Moderating Effect of Entrepreneurship Determinants on the Relationship between Economic Diversification and Sustainable Livelihoods among Fish Farmers in Kakamega County

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ABSTRACT

This study investigates the effect of entrepreneurship determinants on economic diversification and sustainable livelihoods among fish farmers in Kakamega County, Kenya. Entrepreneurship determinants encompass a range of factors including access to finance, training, market information, infrastructure, and supportive institutional frameworks. Economic diversification is vital for reducing reliance on traditional income sources and enhancing resilience to economic shocks, while sustainable livelihoods ensure long-term prosperity while preserving natural resources. The specific objective was to examine the moderating effect of entrepreneurship determinants on the relationship between economic diversification and sustainable livelihoods among fish farmers in Kakamega County. The study was guided by Sustainable Livelihoods Theory. 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. Using descriptive and survey research designs, data was collected from a sample of fish farmers in Kakamega County. The findings reveal significant correlations between entrepreneurship determinants, economic diversification, and sustainable livelihoods. Economic Activity Diversification explained 50.8% changes on sustainable livelihoods. However, when moderated with entrepreneurial determinants, the influence of economic diversification explained 66.3% of the changes in sustainable livelihoods among the fish farmers in Kakamega County. The analysis utilized unstandardized coefficients to elucidate the relationships between variables. In Model 1, Vertical Diversification (B = 0.271, p = 0.000) and Portfolio Diversification (B = 0.488, p = 0.000) significantly influenced Sustainable Livelihoods, while Structural Diversification (B = -0.044, p = 0.493) did not. Model 2 introduced Entrepreneurial Determinant, which exhibited a significant positive effect (B = 0.356, p = 0.000), alongside Vertical (B = 0.111, p = 0.041) and Portfolio (B = 0.329, p = 0.000) Diversifications. In Model 3, while all diversification variables remained significant, the interaction terms showed significant impact, emphasizing the moderating role of entrepreneurial determinants in influencing sustainable livelihoods among fish farmers in Kakamega County. Access to finance and market information emerged as key determinants influencing the ability of fish farmers to diversify their economic activities and achieve sustainable livelihoods. Additionally, supportive institutional frameworks, infrastructure development and access to training were identified as critical enablers of entrepreneurial success among fish farmers. The study concludes by highlighting policy implications and recommendations aimed at enhancing entrepreneurship development, promoting economic diversification, and fostering sustainable livelihoods among fish farmers in Kakamega County and similar contexts.

Keywords: Fish Farming, Sustainable Livelihoods, Economic Diversification, Value Chain, Entrepreneurship Determinants

I. INTRODUCTION

Rural economic diversification, both within agriculture and into non-agricultural activities, has significant potential to reduce poverty, increase coping mechanisms in face of crop failure or price volatility, and improve food and livelihood security of rural households both regionally and globally (International Labour Office [ILO], 2019). While approximately 20 to 50 per cent of the rural population in Africa, Asia and Latin America is employed in non-farm work, a large share of the population continues to depend on agriculture for their livelihoods (Wahome et al., 2023).

Lanzolla and Markides (2021) define economic activity diversification as an entrepreneurial behavior whereby people are engaged in different commercial activities for their livelihoods. Peng et al. (2022) view livelihood activity diversification as the process by which households construct a diverse portfolio of activities and social support capabilities in order to improve their standard of living. Rantamäki-Lahtinen et al. (2018) acknowledges that diversification is not a new phenomenon among farmers and the sharing of farms with other gainful activities is on the

rise in the European Union. She further states that, farmers who have diversified their livelihoods are well placed in harnessing resources to run their farm-firm complexes. According to Yoshida et al. (2019), entrepreneurial behaviour among the small-scale farmers has concentrated on the value addition chain of the farm produce; whereas, there are many non-agricultural entrepreneurship activities practiced by farmers which are ignored. They further say that diversification into non-agricultural activities by farmers make a big contribution to employment creation and rural economic development.

In addition, Yoshida et al. (2019) observed that growth in farm productivity alone may not guarantee small-scale farmers sufficient incomes to escape from poverty. However, diversification into non-agricultural business may be much more important in reducing vulnerability to poverty.

The rural economies of lower-income countries remain characterized by the significant weight of largely subsistence-driven agriculture. According to surveys conducted in 26 rural areas of seven developing countries (Kenya, Madagascar, Mali, Mexico, Morocco, Nicaragua and Senegal), 93 per cent of surveyed households own a farm (ILO, 2019).

Agriculture in Africa, particularly on small-scale farms, is yet to be a gainful investment, while in developed countries, agriculture is a profitable venture because farmers demonstrate entrepreneurial behaviour by either processing their produce, practicing mixed farming or diversifying into non-agricultural businesses (Yeboah et al., 2020). They state that entrepreneurial activities among the small-scale farmers should lead to increased agricultural production, diversification into off-farm income generating activities, or looking for employment from other farms. Rantamäki-Lahtinen et al. (2018) on the other hand agrees that entrepreneurial agriculture which blends farming and non-agricultural business practices is a very promising path for better livelihoods.

Fish farming has great potential of growth in Africa, Kenya and Kakamega County due to the presence of a wide variety of water sources such as rivers, springs, dams and rainfall (Wahome et al., 2023). However, 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 diversification with an aim of increasing farm incomes and profitability (Wahome et al., 2023).

