
	Portfolio Diversification	.553	.033	.669	16.775
	n				

a. Dependent Variable: SustainableLive
Source: Researcher, 2024

The data presented in the table indicates that portfolio diversification exerted a considerable impact on sustainable livelihoods for fish farmers in Kakamega County, as evidenced by a t-statistic of 16.775 and a p-value of 0.000, which is less than the 0.05 threshold. Consequently, at a 5% level of significance, the null hypothesis was dismissed, suggesting that portfolio diversification positively impacted sustainable livelihoods among fish farmers in Kakamega County. In a similar vein, each unit increase in portfolio diversification corresponded with an enhancement in sustainable livelihoods among fish farmers by a factor of 0.553.

Using the regression coefficients in the table above, the study has the model below.

$$\text{Sustainable Livelihoods} = 1.547 + 0.553\text{PD}$$

4.7 Multiple Linear regression for Economic Diversification and sustainable livelihoods among fish farmers in Kakamega County.

Table 4. 28: Model Summary

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statistics			Sig. F Change
						F Change	df1	df2	
1	.708 ^a	.502	.497	.49611	.502	116.044	3	346	.000

a. Predictors: (Constant), Portfolio Diversification, Vertical Diversification, Structural Diversification

Source: Researcher, 2024

The table above illustrates the variation in the dependent variable (sustainable livelihoods) as anticipated by the independent variables (Vertical Diversification, Structural Diversification, Portfolio Diversification). The multiple regression yielded a R value of 0.708 and a R² of 0.502, indicating that 50.2 percent of the observed variations in sustainable livelihood are accounted for by economic diversification.

Table 4. 29: ANOVA

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	85.684	3	28.561	116.044	.000 ^b
	Residual	85.159	346	.246		
	Total	170.842	349			

a. Dependent Variable: SustainableLive

b. Predictors: (Constant), Portfolio Diversification, Vertical Diversification, Structural Diversification

Source: Researcher, 2024

Table above presents the multiple regression ANOVA. The results demonstrate that the model is valid and useful in explaining sustainable livelihoods among fish farmers in Kakamega county (P=0.000). These values are adequate to demonstrate that the model is

a good fit in explaining the variations in the dependent variable (sustainable livelihoods) as a result of the changes in the predictor variable (economic diversification).

Table 4.30: Coefficients

		Coefficients^a				
		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.327	.127		10.486	.000
	Vertical Diversification	.212	.053	.273	4.010	.000
	Structural Diversification	.001	.055	.001	.019	.985
	Portfolio Diversification	.434	.039	.525	11.037	.000

a. Dependent Variable: SustainableLive

Source: Researcher, 2024

The outcomes of the multiple regression analysis elucidate the impact of various forms of diversification on the dependent variable, SustainableLive. The constant term, possessing an unstandardized coefficient of 1.327 and a significance level of .000, signifies that when all independent variables are zero, SustainableLive has a baseline value of about 1.327. This result is statistically significant, indicating a dependable baseline for the model (Field, 2013).

The unstandardized coefficient for vertical diversification is .212, with a standardized beta of .273. This signifies a positive and substantial correlation with SustainableLive. The t-value of 4.010 and a significance level of .000 indicate that vertical diversification significantly affects variances in SustainableLive. The positive correlation indicates that a rise in vertical diversification is expected to correspond with an increase in SustainableLive, demonstrating a moderate effect size. This study corroborates other research, highlighting that vertical diversity can augment a firm's competitive advantage

and sustainability by optimizing operations and enhancing efficiencies (Brahm, Parmigiani & Tarziján, 2021).

Conversely, structural diversification exhibits a coefficient of .001 and a standardized beta of .001, signifying an almost imperceptible impact on SustainableLive. The t-value of 0.019 and the significance level of 0.985 indicate that structural diversification lacks statistical significance in this context. This research indicates that structural diversification does not significantly affect SustainableLive, in contrast to the outcomes for vertical and portfolio diversification. Research indicates that structural variety may result in inefficiencies and a dilution of focus, ultimately impairing performance (Nzioka 2017).

