Do different Fish Supply Channels Combinations Increase the Net Profitability of for Women-Owned SMEs in Kenya?

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Abstract

In emerging economies, women-owned SMEs often operate within the informal sector, where institutional frameworks, market regulations, and governance structures significantly influence their ability to participate in formal and advanced supply chains. These regulatory and structural barriers can limit their access to key resources, financing, and market opportunities, restricting their business growth. However, ensuring equitable access to supply networks can enhance the market positioning, growth, and resilience of women-owned SMEs. Therefore, this study aims to analyse the decision-making strategies employed by women entrepreneurs to navigate urban aquaculture supply value chains in Kenya. The research expands the understanding of key factors influencing women's selection of tilapia fish suppliers and examines the profitability implications of these choices**.** Multistage random sampling procedure was used to select a sample of 941 women-owned fish micro-enterprises drawn from the major urban centers of Kisumu, Nairobi, Nakuru, Uangishu, Nakuru, Kakamega, and Trans-Nzoia counties in Kenya. The multinomial endogenous switching regression (MESR) model is used to analyze data and to account for selectivity bias. Generally, the study suggests that that women entrepreneurs should consider sourcing tilapia fish from farmers and vertically integrated companies supply channels for the most reliable profits, while being cautious about supplier from the lake and informal traders. women-owned SMES, sourcing Tilapia fish from vertically integrated suppliers lead to better profit margins due to streamlined operations and consistent product quality. Lake supply channels often suffer from seasonal variations, overfishing, and regulatory constraints, leading to inconsistent supply levels. These findings reinforce the importance of supply chain selection and supplier reliability in optimizing the financial performance of women-owned fish enterprises. Stakeholders should introduce capacity-building programs to help women enhance their business management, supply chain knowledge, and market positioning.

Key words: Aquaculture supply chains, vertically integrated, women-owned SMES

1.0 Introduction

Fish products contribute to over 20% of the average per capita animal protein intake for more than 3.3 billion people worldwide (Boyd et al., 2022). In Sub-Saharan Africa's (SSA) growing economies, millions of households depend on wild catch fisheries and fish aquaculture farming for their livelihoods(Thiao & Bunting, 2022). Aquaculture has become increasingly significant in food production, economic growth, and food security, addressing the rising demand for fish in Sub-Saharan Africa. Fish production and marketing is the integral part for the socio-economic development of the aquaculture sector in SSA(Adam et al., 2024). Therefore, development of an efficient value chain that connects the fish farm to the consumer's plate has been the subject of extensive discussion.

In the aquaculture sector, urban value chains exist through specific macro-level mechanisms. Specifically, the increased demand for fish driven by rising incomes and population growth in urban areas has a significant impact on aquaculture chains' configuration(Bunting & Little, 2015). Additionally, other factors like the market power of traders and the perishability of fish significantly influence aquaculture supply chains. The majority of consumers prefer high-quality, fresh fish(Apu, 2014). However, the current marketing system is unable to fully meet their needs for premium fish, despite their willingness to spend a substantial amount of money. A range of marketing considerations influence the quality of the fish(Zander & Feucht, 2018). Efficient and enduring fish marketing relies on a well-functioning distribution infrastructure that includes proper cooling chain maintenance. Approximately 35% of the quality loss may be attributed to the prolonged exposure of fish to high temperatures, while approximately 25% can be attributed to harsh handling and excessive pressure (Mugwanya et al., 2022). In contrast to medium- to large-sized fish, the Small Indigenous Species (SIS) easily get spoilt. The quality of the SIS fish is compromised as a result of the ignorance and/or negligence of individuals during the harvesting and post-harvest processing processes(Abraha et al., 2018). On the marketing side, supply and demand, as well as the grade of the fish, determine the price of the fish(Hendriks, 2022).