1.2 Statement of the Problem

On-farm diversification is considered as a mitigation strategy against risks related to agriculture and thereby increases farm incomes. The controversy surrounding the World Bank report on poverty, 2022 and the economic strategies of the other Bretton Woods Institutions indicate that there is lack of consensus on what can be done to improve the African rural livelihoods (Yeboah et al., 2020). Food and Agricultural Organization (FAO, 2022) suggested an investigation into what was urgently needed to revive the Kenyan economy and promotion of economic activities which was paramount. This investigation was to underscore how the potential for better livelihoods stemming through small scale agricultural producers could be achieved. Rantamäki-Lahtinen et al. (2018) and Panthi (2015) hypothesized that entrepreneurship proxied by economic activity diversification holds the key to better livelihoods among the small-scale farmers. Kenya National Bureau of Statistics (KNBS, 2023) notes that Kakamega County has a massive potential in fish production. The county is also noted to have declined numbers of fish farmers between 2020 and 2023. These statistics are further confirmed by the declined number of ponds. Lack of finances, extension services, market information, infrastructure, and supportive institutional frameworks among other factors have forced many farmers to the quit the trade. KNBS (2023) notes that many farmers have opted to engage in economic diversification with the hope of reducing uncertainties and improving agricultural incomes. This justifies the need for this study to examine whether the effect of entrepreneurship determinants on economic diversification has led to sustainable livelihoods among fish farmers in Kakamega County.

1.3 Research Objectives

This study sought to achieve the following research objective;

(i) To examine 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

$\mathbf{H_{01}}$: Entrepreneurship determinants have no statistically significant moderating effect on the relationship between economic diversification and Sustainable livelihoods among fish farmers in Kakamega County.

II. LITERATURE REVIEW

2.1 Theoretical Literature Review

2.1.1 Sustainable Livelihoods Theory

The Sustainable Livelihoods Theory was espoused by Scoones (1998). Scoones believed that if farmers were able to diversify their income generating opportunities, then their livelihoods were sustainable. Sustainable livelihood theory is pegged on a holistic perspective in the sense that the transformative structures like policies, laws and infrastructure are very vital to sustainability of livelihoods (Adem et al., 2018). This theory was applicable in this study because it champions for the sustainability of livelihoods for small scale farmers like fish farmers.

Further, vulnerability according to this theory is determined by the external environment in which humans live in. Noteworthy, asset and capital accumulation are an important part of sustainability for purposes of improving Sustainable livelihoods among persons in a community practicing a given economic activity (Adem et al., 2018). The major strength of this theory making it fit for this study is because it explores aspects of the achievement of positive Sustainable livelihoods through employing practices like economic diversification.

2.3 Empirical Review

Empirical studies have provided differing findings about various entrepreneurial determinants and how they impact economic diversification of farmers as well as the subsequent effects on farmer livelihoods. In Nepal, Panthi (2015) aimed to enhance knowledge of facilitated entrepreneurship programs in subsistence settings by identifying the factors influencing entrepreneurship processes and potential challenges faced by such programs. The thesis conducted a detailed literature review on two entrepreneurship theories and contextualized them within the subsistence setting of Nepal, namely, personality trait and economic theories. The study identified multiple factors such as need, capability, and motivation which affected entrepreneurship at the individual level, while technology, management, and business differentiation influenced enterprise-level entrepreneurship. Economic factors and access to finances played a role at the level of the economic environment. Social, cultural, and political factors, including traditional knowledge and migration, impacted the social-cultural-political environment of the entrepreneurship ecosystem. Geographical and ecological factors served as both barriers and opportunities. This thesis filled a gap in the understanding of entrepreneurship in subsistence settings, particularly in Nepal. This study built on these findings to use primary data to study entrepreneurship determinants as a moderator between economic diversification and sustainable livelihoods in Kakamega County, Kenya.

In Ethiopia, Bayu (2019) aimed to address the effect of gender as an entrepreneurship determinant and its impact on livelihood diversification among farmers. It aimed to assess various factors influencing women's engagement in farm activities, including demographic characteristics, educational status, and land ownership, access to credit, training, and socio-cultural factors. Quantitative data was collected through interviews with 267 women from four rural kebelles in the study area. Qualitative data was gathered from key informants, focus group discussions, and observations, analyzed thematically. The study found that more than half of the respondents participated in farm activities, with self-employment being predominant over wage employment. The most common farm activities included trade of food products, sale of local drinks, and daily labouring. The study also revealed that women's age, marital status, educational level, land ownership, access to credit and training, and gender roles significantly influenced their participation in the farm activities. The study sheds light on the gender as a factor that determines engagement in farm activities in rural Ethiopia. However, this study explores entrepreneurial determinants beyond personal and social characteristics as mediating variables in the relationship between economic diversification and sustainability of farmer livelihoods.

A related study was by Munyeke (2019). This study aimed to identify the determinants influencing smallholder farming entrepreneurship in Taita Taveta County. The study drew on theories of entrepreneurship, human capital, and social networks to conceptualize the factors influencing smallholder farming entrepreneurship. In this study entrepreneurship determinants were the independent variables. The target population included all smallholder farmers in Taita Taveta County, with 397 respondents sampled using purposive and stratified random sampling techniques. The study found that most respondents were over 40 years and had secondary education level. The study also revealed that social networks, entrepreneurial culture and formal significantly influenced smallholder farming entrepreneurship in Taita Taveta County, while access to finance did not. The study contributes to providing empirical evidence on the entrepreneurial determinants that are relevant for small scale farmers in Taita Taveta County. This study goes further to focus on fish farmers in Kakamega county and entrepreneurial determinants beyond personal and

social characteristics as mediating variables in the relationship between economic diversification and sustainability of farmer livelihoods.