Portfolio diversity exhibits a robust positive correlation with SustainableLive. The unstandardized coefficient of .434 and a standardized beta of .525 signify a considerable influence, accompanied by a t-value of 11.037 and a significance level of .000. The robust statistical significance indicates that enhancements in portfolio diversity are likely to result in substantial advancements in SustainableLive. The results corroborate prior literature demonstrating that portfolio diversity enables enterprises to utilize resources across many markets, promoting innovation and sustainability (Medase & Abdul-Basit, 2020).

The results underscore the significance of vertical and portfolio diversification in improving sustainability outcomes, whereas structural diversification seems to have no impact. These findings underscore the strategic advantages of diversification in attaining sustainability objectives, aligning with theories that support varied strategies in intricate market contexts (Medase & Abdul-Basit, 2020).

The generic multiple regression equation model given was as shown:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$$

Using the regression coefficients in the table above, the study has the model below.

$$\text{Sustainable Livelihoods} = 1,327 + 0.212\text{VD} + 0.001\text{SD} + 0.434\text{PD}$$

Where VD=Vertical Diversification

SD=Structural Diversification

PD=Portfolio Diversification

4.8 Hierarchical regression for moderation

Table 4. 31: Model Summary

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statistics			Sig. F Change
						F Change	df1	df2	
1	.666 ^a	.444	.443	.52239	.444	278.039	1	348	.000
2	.762 ^b	.581	.578	.45443	.136	112.872	1	347	.000
3	.768 ^c	.589	.586	.45032	.009	7.366	1	346	.007

a. Predictors: (Constant), EconomicActivityDiv

b. Predictors: (Constant), EconomicActivityDiv, Entrepreneurial Determinants

c. Predictors: (Constant), EconomicActivityDiv, Entrepreneurial Determinants, EconomicActivityDivInteraction

Source: Researcher, 2024

The first model has a practical significant r-squared value of 0.444. These findings indicated that Economic Diversification could explain 44.4% variations in Sustainable livelihoods. The results also indicated that Economic Diversification practices had a strong, positive relationship with Sustainable livelihoods with an $r = 0.666$.

Model 2 demonstrated that when Entrepreneurial Determinant was introduced to the model as a moderator, all the predictor variables (Vertical Diversification, Structural Diversification, Portfolio Diversification) and the moderating variable, Entrepreneurial Determinants were jointly and significantly related to the outcome variable of Sustainable livelihoods with an r value of 0.762, and a p value that is less than 0.05. The change in the r-squared value from 0.444 in model 1 to 0.581 in model 2 (an increase of 0.137). These results demonstrate that model 2 can be used to explain the change in Sustainable livelihoods from 44.4% to 58.1% as attributed to Entrepreneurial Determinants.

Model 3 tested how Entrepreneurial determinants moderates the relationship between economic diversification and sustainable livelihoods among fish farmers in Kakamega County. The model entailed entering all the interaction terms; the predictor variables and the moderating variable. The R-squared value increased from 0.581 to 0.589. The results indicated that Entrepreneurial determinants had a positive statistically significant effect on the relationship between Economic diversification and sustainable livelihoods among fish farmers in Kakamega County with an R-value of 0.768, R-squared value of 0.589 and a p value (0.007) that is less than 0.05. These findings demonstrate that when interaction terms of independent variables with Entrepreneurial determinants, the influence of economic diversification could explain 58.9% of the changes in sustainable livelihoods among fish farmers in Kakamega County., with the model being statistically significant with a p-value less than 0.05.

Table 4. 32: ANOVA

ANOVA ^a						
		Sum of				
Model		Squares	Df	Mean Square	F	Sig.
1	Regression	75.875	1	75.875	278.039	.000 ^b

	Residual	94.967	348	.273		
	Total	170.842	349			
2	Regression	99.184	2	49.592	240.147	.000 ^c
	Residual	71.658	347	.207		
	Total	170.842	349			
3	Regression	100.678	3	33.559	165.490	.000 ^d
	Residual	70.164	346	.203		
	Total	170.842	349			

a. Dependent Variable: SustainableLive

b. Predictors: (Constant), EconomicActivityDiv

c. Predictors: (Constant), EconomicActivityDiv, Entrepreneural Determinants

d. Predictors: (Constant), EconomicActivityDiv, Entrepreneural Determinants, EconomicActivityDivInteraction

Source: Researcher, 2024

In the context of model 1, at a 5% significance level, the ANOVA tests reveal that the independent variables—Vertical Diversification, Structural Diversification, and Portfolio Diversification—serve as significant predictors of sustainable livelihoods among fish farmers in Kakamega County. This is evidenced by an F-value of 278.039 and a p-value of 0.000, which is notably less than 0.05.