Consumers' ultimate happiness depends on the efficiency of a fish marketing system that enables them to purchase high-quality fish at affordable costs(Freitas et al., 2020; Zander & Feucht, 2018). The price of the fish is contingent upon both supply and demand factors, in addition to the fish's quality. There is a significant disparity in market prices for fish species from the same water body that possess distinct traits. The issues pertaining to fish quality lead to significant economic losses for fish producers, traders, and consumers(Kambewa, 2007). The negligent operations of the current fish market have a detrimental effect on farmers, fishermen, and impoverished traders(Brown, 2012; Gichuki et al., 2025).

The quality of fish is rapidly diminished due to a variety of factors, as it is an extremely perishable food item. The literate recognizes that modern food supply chains in developing countries face significant challenges due to restrictive government marketing regulations, a weak policy and regulatory framework for food safety, insufficient enforcement of existing standards, poor market infrastructure and agricultural support services, and the dominance of small farm operations (Nicita et al., 2013; Swinnen & Kuijpers, 2019). Nevertheless, the fish supply chains in SSA have been undergoing a substantial market power transition in the recent past as a result

of the establishment of a greater number of large-scale and vertically integrated companies(Barrett et al., 2022; Jolly et al., 2023). A diverse array of marketing strategies are employed to sell fish that are sourced from both aquaculture farms and natural fisheries(van Anrooy, 2003). Global agri-food systems dominated by vertically integrated, large private enterprises have undoubtedly contributed to achieving higher food output and productivity levels along the food supply chain(Smyth et al., 2021).

The value chains in aquaculture in SSA have improved mostly due to investments in high-value fish production technologies and the adoption of efficient operations in both upstream and downstream chains(Ababouch et al., 2023). The ability to achieve this is largely due to the growing vertical integration of operations and stronger contractual agreements between companies and retail supply nodes mostly controlled women fish traders. In addition, private enterprises and intermediaries' actors commonly known as middlemen frequently provide robust fish distribution networks that extend to isolated or rural regions that may lack public services(Belhadi et al., 2024). These aquaculture supply networks facilitate the efficient connection between farmers and markets, resulting in reduced transaction costs and improved supply of fish to retailer's outlets mainly controlled women traders(Salayo et al., 2022). For instance, 80% of seafood and fish products in West African countries is marketed women by women small micro enterprises(Udong, 2011).

The aquaculture supply chains in Sub-Saharan Africa have been significantly transformed by vertically integrated companies and intermediary companies. The environmental impact and social externalities that contribute to the increased marginalization, inequality, and vulnerability of women entrepreneurs at the retail end of the supply chain must be considered by actors in the supply chain when prioritizing sustainable practices. Women account for more than half of inland fishing labor and around 42% of the workforce of commercial aquaculture companies in Sub-Saharan Africa (Menezes et al., 2024). The participation of women in aquaculture sector has resulted in the creation of additional employment opportunities, which has subsequently increased the income of women in both urban and rural areas. In addition, the aquaculture sector's involvement of women is essential for the attainment of the United Nations' 2030 Sustainable Development Goals (SDGs), as it promotes gender equality and empowerment(Nicita et al., 2013).

Women entrepreneurs in Africa are traditionally considered to be vulnerable groupings that face several challenges due to their common lack of properties, fixed assets, lesser income and entrepreneurial inexperience than men. In the aquaculture sector, women entrepreneurs are mainly challenged by low and limited access to income despite their heavy involvement in the sector(Overå et al., 2022). In addition, they also lack access to collaterals to access credit. Equal and equitable participation of women, in the aquaculture value chains is necessary for the wise use and conservation of aquatic resources to foster food security and sustainable socio-economic development in sub-Saharan Africa (SSA) (Elias et al., 2023). Traders' declining share of profit, the cost of business operation, squeeze of quality and the unequal bargaining power in the supply chain has increased barriers success for small enterprises(Kambewa, 2007). The relation between main suppliers and retailer has been described as "fight" over the control of the supply chain, and retail traders position in the chain has been seen as "weak"(Mohammed et al., 2023).