III. METHODOLOGY

3.1 Study Area

The study was carried out in Kakamega County, Kenya. The choice of Kakamega County for the study was because aquaculture suitability for the county is 95.86% (Wahome et al., 2023) and it has many fish farmers who have attempted economic diversification. Additionally, Kakamega County was awarded the first position in fish farming countrywide by Lattice Aquaculture Academy because of farmers' hard work and commitment in fish farming coupled with government support through extension services and subsidized fish feeds, (Wahome et al., 2023).

3.2 Research Design

Descriptive and survey research designs were used in this study to generate quantitative data. 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.

3.3. Research Population

The population of this study comprised of 4,500 registered fish farmers from the sub-counties in Kakamega County (Kakamega County Agriculture Report, 2023).

3.4 Sampling Strategy and Sample Size

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.

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.

Table 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 Data Analysis and Presentation Techniques

In this study, data collected was analysed descriptively by use of frequencies, percentages and means and inferentially by use of regression analysis using SPSS version 26.

3.6 Ethical Consideration

This study did abide by research ethics and principles. The researcher never put subjects in a position where their participation could put them in danger of injury. In order to protect the privacy of research participants, the principles of voluntary participation, anonymity, and freedom was used in this study.

IV. FINDINGS & DISCUSSIONS

4.1 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.

4.1.1 Gender of the Respondents

From Table 2, it was established that most of fish farmers in Kakamega County were males who represented 66.5% of the respondents, while 33.5% represented women.

Table 2

Gender of the Respondents

Gender	Frequency	Percentage (%)
Male	233	66.5
Female	117	33.5
Total	**350**	**100**

4.1.2 Age of the Respondents

Table 3 above revealed that most (47.1%) of the respondents are aged between 21-40 years, 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.

Table 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**

4.1.3 Marital status of the Respondents

Table 4 reveals that most (54.1%) of the respondents are married, 12.3% were single, 8.9% were divorced while 24.5% were widowed.

Table 4

Marital Status of the Respondents

Marital status	Frequency	Percentage (%)
Single	43	12.3
Married	190	54.1
Divorced	31	8.9
Widowed	86	24.5
Total	350	100

4.1.4 Level of Education

Table 5 revealed that most (50.18%) of the respondents attained secondary education;24.21% had Primary Education while 25.61% attained tertiary education.

Table 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**

4.1.5 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 4.5.

Table 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**

4.1.6 Farm size

The researcher discovered that most of the respondents (132) representing 37.7% of the respondents were in farm sizes of 1 to 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 7.

Table 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**

Source: Researcher, 2024

4.1.7 Member of cooperative society

The researcher discovered that most respondents (180) representing 51.4% of the respondents were members of a cooperative society while (170) representing 48.6% were not members of any cooperative society. The distribution of the respondents is shown in the Table 8.

Table 8
Member of a Cooperative Society

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

4.1.8 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, while 116 of the respondents representing 33.14% had access to microcredit. The distribution of the respondents is shown in the Table 9.

Table 9

Access to Microcredit

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

4.1.9 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; while 160 respondents representing 45.71% of the farmers do not possess productive assets. The distribution of the respondents is shown in the Table 10.

Table 10

Ownership of Productive Assets

Ownership of Productive Assets	Frequency	Percentage (%)
Yes	190	54.29
No	160	45.71
Total	**350**	**100**

4.2 Descriptive statistics

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.

4.2.1 Descriptive Statistics for Diversification

This section presents descriptive statistics for vertical diversification, structural diversification and, portfolio diversification.

Table 11

Descriptive statistics for Vertical Diversification

	N	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean	Std. Dev.
Value addition to farm produce has more income gains than costs.	350	80 (22.9%)	73 (20.9%)	26 (7.4%)	86 (24.6%)	85 (24.3%)	3.07	1.530
Packaging, processing and branding products increases livelihood outcomes among fish farmers	350	94 (26.9%)	105 (30%)	39 (11.1 %)	43 (14%)	63 (18%)	2.66	1.458
Value addition increases Entrepreneurial Network	350	48 (13.7%)	82 (23.4%)	13 (3.7%)	114 (32.6%)	93 (26.6%)	3.35	1.434
Value addition increases Risk-sharing and asset accumulation	350	44 (12.6%)	74 (21.1%)	68 (19.4%)	90 (25.7%)	74 (21.1%)	3.22	1.332
Value addition increases Access to Extension Services	350	44 (12.6%)	74 (21.1%)	73 (20.9%)	137 (39.1%)	22 (6.3%)	3.05	1.165
Value addition increases access to infrastructural facilities	350	32 (9.1%)	63 (18%)	109 (31.1%)	126 (36%)	20 (5.6%)	3.11	1.061
Value addition increases Social Capital gains	350	20 (5.7%)	54 (15.4%)	138 (39.4%)	99 (28.3%)	39 (11.1%)	3.24	1.029
Acquiring or upgrading of Technological Resources for fish farming	350	17 (4.9%)	42 (12.0%)	157 (44.9%)	66 (18.9%)	68 (19.4%)	3.36	1.074

From Table 11, the statement on value addition to farm produce has more income gains than costs, a majority of the respondents agreed as indicated by a mean of 3.07 and a standard deviation of 1.530. On packaging, processing and branding products in increasing livelihood outcomes among fish farmers, a majority of the respondents were in undecided as indicated by a mean of 2.66 and a standard deviation of 1.458. For value addition in increasing

Entrepreneurial Network, a majority of the respondents were in agreement about the outcomes as indicated by a mean of 3.35 and a standard deviation 1.434. As to whether value addition increases risk sharing and asset accumulation, a majority of the respondents were in agreement as indicated by a mean of 3.22 and a standard deviation of 1.332. With regards to Value addition increasing access to Extension Services, a majority of the respondents were in agreement as indicated by a mean of 3.05 and a standard deviation of 1.165. Likewise, for Value addition increasing access to infrastructural facilities, majority of the respondents were in agreement as indicated by a mean of 3.11 and standard deviation of 1.061. For value addition increasing Social Capital gains, also a majority of the respondents were in agreement as indicated by a mean of 3.24 and standard deviation of 1.029. Acquiring or upgrading of technological resources for fish farming also indicated similar findings with a mean of 3.36 and a standard deviation of 1.074.