The results pertaining to model 2 at a 5% significance level reveal that the ANOVA tests underscore the significance of the independent variables—Vertical Diversification, Structural Diversification, and Portfolio Diversification—alongside the moderating variable, Entrepreneurial determinants. These elements collectively serve as crucial predictors of sustainable livelihoods for fish farmers in Kakamega County, as evidenced by an F-value of 240.147 and a p-value of 0.000, which is notably less than 0.05. The results delineated in model 3, at a 5% significance level, reveal that the ANOVA tests underscore the significance of the independent variables (Vertical Diversification, Structural Diversification, Portfolio Diversification) alongside the moderating variable (Entrepreneurial determinants). Furthermore, the interaction terms (independent

variables * Entrepreneurial determinants) emerged as crucial predictors of sustainable livelihoods, evidenced by an F-value of 165.490 and a p-value of 0.000, which is notably less than 0.05.

Table 4. 33: Coefficients

Coefficients^a					
		Unstandardized Coefficients		Standardized Coefficients	
Model		B	Std. Error	Beta	t Sig.
1	(Constant)	1.609	.125		12.918 .000
	EconomicActivityDiv	.200	.012	.666	16.675 .000
2	(Constant)	1.424	.110		12.974 .000
	EconomicActivityDiv	.062	.017	.206	3.719 .000
	Entrepreneurial Determinants	.478	.045	.590	10.624 .000
3	(Constant)	.182	.470		.388 .698
	EconomicActivityDiv	.175	.045	.585	3.903 .000
	Entrepreneurial Determinants	.955	.181	1.179	5.267 .000
	EconomicActivityDivI nteraction	-.042	.016	-.919	-2.714 .007

a. Dependent Variable: SustainableLive

Source: Researcher, 2024

In the first model, the constant term is 1.609 with a significance level of .000, indicating a statistically significant baseline for SustainableLive when EconomicActivityDiv is zero. The unstandardized coefficient for EconomicActivityDiv is .200, with a standardized beta of .666, suggesting a strong positive relationship with SustainableLive. The t-value of 16.675 and significance level of .000 indicate that EconomicActivityDiv is a significant predictor of SustainableLive. This aligns with existing literature that highlights the importance of economic activity in driving sustainability initiatives, as active economic environments often foster innovation and sustainable practices (Ramanathan, Black, Ghobadian & Galleary, 2017).

The second model refines the analysis by adding Entrepreneurial Determinants as an additional independent variable. The constant here is 1.424, also significant ($p < .001$). EconomicActivityDiv retains a positive relationship, with a coefficient of .062 and a standardized beta of .206, although the effect appears smaller compared to the first model. The addition of Entrepreneurial Determinants shows a substantial positive effect with an unstandardized coefficient of .478 and a standardized beta of .590. The significance level of .000 for this variable suggests it is a strong predictor of SustainableLive. This finding supports the notion that entrepreneurial factors, including innovation and risk-taking, significantly contribute to sustainability outcomes (Muturi & Olaniran, 2017).

In the third model, which includes both EconomicActivityDiv and Entrepreneurial Determinants, as well as an interaction term (EconomicActivityDivInteraction), the constant is .182 and not statistically significant ($p = .698$). EconomicActivityDiv shows a coefficient of .175 with a standardized beta of .585, indicating a positive relationship with SustainableLive, although slightly diminished from earlier models. Entrepreneurial Determinants has a strong unstandardized coefficient of .955 and a standardized beta of 1.179, highlighting its significant positive effect. The significance level of .000 for this variable suggests a robust influence on SustainableLive.

Interestingly, the interaction term, EconomicActivityDivInteraction, has a negative coefficient of -.042 and a standardized beta of -.919, with a significance level of .007. This indicates that while both EconomicActivityDiv and Entrepreneurial Determinants positively affect SustainableLive, the interaction between these two variables may negatively influence the sustainability outcomes when considered together. This finding suggests a potential diminishing return effect, where increasing economic activity does not always enhance sustainability when paired with certain entrepreneurial factors. Such

results resonate with literature suggesting that excessive focus on economic growth can sometimes overshadow sustainability efforts (Meza, 2020).