Women in fisheries value chain in Nairobi City County comprise a significant majority yet least in ranking as far as access and control of economic utilities are concerned. Therefore, the study aims to understand how women fish entrepreneurs enhance their business resilience by diversifying tilapia fish sourcing strategies and key purchasing criteria that influence the selection fish suppliers. The study further examines the application of Supply Chain Management (SCM) paradigm, where effective supplier relationships, and coordination, are crucial for profitability and improvement of Small and Medium Enterprises (SMEs) performance.

This study contributes to the literature by exploring the strategies and mechanisms women entrepreneurs employ to navigate urban aquaculture supply value chains. By recognizing the crucial role of supply chain governance and institutional dynamics, the research broadens the understanding of key factors influencing women's choice of tilapia fish suppliers and the profitability implications associated with these decisions. Furthermore, the study highlights how these factors shape women's capacity to generate sustainable livelihood benefits within the fish value chain. Nicita et al., (2013) emphasizes the interplay between access to reliable suppliers, regulatory constraints, financial limitations, and market opportunities, all of which influence the ability to thrive in the agriculture industry.

Evidence suggests that gender disparities persist in Small and Medium Enterprises (SMEs) and in agricultural value chains, primarily due to men's greater control over productive resources(Crane, 2022; Gichuki & Kamau, 2022). As a result, women entrepreneurs in the aquaculture sector continue to face socio-cultural and economic barriers, limiting their business potential(Gideon, 2023). Despite these disparities, value chain studies have largely overlooked domestic aquaculture chains, particularly those with strong urban orientations—even though they represent the majority of global aquaculture production (Naylor et al., 2021; Tezzo et al., 2021). Existing aquaculture research has predominantly focused on well-documented Global Value Chains (GVCs), often leaving gaps in understanding the dynamics of urban domestic supply chains in low-income and emerging countries economies(Ababouch et al., 2023; Paremoer, 2021). A deeper investigation into what drives these urban aquaculture value chains is essential for complementing existing knowledge on GVCs (Liverpool-Tasie et al., 2024). Such insights could help inform inclusive policy development, enhance aquaculture supply chain efficiency, and address gender-based inequalities in the fisheries sector.

The remaining sections of the paper are organized as follows: The section two provides conceptual framework of the study; section three shows an overview of results and discussions as well as empirical estimates. This is followed by section four on results and discussions, key purchasing criteria of tilapia fish supply, determinants for market channel choice, determinants of profits revenues from women owned SMEs and impacts of tilapia fish supply channel choice on outcome variables. The final section highlights the main conclusions and policy recommendations of the study.

2.0 Conceptual Framework

The decision-making process of women in selecting fish suppliers and marketing channels, along with their consideration of key purchasing criteria, can significantly influence the performance of micro-enterprises and household incomes. Figure 1 illustrates a basic framework that outlines the potential pathways through which profit returns may be affected. The framework indicates that the profit returns from fish sales in women-owned micro-enterprises are likely influenced by key purchasing criteria, which also play a role in determining the choice of fish supply channels. These criteria include factors such as timely delivery, high product quality, cleanliness, affordability, bulk discounts, availability of processed fish, and the distance to access the fish.

The second pathway highlights the challenge women fish retailers face in selecting primary fish suppliers, a decision that can impact the overall performance of their micro-enterprises. Urban market fish retailers typically source their supplies from various channels, including fish farmers, intermediary companies, suppliers from lakes, trader brokers, vertically integrated companies, and wet markets. Previous studies, such as Heydari, Bakhshi, and Nikoofal (2024), suggest that contractual arrangements between suppliers and buyers help mitigate uncertainties and risks. Therefore, fish quality and prices, enabling retailers to maintain stable supplies channels and timely sales(Maulana & Ratnaningtyas, n.d.). Involvement in supply chains significantly enhances income in various agricultural, for instance, Sarmiento (2024) found that smallholder farmers in the Philippine tobacco industry who participated in high-value chains through contract farming experienced an increase in net income. The analysis clearly demonstrates that in fish value chains sector can help increase net income for women fish retailers by boosting fish sales, improving profit margins, and reducing operational costs.