Table 12

Descriptive Statistics for Structural Diversification

	N	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean	Std. Dev.
The practice of mixed farming increases affordability of food for your household	350	48 (13.7%)	76 (21.7%)	40 (11.4%)	110 (31.4%)	76 (21.7%)	3.26	1.374
The variety and diversity in fish farming increases income and revenue gains	350	49 (14%)	66 (18.9%)	26 (7.4%)	136 (38.9%)	73 (20.9%)	3.34	1.365
Structural diversification in enhances the sustainability of your fish farm and livelihood	350	68 (19.4%)	107 (30.6%)	47 (13.4%)	92 (26.3%)	36 (10.3%)	2.77	1.308
Structural diversification has influenced the social dynamics within your community? (e.g., community engagement, knowledge sharing)	350	15 (4.3%)	69 (19.7%)	67 (19.1%)	125 (35.7%)	74 (21.1%)	3.50	1.152
Structural diversification has impacted the overall productivity and efficiency of your fish farm	350	12 (3.4%)	80 (22.9%)	68 (19.4%)	162 (46.3%)	28 (8%)	3.33	1.022

Table 12 depicts the descriptive results for the statements on structural diversification. As to whether the practice of mixed farming increases affordability of food for households, a majority of the respondents were in agreement as indicated by a mean of 3.26 and a standard deviation of 1.374. as to whether variety and diversity in fish farming increases income and revenue gains, a majority of the respondents were in agreement as indicated by a mean of 3.34 and a standard deviation of 1.365. With regards to structural diversification enhancing the sustainability of fish farms and livelihood, a majority of the respondents were neutral as indicated by a mean of 2.77 and a standard deviation of 1.308. As to whether structural diversification has influenced the social dynamics within the community, a majority of the respondents were in agreement as indicated by a mean of 3.50 and a standard deviation of 1.152. Likewise, for structural diversification impacting the overall productivity and efficiency of fish farm, a majority of the respondents were in agreement as indicated by a mean of 3.33 and a standard deviation of 1.022.

Table 13

Descriptive Statistics for Portfolio Diversification

	N	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean	Std. Dev.
Portfolio diversification has reduced financial risks	350	29 (8.3%)	41 (11.7%)	34 (9.7%)	114 (32.6%)	132 (37.7%)	3.80	1.285
Overall financial stability of your household has improved	350	9 (2.6%)	16 (4.6%)	85 (24.3%)	115 (32.9%)	125 (35.7%)	3.95	1.007
Product diversification has created multiple income sources.	350	0(0%)	29 (8.3%)	80 (22.9%)	156 (44.6%)	85 (24.3%)	3.85	0.884
With reduced risks, farmers have embraced fish farming	350	6 (1.7%)	68 (22.3%)	54 (15.4%)	154 (44%)	58 (16.6%)	3.51	1.064

Table 13 above indicates the descriptive statistics for portfolio diversification. As to whether portfolio diversification has reduced financial risks, a majority of the respondents agreed with a mean of 3.80 and a standard deviation of 1.285. With regards to whether the overall financial stability of households has improved, a majority of the respondents agreed with a mean of 3.95 and a standard deviation of 1.007. As to whether product diversification

has created multiple income sources, a majority of the respondents were in agreement as indicated by a mean of 3.85 and a standard deviation of 0.884. As to whether farmers have embraced fish farming as a result of reduced risk, a majority of the respondents were in agreement as indicated by a mean of 3.51 and a standard deviation of 1.064.

4.2.2 Descriptive Statistics for Entrepreneurial Determinants

Table 14 depicts the descriptive results for entrepreneurial determinants. As to whether the respondents had knowledge on seasonal patterns, a majority of the respondents were in agreement as indicated by a mean of 3.53 and a standard deviation of 1.174. As to whether the respondents ventured on fish farming because of the information already known, a majority of the respondents agreed with a mean of 3.64 and a standard deviation of 1.031. As to whether the respondents preferred experiments to systematic thinking, a majority of the respondents were in agreement with a mean of 3.50 and a standard deviation of 1.094. Whether the respondents social and business networks assisted them to get what they required, a majority of the respondents were undecided with a mean of 3.05 and a standard deviation of 0.976. With regards to the respondents noticing changes in customer needs, a majority of the respondents agreed with a mean of 3.32 and a standard deviation of 1.115. Likewise, the respondents were in agreement that they depended on their instincts in coming up with business ideas as indicated by a mean of 3.44 and a standard deviation of 1.019.