Hence, the results from the table above led to a hierarchical multiple regression model that can be displayed as below:

$$Y = 0.182 + 0.175X_1 + 0.955X_2 - 0.042X_3 + X_4 + e$$

4.9 Summary of the Hypothesis

Hypothesis	P – value	Decision
Ho₁: Vertical diversification has no statistically significant effect on Sustainable livelihoods among fish farmers in Kakamega County.	0.000	rejected
Ho₂: Structural diversification has no statistically significant effect on Sustainable livelihoods among fish farmers in Kakamega County.	0.985	Failed to reject

Ho₃: Portfolio diversification has no statistically significant effect on Sustainable livelihoods among fish farmers in Kakamega County.	0.000	rejected
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Ho₄: Entrepreneurship determinants have no statistically significant moderating effect on the relationship between economic diversification and Sustainable livelihoods among fish farmers in Kakamega County.	0.000	rejected
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Source: Researcher 2024

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

Economic activity diversification among fish farmers in Kakamega County has become a crucial aspect in enhancing sustainable livelihoods. As the demand for fish products continues to rise and the challenges faced by traditional farming practices persist, exploring alternative economic activities has become imperative. This section presents summary findings, conclusion, policy recommendation and areas of further studies.

5.2 Summary Findings

The findings of the demographic characteristics revealed that most (66.5%) of the respondents were male, while 33.5% were females, suggesting a male dominated population and engagements in livelihood activities. 47.1% of the respondents were between the age bracket of 21-40, followed by 6.6% were between 1-20 years, 29.4% were between 41-60 years and lastly, 16.9% were between 61-80 years. 54.3% of the respondents are married. 50.18% of the respondents attained secondary education, followed by tertiary levels of education 25.61% and primary level of education 24.21%. 52.0% of the respondents were in households consisting of 6 to 10 family members; the estimated mean household population is 7 people. 37.7% of the respondents have 1-3 acres of land size. Also, the estimated mean farm size was 2.3 acres. 51.4% belong to a cooperative while those who were not members of cooperative society constituted 48.6%. 66.86% of the farmers in the study area do not have access to microcredit. 54.29% of the respondents own productive assets, while 45.71% do not possess productive assets.

5.2.1 Vertical Diversification on Sustainable livelihoods among Fish Farmers in Kakamega County.

Vertical Diversification shows a significant positive effect on sustainable livelihoods with a $B = 0.273$ and $p\text{-value} = 0.000$ that is less than 0.05, indicating that this relationship is statistically significant. This shows that a one-unit increase in vertical diversification leads to a 0.273 increase in sustainable livelihoods, meaning vertical diversification positively effect sustainable livelihoods.

5.2.2 Structural Diversification on Sustainable livelihoods among Fish Farmers in Kakamega County.

Structural Diversification has an insignificant effect on sustainable livelihoods with $B = 0.001$ and $p\text{-value} = 0.985$ that is greater than 0.05 showing that structural diversification does not appear to significantly influence sustainable livelihoods. The very small Beta value further suggests that its effect minimal on dependent variable.

5.2.3 Portfolio Diversification on Sustainable livelihoods among Fish Farmers in Kakamega.

Portfolio Diversification has a significant positive effect on sustainable livelihoods with $B = 0.525$ and a $p\text{-value} = 0.000$. The Beta value of 0.525 shows that portfolio diversification had a stronger effect on dependent variable with $p\text{-value}$ of 0.000 confirms this relationship is statistically significant, meaning portfolio diversification has a substantial and positive effect on sustainable livelihoods.

5.2.4 The relationship of Entrepreneurship determinants with economic diversifications activities on Sustainable livelihoods among Fish Farmers in Kakamega.