In the context of fish retail, higher income generated from effective value chain participation can have a direct impact on household income and consumption expenditure. This increased income not only raises the standard of living but also influences how households allocate their spending. However, it's important to note that income from fish retailing alone provides only a partial view of overall household welfare. Thus, this study goes a step further by empirically examining how participation in fish retail value chains affects household income and consumption patterns, aiming to deepen our understanding of the broader welfare implications of such participation

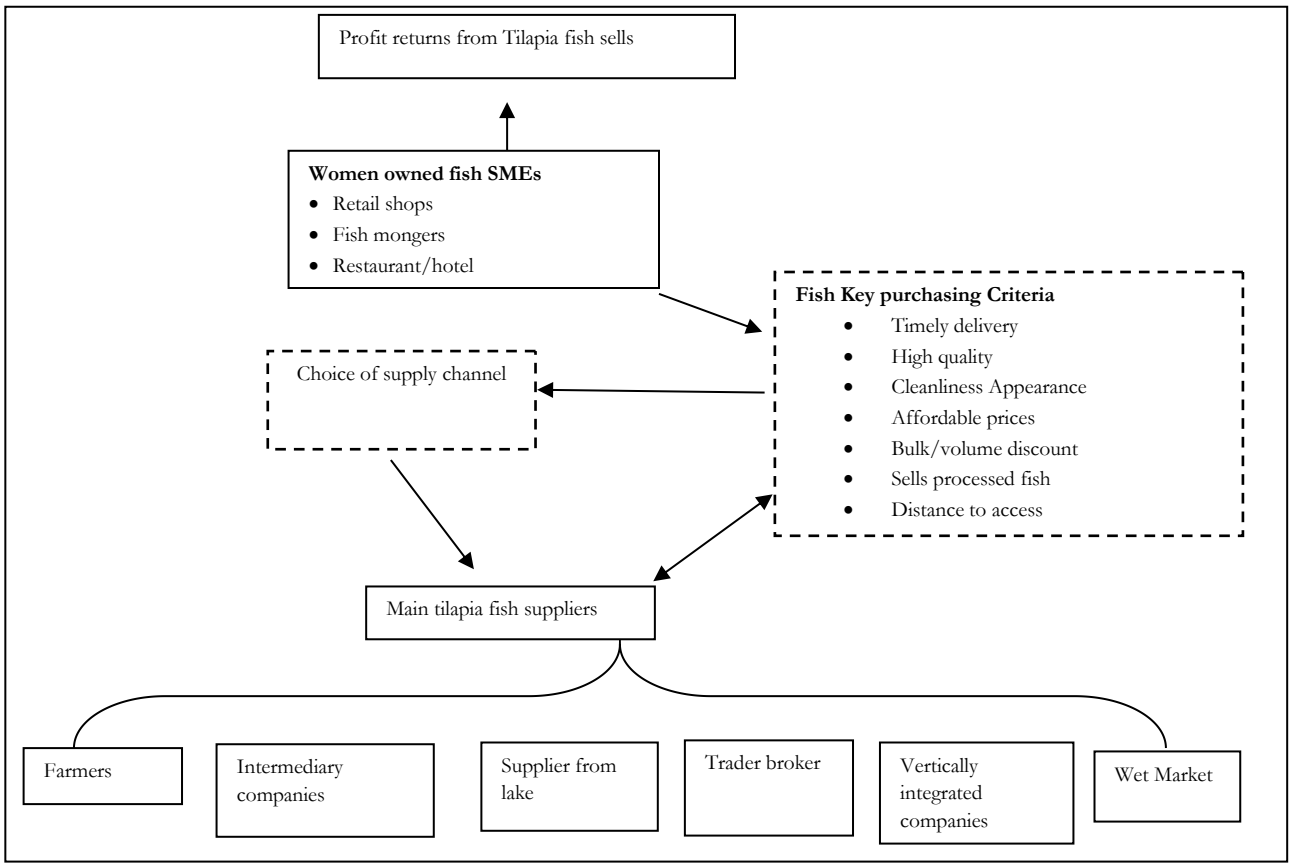

FIGURE 1 Agri-value chain participation and net profit nexus

3.0 Data and description

The present study utilizes data from a survey of women-owned fish microenterprises in the major urban centers of Kisumu, Nairobi, Nakuru, Uangishu, Nakuru, Kakamega, and Trans-Nzoia counties in Kenya. We employed a multistage random sampling procedure to select 941 women-owned fish micro-enterprises for the survey, purposefully selecting counties and sub-counties based on the intensity of fish retail outlets and randomly selecting fish retail micro-enterprises. A questionnaire was used to collect information on their personal and microenterprises characteristics, asset ownership, financial situation, main fish suppliers, key purchasing criteria, fish sales and returns during normal, high, and low seasons, as well as marketing activities.

Only 1.59 percent of women relied on farmers as their primary source of Tilapia fish supply, whereas 7.76 and 10.52 percent relied on intermediate companies and dealers, respectively. The bulk of women's microenterprises (39.74 percent) received their tilapia fish from lake supply. Only 14.77 percent of women-owned businesses sourced seafood from vertically integrated companies with retail locations, whereas 25.61 percent primarily sources fish from the wet market.

3.1 Empirical Analytical Framework

When studying the choice of marketing channel for supply as a binary choice (whether to participate or not), researchers employ various econometric techniques to address challenges posed by selection bias(Bourguignon et al., 2007). They aim to accommodate the reality that the choice to select market might not be arbitrary and could be influenced by both observable and unobservable variables. However, in cases where women fish entrepreneurs' selection of fish supply involves more than two choices (say, farmers, traders, intermediary companies, lake suppliers v, wet market and vertically integrated companies) as in this study, researchers have to turn to more specialized methodologies to handle selection bias.