Table 14

Descriptive Statistics for Entrepreneurial Determinants

	N	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean	Std. Dev.
I have knowledge on seasonal patterns	350	27 (7.7%)	30 (8.6%)	110 (31.4%)	97 (27.7%)	86 (24.6%)	3.53	1.174
I ventured on fish farming because of the information I already knew	350	16 (4.6%)	32 (9.1%)	80 (22.9%)	157 (44.9%)	65 (18.6%)	3.64	1.031
I prefer experiments to systematic thinking	350	24 (6.9%)	36 (10.3%)	88 (25.1%)	145 (41.4%)	57 (16.3%)	3.50	1.094
Social and business networks enable me get the assets I require	350	31 (8.9%)	43 (12.3%)	176 (50.3%)	78 (22.3%)	22 (6.3%)	3.05	0.976
I always notice changes in customer needs	350	23 (6.6%)	69 (19.7%)	73 (20.9%)	144 (41.1%)	41 (11.7%)	3.32	1.115
I depend on instincts in innovations	350	27 (7.7%)	22 (6.3%)	107 (30.6%)	159 (45.4%)	35 (10%)	3.44	1.019

4.2.3 Descriptive statistics for Sustainable Livelihoods

The table below presents descriptive findings for sustainable livelihoods. As to whether social capital gains had improved their performance, a majority of the respondents were in agreement with a mean of 3.99 and a standard deviation of 0.875. With regards to physical asset accumulation enhancing the societal wellbeing, a majority of the respondents were in agreement as indicated by a mean of 3.67 and a standard deviation of 1.038. Likewise, a majority of the respondents were in agreement that income gain had contributed to accessibility, affordability and availability of goods and services with a mean of 3.38 and a standard deviation of 1.186. As to whether Social capital gain had led to community empowerment and reduced conflicts, a huge portion of the respondents were in agreement as indicated by a mean of 3.89 and a standard deviation of 0.978. They were also in agreement that income gains had enhanced their capacities with a mean of 3.24 and a standard deviation of 1.228.

Table 15

Descriptive statistics for Sustainable Livelihoods

	N	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean	Std. Dev.
Social capital gains has improved our performance	350	0 (0)	33 (9.4%)	37 (10.6%)	182 (52%)	98 (28%)	3.99	0.875
Physical Asset accumulation has enhanced the societal well being	350	10 (2.9%)	49 (14%)	59 (16.9%)	162 (46.3%)	70 (20%)	3.67	1.038
Income gain has contributed to accessibility, affordability and availability of goods and services	350	27 (7.7%)	61 (17.4%)	75 (21.4%)	125 (35.7%)	62 (17.7%)	3.38	1.186
Social capital gain has led to community empowerment and reduced conflicts	350	6 (1.7%)	40 (11.4%)	32 (9.1%)	180 (51.4%)	92 (26.3%)	3.89	0.978
Income gains has enhanced our capacities	350	54 (15.4%)	27 (7.7%)	91 (26%)	136 (38.9%)	42 (12%)	3.24	1.228

4.3 Regression Analysis

The first model has a practically significant r-squared value of 0.508. These findings indicated that Economic Diversification could explain 50.8% variations in Sustainable livelihoods. The results also indicated that Economic Diversification practices had a strong, positive relationship with Sustainable livelihoods with an r =0.713.

Model 2 also 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 0.771, and a p value that is less than 0.05. The change in the r-squared value from 0.508 in model 1 to 0.594 in model 2 (an increase of 0.086) demonstrates that model 2 can be used to explain the change in Sustainable livelihoods from 0.508% to 0.594% as attributed to Entrepreneurial Determinants.

Model 3 tested how entrepreneurial determinants moderate 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 0.594 to 0.663. The results indicated that Entrepreneurial determinants had a positive statistically significant impact on the relationship between Economic diversification and sustainable livelihoods among fish farmers in Kakamega County with an R-value of 0.815, R- squared value of 0.663 and a p value that is less than 0.05. These findings demonstrate that when moderated with Entrepreneurial determinants, the influence of economic diversification could explain 66.3% 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 16

Model Summary

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig.F Change
1	.713[a]	.508	.504	.52718	.508	118.355	3	344	.000
2	.771[b]	.594	.589	.47974	.086	72.403	1	343	.000
3	.815[c]	.663	.657	.43852	.070	23.507	3	340	.000

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

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

c. Predictors: (Constant), Vertical Diversification, Structural Diversification, Portfolio Diversification, Entrepreneurial Determinant, VDED, SDED, PDED

Table 17
ANOVA

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	98.681	3	32.894	118.355	.000[b]
	Residual	95.606	344	.278		
	Total	194.286	347			
2	Regression	115.344	4	28.836	125.292	.000[c]
	Residual	78.942	343	.230		
	Total	194.286	347			
3	Regression	128.905	7	18.415	95.764	.000[d]
	Residual	65.381	340	.192		
	Total	194.286	347			

a. Dependent Variable: Sustainable Livelihood
b. Predictors: (Constant), Vertical Diversification, Structural Diversification, Portfolio Diversification
c. Predictors: (Constant), Vertical Diversification, Structural Diversification, Portfolio Diversification, Entrepreneurial Determinant
d. Predictors: (Constant), Vertical Diversification, Structural Diversification, Portfolio Diversification, Entrepreneurial Determinant, VDED, SDED, PDED

For model 1 at 5% significance level, the ANOVA tests indicate that the independent variables (Vertical Diversification, Structural Diversification, Portfolio Diversification,) were an important predictor of sustainable livelihoods among fish farmers in Kakamega County as demonstrated by an F-value of 118.355, with a 0.000 significance value at a p value that is less than 0.05.