Entrepreneurial determinants have a strong positive effect on economic activity, as indicated by the high Beta value of 0.590 and a p-value of 0.000 making it a significant predictor. Additionally, economic activity diversification also contributes positively to economic activity, though to a lesser extent (Beta = 0.206). The moderator role of entrepreneurial determinants is evident, as they significantly enhance the relationship between diversification and economic activity. This suggests that fostering entrepreneurial skills and resources can amplify the positive effect of diversifying economic activities

5.3 Conclusion

The study reveals that various forms of diversification, including vertical, structural and portfolio diversification, have a significant and positive effect on economic activity and sustainable livelihoods. Vertical diversification and portfolio diversification show strong positive relationships with improved economic outcomes, underscoring the importance of broadening product portfolios and integrating vertically within industries to enhance sustainability. However, structural diversification did not exhibit a significant effect, suggesting that its influence on economic activity and livelihoods may be less pronounced in this context.

The role of entrepreneurial determinants as a moderator further reinforces the importance of individual capabilities, such as innovation, risk-taking and resource management, in shaping the effect of diversification strategies. The interaction of entrepreneurial determinants with economic activity diversification slightly diminishes the positive effects of diversification, but it remains clear that entrepreneurial skills and resources are crucial in maximizing the benefits of diversification. To achieve sustainable economic growth, policies and initiatives should focus on promoting both diversification and

entrepreneurship, ensuring that individuals and businesses are equipped with the skills and resources needed to thrive in a diversified economic environment.

5.4 Policy Recommendation for the Study

Businesses and organizations should consider increasing their vertical integration by expanding into related activities within their supply chains, such as processing, packaging, or distribution. This can create new revenue streams, reduce dependency on single products, and improve resilience to market fluctuations. Investment in research and development (R&D) to explore innovative ways to add value at different stages of production would further enhance the benefits of vertical diversification while structural diversification did not show a significant direct effect in the study, businesses can still explore this strategy by expanding into different markets or introducing new business units that target different customer segments. For sectors with limited diversification opportunities, organizations should explore hybrid models, combining structural diversification with vertical and portfolio diversification to maximize potential benefits. Training programs to enhance managerial skills in managing diverse business units could help unlock its potential.

Organizations should actively pursue portfolio diversification by expanding into different sectors or industries to spread risk and capitalize on new growth opportunities. Businesses should assess market trends, customer demands, and technological advancements to identify high-potential areas for diversification. Developing strategic partnerships and collaborations across sectors can further enhance the scope and impact of portfolio diversification. Since entrepreneurial determinants such as innovation, risk-taking, and resource management have a significant impact on economic activity, businesses should focus on entrepreneurship training and capacity-building programs. Governments and educational institutions should invest in initiatives that foster

entrepreneurship, such as incubators, mentorship programs, and access to funding. Furthermore, creating an environment that supports entrepreneurial innovation and encourages risk-taking can lead to greater economic activity and the successful implementation of diversification strategies.

5.5 Study implications

In summary, the study provides both theoretical and practical insights into the role of diversification and entrepreneurial determinants in enhancing economic activity and livelihoods. Theoretically, it contributes to the understanding of diversification theories, particularly by differentiating the effect of vertical, structural and portfolio diversification on economic outcomes. It highlights the moderating role of entrepreneurial determinants adding complexity to the dynamic capabilities theory and emphasizing that entrepreneurial skills can enhance or, in certain contexts, reduce the effectiveness of diversification strategies. From a practical perspective, the study underscores the importance of portfolio and vertical diversification for businesses and communities to reduce risks, increase resilience, and drive growth. It suggests that policies should foster entrepreneurial education, improve access to capital, and create an enabling environment for diversification. For entrepreneurs, the study emphasizes the need to build entrepreneurial capacities to maximize the benefits of diversification.

5.6 Areas of Further Studies

Areas for further studies on the effect of economic activity diversification on sustainable livelihoods among fish farmers in Kakamega County could include:

- i. Conduct longitudinal studies to track the long-term impacts of economic diversification on livelihood outcomes among fish farmers. Longitudinal data collection would provide insights into the dynamics of diversification strategies,

their sustainability over time, and their implications for livelihood resilience and well-being.

- ii. Investigate the effectiveness of policy interventions and support programs aimed at promoting economic diversification among fish farmers. Assess the impact of government policies, development projects, and institutional initiatives on livelihood outcomes, access to resources, and social-economic empowerment within farming communities.
- iii. Explore the role of market access and value chain development in facilitating economic diversification among fish farmers. Analyse the linkages between market dynamics, value addition opportunities, and diversification strategies to enhance income generation, market competitiveness, and value chain resilience in the fisheries sector.
- iv. Explore the gender and youth dimensions of economic diversification among fish farmers. Investigate the differential impacts of diversification strategies on men and women, including access to resources, participation in decision-making, and benefits distribution. Similarly, examine the role of economic diversification in addressing youth unemployment, fostering entrepreneurship, and promoting youth inclusion in agricultural value chains.