Previous studies have employed several methods to address selection bias in binary technology adoption cases. The endogenous switching regression model (ESRM), inverse probability weighted regression adjustment, treatment effects models, and the conditional mixed process model are some of the main models that are used. However, in cases where choices are not binary but involve multiple options, the multivariate treatment effects model and MeSRM are likely used to address the selection bias challenge (Kassie et al., 2015; Konja & Abdulai, 2024). Considering these variables, this study has opted to utilize the MeSRM for its empirical studies. The MeSRM provides a comprehensive knowledge of the factors that affect fish supply choice, taking into account both observable and unobservable elements that can influence the women decision-making process. The MeSRM is an estimation procedure consisting of two stages, which includes selection equations and substantive equations. In the initial phase of MeSRM, we employ a multinomial logit (Mnl) model to determinants factors that influence the choice of fish supply channels (say, farmers, traders, intermediary companies, lake suppliers, wet market and vertically integrated companies). The options are then classified into distinct and non-overlapping groups(Kassie et al., 2015; Khonje et al., 2015). In the second phase, eSRM method is used to examine the impacts of choosing multiple fish supply channels on profits from fish enterprises

The framework employed in the analysis presupposes that women entrepreneurs select between two mutually exclusive fish supply channels. The assumption is that women entrepreneurs are risk-neutral and typically consider the profit returns when selecting fish suppliers during the decision-making process. Farmers, merchants, intermediary companies, wet markets, lake supplies, and vertically integrated companies comprise the fish supply channels. Given that women entrepreneurs are recognized for maximizing profits in their businesses, the primary requirement for selecting a particular fish supply channel 'j' is that it must generate higher anticipated profits than any other channels. The latent variable Y_{ij}^{*} encapsulates the anticipated profits determined by a combination of observed factors (table 1). The formulation is as follows:

$$\gamma_{ij} = \beta_j X_i + \mathcal{E}_{ij} \quad \text{.....(1)}$$

where, the term X_i encompasses the observed exogenous variables.