The findings on model 2 at 5% significance level, the ANOVA tests indicate that the independent variables (Vertical Diversification, Structural Diversification, Portfolio Diversification) together with the moderating variable, Entrepreneurial determinants, were an important predictor of sustainable livelihoods among fish farmers in Kakamega county as demonstrated by an F-value of 125.292, with a 0.000 significance value at a p value that is less than 0.05.
The findings presented in model 3, at 5% significance level, the ANOVA tests indicate that the independent variables (Vertical Diversification, Structural Diversification, Portfolio Diversification) moderating variable (Entrepreneurial determinants), together with the interaction terms (independent variables * Entrepreneurial determinants) were an important predictor of sustainable livelihoods as demonstrated by an F-value of 95.764, with a 0.000 significance value at a p value that is less than 0.05.

Table 18
Coefficients

		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.007	.136		7.424	.000
	Vertical Diversification	.271	.056	.313	4.824	.000
	Structural Diversification	-.044	.064	-.051	-.687	.493
	Portfolio Diversification	.488	.049	.531	10.017	.000
2	(Constant)	.425	.141		3.007	.003
	Vertical Diversification	.111	.054	.129	2.047	.041
	Structural Diversification	.096	.061	.112	1.584	.114
	Portfolio Diversification	.329	.048	.358	6.834	.000
	Entrepreneurial Determinant	.356	.042	.353	8.509	.000
3	(Constant)	2.720	.587		4.634	.000
	Vertical Diversification	-.637	.217	-.735	-2.941	.003
	Structural Diversification	-1.157	.317	-1.345	-3.645	.000
	Portfolio Diversification	1.499	.189	1.632	7.925	.000
	Entrepreneurial Determinant	-.318	.184	-.315	-1.729	.085
	VDED	.261	.068	1.536	3.838	.000
	SDED	.362	.095	2.138	3.814	.000
	PDED	-.377	.058	-2.332	-6.445	.000

a. Dependent Variable: Sustainable Livelihoods

Table 18 above represents the unstandardized and standardized coefficients for hierarchical regression analysis for model 1, 2 and 3. First, the table demonstrates the beta values for the mean centred independent variables for model 1. While vertical diversification ((P=0.000<0.05) and portfolio diversification (P=0.001<0.05) were significant predictors of sustainable livelihoods, structural diversification (P=0.493>0.05) was insignificant in predicting sustainable livelihoods. Model 2 depicts the beta values for the mean centred independent variable of Vertical diversification, portfolio diversification and Entrepreneurial determinants were positive and significant while the beta values for structural diversification was positive but insignificant. Vertical diversification, portfolio diversification and Entrepreneurial determinants, however, had a positive contribution towards sustainable livelihood among fish farmers in Kakamega County.

The table above shows that entrepreneurial determinants (P=0.000>0.05) was not a significant predictor of sustainable livelihoods. The interaction between Entrepreneurial determinants and each of the independent variables such as Vertical diversification (P=0.000<0.05), structural diversification (P=0.000<0.05), and portfolio diversification (P=0.000<0.05), were significant contributors to sustainable livelihoods among fish farmers in Kakamega county. Hence, the results from the table above led to a hierarchical multiple regression model that can be displayed as below:

$$Y = 2.720 - .637X_1 - 1.157X_2 + 1.499X_3 - .318X_4 + .261X_1 * X_4 + 0.362X_2 * X_4 - .377X_3 * X_4 + 0.587$$

4.4 Discussions

4.4.1 Demographic Characteristics of Fish Farmers in Kakamega County

Table 3 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. It can be attributable to the fact that men have more access to productive assets (Land) and therefore engage in more economic activities than their female counterparts. Findings also reveal disparities in access to resources, decision-making power, and income between male and female fish farmers in Kakamega County. Promoting gender equity and empowering women in aquaculture could contribute to more sustainable and inclusive livelihoods in the sector. It concurs with the Onuwa et al. (2022) who reported similar results in their study on the determinants of off-farm investments.

Table 4 revealed that most (47.1%) of the respondents were between the age bracket of 21-40. 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 (Martin & Lorenzen, 2016).

Table 5 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 the engage in multiple livelihood activities. It corroborates with the Onuwa et al. (2022) who reported similar results in their study on the determinants of off-farm investments.

Table 6 revealed that most (50.18%) 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 was found to determine the livelihood strategies and opportunities available to farmers. This research revealed that fish farmers with higher levels of education and training are more likely to adopt sustainable farming techniques, utilize resources efficiently, and access markets effectively. This finding underscores the importance of educational programs and training initiatives in promoting sustainable livelihoods in aquaculture (Alobo-Loison, 2019; Joshi et al., 2021).

Table 7 reveals that most (52.0%) of the respondents were in households consisting of 6 to 10 family members; the estimated mean household population is 7 people. It denotes that the respondents have relatively populated households. Family size may enhance the chances of livelihood diversification within households (Babatunde & Martin, 2020).

Table 8 reveals that most (37.7%) of the respondents have 1-3 acres of land size. Also the estimated mean farm size was 2.3acres. It implies the prevalence of smallholders in the study area. This farm size is an indication of subsistent agricultural production which may be a push factors for the farmers to diversify into other livelihood activities. It concurs with the Onuwa et al. (2022) who reported similar results in their study on the determinants of off-farm investments.

The result presented in Table 9 revealed that most (51.4%) belong to a cooperative while those who were not members of cooperative society constituted 48.6%. It suggests that most farmers may need a structured medium or platform for information sharing and exchanges on enterprise opportunities and livelihood activities. This result

corroborates with Barrett et al. (2021) who reported that cooperatives ensure that members derive benefits from the group that they could not have achieved individually. Barrett et al. (2021) also added that membership of cooperative affords farmers opportunities to share information on modern production practices and livelihood strategies.