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APPENDICES

APPENDIX I: SAMPLE SIZE DETERMINATION

Sample Size Determination Using Krejcie and Morgan Table (1970)

Table for Determining Sample Size for a Finite Population

<i>N</i>	<i>S</i>	<i>N</i>	<i>S</i>	<i>N</i>	<i>S</i>
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note.—*N* is population size. *S* is sample size.

Source: Krejcie & Morgan, 1970

The Table is constructed using the following formula for determining sample size:

Formula for determining sample size

$$s = X^2 NP(1 - P) + d^2 (N - 1) + X^2 P(1 - P)$$

s = required sample size.

X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841).

N = the population size.

P = the population proportion (assumed to be .50 since this would provide the maximum sample size).

d = the degree of accuracy expressed as a proportion (.05).

Source: Krejcie & Morgan, 1970

NOTE:

There is no need of using the formula since the table of determining sample size has all the provisions you require to arrive at your sample size.

APPENDIX II: RESEARCH APPROVAL LETTER



MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

Tel: 056-30870
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P.O Box 190
Kakamega – 50100
Kenya

Directorate of Postgraduate Studies

Ref: MMU/COR: 509099

31st October 2022

Daisy Linda Wesonga
ECO/G/01 – 70069/2020
P.O. Box 190-50100,
KAKAMEGA.

Dear Ms. Wesonga,

RE: APPROVAL OF PROPOSAL

I am pleased to inform you that the Directorate of Postgraduate Studies has considered and approved your Masters proposal entitled '*Effect of Economic Activity Diversification on Sustainable Livelihoods among Fish Farmers in Kakamega County*' and appointed the following as supervisors:

1. Dr. Consolata Ngala - SOBE, MMUST
2. Dr. Edwin Simiyu - SOBE, MMUST

You are required to submit through your supervisor(s) progress reports every three months to the Director Postgraduate Studies. Such reports should be copied to the following: Chairman, School of Business and Economics Graduate Studies Committee and Chairman, Economics Department. Kindly adhere to research ethics consideration in conducting research.

It is the policy and regulations of the University that you observe a deadline of two years from the date of registration to complete your Master's thesis. Do not hesitate to consult this office in case of any problem encountered in the course of your work.

We wish you the best in your research and hope the study will make original contribution to knowledge.

Yours sincerely,



Prof. Stephen O. Oduero, PhD, FIEEP
DIRECTOR, DIRECTORATE OF POSTGRADUATE STUDIES

APPENDIX III: RESEARCH PERMIT



NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION



Ref No: **890476**

Issue: **21/November/2022**

Date of

RESEARCH LICENSE



This is to Certify that Ms. Daisy Linda Wesonga Mukoya of Masinde Muliro University of Science and Technology, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Kakamega on the topic: Effect of Economic Activity Diversification on Sustainable Livelihoods among fish farmers in Kakamega County for the period ending: 21/November/2023.

License No: NACOSTI/P/22/22078

890476

Applicant Identification Number



APPENDIX IV: RESEARCH AUTHORIZATION

REPUBLIC OF KENYA



THE PRESIDENCY

MINISTRY OF INTERIOR & NATIONAL ADMINISTRATION.
State Department for Internal Security and National Administration.

Telegrams "PROVINCER" Kakamega
Telephone: 056-31011
Fax: 056-30327
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THE REGIONAL COMMISSIONER
WESTERN REGION
P.O.BOX 218
KAKAMEGA

REF. NO.PER.IND.ATT.CORR/VOL VIII/89

3RDFebruary 2023

DAISY LINDA WESONGA MUKOYA
REG NO.ECO/G/01-70069/2020

THRO,
THE SUPERVISORS
DR. CONSOLATA NGALA
DR. EDWIN SIMIYU
MASINDE MULIRO UNIVERSITY OF SCIENCE & TECNOLOGY
SCHOOL OF BUSINESS ANDECOMICES.