The result presented in Table 10 revealed that most (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. Findings also suggested that limited access to land, credit, and water resources hinders the adoption of sustainable practices among fish farmers in Kakamega County. Addressing these resource constraints through policy interventions or support programs (Micro-credit) could contribute to enhancing the sustainability of livelihoods in the sector. Djurfeldt and Jirstrom (2018) posited that credit was a strong factor needed to acquire, develop, or engage in livelihood enterprise. Its availability could determine the extent of production capacity. Djurfeldt et al. (2018) posited that access to credit allows the farmers to expand and improve their agricultural and economic activities.

Table 11 showed that (54.29%) of the respondents own productive assets, while 45.71% do not possess productive assets. Productive assets are major determinants of diversification. Martin and Lorenzen (2016) posited that asset ownership is important for agricultural and non-agricultural diversification; productive assets are germane for livelihood diversification strategies.

4.4.2 Moderating Effect of Entrepreneurship Determinants on the Relationship between Economic Diversification and Sustainable Livelihoods among Fish Farmers in Kakamega County

It was established from the study that entrepreneurship determinants contributed to economic diversification and sustainable livelihoods in the following ways:

Access to credit: Fish farmers that have greater access to capital have a broader economic base and are more inclined to engage in non-fish farming ventures that generate revenue. Fish farmers need access to investment options, savings accounts, and credit facilities in order to grow their enterprises and enhance their standard of living. This outcome is in line with conclusions by Yeboah et al. (2020) who noted that access to credit promotes economic diversification.

Capacity Building: Fish farmers who have benefited from training and capacity development exhibit more innovation and entrepreneurship skills. Training courses covering business administration, value addition, marketing skills, and fish farming methodologies enable farmers to broaden their sources of income, explore emerging markets, and boost output and profitability. This finding is consistent with the study by Yoshida et al., (2019) who concluded in their study that capacity building stimulates innovation and entrepreneurial skills.

Commercial Intelligence and Networks: In order to develop profitable market connections, recognize lucrative market opportunities, and alter their production and marketing plans accordingly, fish farmers must have access to market statistics and connections. Access to dependable networks and channels for market information gives fish farmers the edge they need to target niche markets, diversify their merchandise, and maximize sales and distribution networks. Wahome et al., (2023) discovered that marketing connections encouraged sharing of information leading to achievement of social gains.

Development of Infrastructure: The fish farming industry depends on sufficient infrastructure to support economic diversification and value addition. This includes storage facilities, processing plants, and transportation networks. Expanding fish farming operations into new regions or market niches is made easier by improved infrastructure, which also improves market access and lowers post-harvest losses. This result is in line with that of Panthi, 2015 who found that Entrepreneurship was facilitated by improved road networks and investment in storage facilities for perishable farm products.

Policy frameworks: Government policies, laws, and support initiatives, among other institutional frameworks, have a major impact on entrepreneurship and livelihood sustainability of fish farmers. Fish farmers in Kakamega County can benefit from policies that encourage entrepreneurship, economic diversification, and sustainable livelihoods by having more access to land, water resources, extension services, and market facilitation. This fits with the findings of Lanzolla and Markides, (2021) study, which revealed that policy interventions have a major impact on entrepreneurship and livelihood sustainability of fish farmers.

Overall, the results demonstrate how diverse entrepreneurial determinants are and how much of an impact they have on fish farmers in Kakamega County's livelihood sustainability and economic diversification. Unlocking the full potential of the fish farming business and encouraging inclusive growth and development in the region requires addressing key drivers such as infrastructure, supportive institutional frameworks, market knowledge, training, and availability of capital.

V. CONCLUSIONS & RECOMMENDATIONS

5.1 Conclusions

The study's conclusion on the Moderating Effect of Entrepreneurship Determinants on the Relationship between Economic Diversification and Sustainable Livelihoods among Fish Farmers in Kakamega County emphasizes the importance of addressing critical issues in order to foster resilience, innovation, and prosperity in the fish farming industry. The results underscore the need for focused interventions and policy measures to assist the holistic development of fish farming communities by highlighting the interplay between entrepreneurship determinants and their impact on economic diversification and sustainable livelihoods.

5.2 Recommendations

Research findings depict that entrepreneurship determinants promoted economic diversification and sustainable livelihoods among fish farmers in Kakamega County. Therefore, through the establishment of microfinance institutions catered to the needs of small-scale farmers, strategies to promote access to financial services and credit facilities for fish farmers should be taken into consideration. Government assistance initiatives should also focus on disadvantaged groups in the fish farming industry. Additionally, it is important to support funding for training and capacity-building initiatives through vocational training programs and agricultural extension services tailored to the unique requirements of Kakamega County's fish farmers. Practical knowledge of fish farming methods, value addition, marketing tactics, and financial literacy should be prioritized. The establishment of market information centers and online marketplaces is necessary to give fish farmers access to current pricing and information on demand and supply. The Government should also prioritize investment in infrastructure development to address critical gaps in processing, storage, and transportation for the fish farming industry. Road networks, cold storage facilities, and processing facilities should all be improved in order to reduce post-harvest losses and boost value chain effectiveness. To strengthen regulatory frameworks protecting the rights and interests of fish farmers, encourage compliance with quality standards, and reduce risks related to market volatility and climate change, it is important to support the development and implementation of policies, regulations, and support programs that foster entrepreneurship and sustainable livelihoods in the fish farming sector. In order to maximize resources, expertise, and networks for the benefit of fish farmers, cooperation and partnerships between government agencies, non-governmental organizations (NGOs), research institutions, community-based organizations (CBOs), and private sector entities should be promoted.

REFERENCES

Adem, M., Tadele, E., Mossie, H., & Ayenalem, M. (2018). Income diversification and food security situation in Ethiopia: *A review study. Cogent Food & Agriculture*, *4*(1), 1513354.

Alobo-Loison, S. (2019). Household livelihood diversification and gender: Panel evidence from rural Kenya. Journal of Rural Studies. 69. 10.1016/j.jrurstud.2019.03.001.

Babatunde, RO & Martin, Q. (2009). Patterns of income diversification in rural Nigeria: determinates and impacts. *Quarterly Journal of International Agriculture*, *48*(4), 305- 320.

Barrett, C. B., Reardon, T., & Webb, P. (2015). Nonfarm income diversification and household livelihood strategies in rural Africa: concepts, dynamics, and policy implications. *Food policy*, *26*(4), 315-331.

Bayu, E.K. (2019). The Gender, Participation and Employment Status in Non-Farm Livelihood Activities in Rural Ethiopia: The Case of Shebel Berenta Woreda, Amhara National Regional State: Women in livelihood diversification. *American Journal of Humanities and Social Sciences*, *7*(2), 16-29. Retrieved from https://worldscholars.org/index.php/ajhss/article/view/980

Djurfeldt, G., Hall, O., Jirström, M., Archila Bustos, M., Holmquist, B., & Nasrin, S. (2018). Using panel survey and remote sensing data to explain yield gaps for maize in sub-Saharan Africa. *Journal of Land Use Science*, *13*(3), 344–357.

ILO. (2019). *Economic Diversification of the Rural Economy*. International Labour Office

Joshi, P. K., Gulati, A., Birthal, P. S., & Tewari, L. (2021). Agriculture diversification in South Asia: patterns, determinants and policy implications. *Economic and Political Weekly*, *39* (24), 2457-2467.

Kakamega County. (2021). *About Us*. Retrieved from: https://kakamega.go.ke/category/about-us/political-units/sub-counties/

KNBS. (2023). *2023 Statistical Abstracts.* Kenya National Bureau of Statistics. https://www.knbs.or.ke/wp-content/uploads/2023/11/2023-Statistical-Abstract.pdf

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement, 30*(3), 607-610.

Lanzolla, G., & Markides, C. (2021). A Business Model View of Strategy. *J. Manage. Stud., 58*, 540-553.

Martin, S. M., & Lorenzen, K. A. I. (2022). Livelihood diversification in rural Laos. *World Development, 83*, 231-243.

Munyeke, C. N. (2019). *Factors influencing smallholder farming entrepreneurship in Taita Taveta County, Kenya* (Doctoral Dissertation, JKUAT-COHRED).

Musumba, M., Palm, C. A., Komarek, A. M., Mutuo, P. K., & Kaya, B. (2022). Household livelihood diversification in rural Africa. *Agricultural Economics*, 53(2), 246-256.

Onuwa, G., Mailumo, S., Chizea, C., & Alamanjo, C., (2022). Socioeconomic Determinants of Livelihood Diversification among Arable Crop Farmers in Shendam, Plateau State, Nigeria, *Agricultural Socio-Economics Journal, 22*(4), 301-309.

Panthi, T.P. (2015). *Entrepreneurship in subsistence setting: Evidence from facilitated entrepreneurship program in Nepal* (Master's Thesis, Aalto University, School of Business),

Peng, W., Robinson, B., Zheng, H., Li, C., Wang, F., & Li, R. (2022). The limits of livelihood diversification and sustainable household well-being, evidence from China. *Environmental Development*, 43(4), 100736-100772.

Rantamäki-Lahtinen, L. M., Väre, M., & Saastamoinen, M. (2018). *Part-Time and Full-Time Rural Entrepreneurship from Strategic Management Perspective - Evidence from Finnish Equine Enterprises*. In RENT XXXII Research in Entrepreneurship and Small Business Conference 2018, Toledo, Spain, 15/11/2018 - 16/11/2018 (pp. 1-10).

Scoones, I. (1998). *Sustainable Rural Livelihoods: A Framework for Analysis*. IDS Working Paper No. 72.

Wahome, A.M., Kiema, J.B., & Mulaku, G.C. (2023). Kenyan Counties Geospatial Data Knowledge to Monitor Crop Production. *Journal of Geographic Information System, 15*(06), 629-651.

World Bank Group. (2022). *Economic Activity Diversification: Lessons from Practice*. World Bank Group.

Yeboah, T., Chigumira, E., John, I., Anyidoho, N. A., Manyong, V., Flynn, J., & Sumberg, J. (2020). Hard work and hazard: Young people and agricultural commercialization in Africa. *Journal of Rural Studies, 76*, 142-151.

Yoshida, S., Yagi, H., Kiminami, A., & Garrod, G. (2019). Farm diversification and sustainability of multifunctional peri-urban agriculture: Entrepreneurial attributes of advanced diversification in Japan. *Sustainability*, 11(10), 2887.

Zain, N., & Lee, L.K. (2022). Sustainable Aquaculture Technologies: Adoption Readiness, Perceived Behaviour and Determinant Barriers among the Fish Farmers in Penang, Malaysia. *Global Conference on Business and Social Sciences Proceeding, 14*, 1-1. 10.35609/gcbssproceeding.2022.2(53).