RE:RESEARCH AUTHORIZATION

Reference is made to your letter ref no.ECO/G/01-70069/2020 dated 3rd February,2023 on the above cited subject. I ampleased to inform you that you have been granted the opportunity to do research in our county for a period of two (2) months with effect from 1st March, 2023 to 30th April,2023 on "Effect of Economic Activity Diversification on sustainable livelihoods among Fish Farmers in Kakamega County."

A handwritten signature in blue ink, appearing to read 'C.N.K. Imbenzi'.

C.N.K.IMBENZI
FOR: REGIONAL COMMISSINER
WESTERN REGION.

CC:
COUNTY COMMISSIONER
KAKAMEGA COUNTY.

APPENDIX V: INTRODUCTION LETTER & INFORMED CONSENT

Dear respondent,

I am a Masters student at Masinde Muliro University of Science and Technology specializing in Economics; currently carrying out field research. The aim of this research is to establish the effect of economic activity diversification on sustainable livelihoods among fish farmers in Kakamega County. You have been selected as one of the respondents. Do not write your name on the questionnaire. Be assured that your responses are to be kept confidential and only used for the purposes of this research. Please give correct and honest responses to the best of your knowledge. Kindly answer all questions. Thank you for participating.

Yours faithfully,

Daisy Linda Wesonga Mukoya

Researcher

APPENDIX VI: QUESTIONNAIRE

PART A: GENERAL INFORMATION

1. Gender

Male ☐ Female ☐

2. Age

Below 20 years 21-40 years 41-60 years 61-80 years above 80 year

3. Marital status

Single Married Divorced Widowed

4. Level of Education

Primary

Secondary

Tertiary

5. Household size ≤ 5

6-10

 ≥ 11 **6. Farm size** ≤ 1 acres

1-3 acres

 ≤ 4 acres**7. Member of cooperate society**

Yes

NO

8. Access to Microcredit

Yes

No

9. Ownership of productive assets

Yes

NO

PART B:**SECTION 1: VERTICAL DIVERSIFICATION**

Kindly provide level of agreement for the following statement on Vertical diversification

; 5 strongly agree, 4 Agree, 3 fairly agree, 1 strongly Disagree, 2 Disagree

	Vertical Diversification	5	4	3	2	1
1	The introduction of value-added products has significantly increased our overall income.					

2	Our investment in vertical diversification has led to a noticeable enhancement in the income generated from our products.					
3	The value-added services we provide contribute positively to our revenue streams					
4	Vertical diversification has improved our profit margins compared to previous periods					
5	The profit margins on our diversified products are higher than those on our core products.					
6	Implementing vertical diversification strategies has led to a reduction in costs, thereby increasing our profit margins.					
7	Our vertical diversification efforts have expanded our market reach significantly.					
8	We have successfully entered new markets as a result of our vertical diversification strategy.					

SECTION II: STRUCTURAL DIVERSIFICATION

Kindly provide level of agreement for the following statement on Structural diversification 5 strongly agree, 4 Agree, 3 fairly agree, 1 strongly Disagree, 2 Disagree

	Structural diversification	5	4	3	2	1
1	Our business has shown improved resilience to income shocks due to structural diversification.					
2	The income generated from non-fish activities contributes significantly to our overall revenue.					
3	Structural diversification has created additional employment opportunities in our organization.					
4	Structural diversification has led to the development of profitable non-fish activities within our business.					
5	Structural diversification has helped us maintain stable income levels during economic downturns.					

SECTION III: PORTFOLIO DIVERSIFICATION

Kindly provide level of agreement for the following statement on Portfolio diversification 5 strongly agree, 4 Agree, 3 fairly agree, 1 Strongly Disagree, 2 Disagree

	Portfolio diversification	5	4	3	2	1
1	Diversifying our portfolio has significantly reduced our overall risk exposure					
2	We have increased the number of income-generating activities as a result of our diversification strategy.					
3	Our diversified portfolio helps protect us from					

	downturns in specific markets or sectors					
4	We experience fewer fluctuations in income due to our diversified portfolio of activities					

SECTION IV: ENTREPRENEURSHIP DETERMINANTS

Kindly provide level of agreement for the following statement on Entrepreneurship determinants

;5 strongly agree, 4 Agree, 3 Fairly agree, 1 Strongly Disagree, 2 Disagree

	Entrepreneurship determinants	5	4	3	2	1
1	I have sufficient access to financial resources to start and grow my business.					
2	The availability of loans and grants has positively impacted my entrepreneurial activities.					
3	I have adequate opportunities to access markets for my products or services.					
4	My business benefits from strong connections with suppliers and customers, facilitating market access.					
5	Access to entrepreneurial training has significantly enhanced my ability to manage and grow my business.					
6	I have participated in training programs that have improved my entrepreneurial skills and knowledge					

SECTION V: SUSTAINABLE LIVELIHOODS

Kindly provide level of agreement for the following statement on Sustainable livelihood;

5 strongly agree, 4 Agree, 3 fairly agree, 1 strongly Disagree, 2 Disagree

	Sustainable livelihood	5	4	3	2	1
1	Our participation in sustainable livelihood programs has significantly reduced our poverty levels					
2	I believe that sustainable livelihood programs contribute positively to income growth in my community.					
3	I feel that our ability to accumulate assets has improved due to support from sustainable livelihood programs					
4	My household experiences greater food security as a result of participating in sustainable livelihood activities					
5	I feel that our community has benefited from initiatives aimed at poverty reduction.					

The map displays Bungoma County and its surrounding neighbors: TRANS NZOIA COUNTY to the north, UASIN GISHU COUNTY to the northeast, NANDI COUNTY to the east, VIHIGA COUNTY to the south, SIAYA COUNTY to the southwest, and BUSIA COUNTY to the west. Bungoma County is divided into several sub-counties, each with its own set of constituencies. The sub-counties and their constituencies are: LUGARI (Lugari, Chekalini, Lwandeti, Manda-Shivanga), LIKUYANI (Sinoko, Nzoia, Kongoni, Sango, Mautuma, Likuyani), MALAVA (Butali/Chegulo, Shirugu-Mugai, Chemuche, West Kabras, East Kabras, South Kabras), NAVAKHOLO (Bunyala East, Bunyala West, Bunyala Central, Ingotse-Mathia), LURAMBI (Butsoto East, Butsoto Central, Butsoto South, Shinyo-Shikomari, Esumeyia, Shenywe, Mahiavallo, Murhanda, Shirere), SHINYALU (Isukha North, Isukha East, Isukha Central, Isukha South), IKOLOMANI (Idakho North, Idakho Central, Idakho South, Idakho East), KWI SERO (Kisa North, Kisa Central, Kisa East, Kisa West, Kisa South), BUTERE (Mumias Central, Mumias North, East Wanga, Malaha, Isongo, Makunga, Butsoto Central, Butsoto South, Idakho North, Idakho Central, Idakho South, Idakho East, Isukha North, Isukha East, Isukha Central, Isukha South), MUMIAS WEST (Mumias Central, Mumias North, East Wanga, Malaha, Isongo, Makunga, Butsoto Central, Butsoto South, Idakho North, Idakho Central, Idakho South, Idakho East, Isukha North, Isukha East, Isukha Central, Isukha South), MATUNGU (Namamali, Koyonzo, Kholera, Khalaba, Mayoni, Mumias Central, Mumias North, East Wanga, Malaha, Isongo, Makunga, Butsoto Central, Butsoto South, Idakho North, Idakho Central, Idakho South, Idakho East, Isukha North, Isukha East, Isukha Central, Isukha South), and MUMIAS EAST (Mumias Central, Mumias North, East Wanga, Malaha, Isongo, Makunga, Butsoto Central, Butsoto South, Idakho North, Idakho Central, Idakho South, Idakho East, Isukha North, Isukha East, Isukha Central, Isukha South). A legend on the right side of the map identifies the colors for each sub-county: Lugari (light green), Likuyani (yellow-green), Malava (yellow), Lurambi (orange), Navakholo (light blue), Mumias West (pink), Mumias East (light brown), Matungu (yellow), Butere (orange), Khwisero (red), Shinyalu (purple), and Ikolomani (blue). A scale bar at the bottom left indicates distances in Kilometers (0, 37.5, 75, 15, 22.5, 30) and a scale of 1:100,000 is provided at the bottom right.