The error term, $\mathcal{E}_{ij}$, represents latent factors that may impact the decision-making process but cannot be directly observed. There is believed to be no correlation between the covariate vector X_i and the unique stochastic element $\mathcal{E}_{ij}$. This implies that the conditional expectation of $\mathcal{E}_{ij}$. given X_i is equal to zero, indicating that the error terms adhere to the principle of the

independent irrelevant alternatives (iia) hypothesis(Manda et al., 2021). The selection model is structured in a way that results in a multinomial logit framework. In this framework, the probability of picking marketing channel 'j', denoted as (ρ_{ij}), is expressed as shown by McFadden (1972).

$$\rho_{ij} = \rho(\varepsilon_{ij} < o/X_i) \frac{\exp(X_i\beta_j)}{\sum_{m=1}^{x} \exp(X_i\beta_m)} \quad \ldots\ldots(2)$$

In the second phase, the study utilizes the eSRM technique to examine the influence of selecting different fish supply channels on the profitability of fish firms. The objective of the study is to utilize a selection bias correction model to account for different scenarios encountered by women entrepreneurs, referred to as 'regimes'. Regime j = 1 is considered the baseline category, reflecting the 'farmers fish supply' channel. The subsequent equation represents the choice for every possible regime:

$$Regime1: \gamma_{i1} = \beta_1 X_i + \varepsilon_{i1} \; if \; 'j' = 'K' \quad \ldots\ldots(3)$$

$$Regime \;\; j: \Upsilon_{ix} = \beta_x X_i + \Sigma_{ix} if \; 'J' = 'K'$$

The variable Υ_{ix} reflects the outcome for the i^{th} farmer under the specified regime *'k'*. *Xi* is a vector of explanatory factors or exogenous covariates. β is the vector of parameters, while ε_{i1} and Σ_{ix} are random disturbance terms. Y_{ik} is noticed only when the marketing channel 'k' participates, which happens when the value of πik * is greater than the maximum value of πim * for all other channels and m that are not equal to k. However, if εk and Σ_{ix} are not independent, the ordinary least squares (OLS) estimations generated from equation (2) will be biased. Therefore, in order to accurately estimate X_i, it is necessary to incorporate adjustment terms for selection bias in equation (2) for current marketing channels 'm'. The MeSRM model assumes linearity, as shown by the equation ($\delta_{ik}/\varepsilon_{i1}$ …… ε_{ik}) = σ j∑ m k k ≠ rk(ε_{im} - E(ε_{im})(Dubin & McFadden, 1984). Equations (2 and 3) are intentionally designed to have no association between their error terms. Given this assumption, we express equation (3) in the following manner:

$$Regime1: Y_{i1} = \beta_1 X_i + \sigma_1 \lambda_1 + \Phi_{i1} \; if 'j' = 1 \quad \ldots\ldots(4)$$

$$RegimeJ: \beta_k X_i + \sigma_k \lambda_k + \Phi_{ik} \; if \; 'j' = K$$

In equation (4) Bourguignon (2007), σ_k represents the covariance between error terms δ and ε, Φ's are zero-expected error terms, and λ_k is the inverse Mills Ratio (iMR) calculated from the MeSRM estimate.

$$\lambda_k = \sum_{m \neq k}^{k} \sigma_k \left[\frac{\rho_{im} \widehat{lm(\hat{\rho}_{im})}}{1 - \widehat{\rho_{im}}} \right] + ln(\hat{\rho}_{ik}) \ldots\ldots\ldots\

4. Results and discussion

4.1. Summary statistics

Table 1 offers a comprehensive overview of descriptive statistics pertaining to various variables, categorized by different fish supply channel choices. The data provides insights on the potential factors that are likely to influence women entrepreneurs' choices for fish suppliers. The data shows that fish micro enterprises characteristics such as having contacts list of clients for fish was higher (87.8%) for women entrepreneurs who preferred vertically integrated company as the main supply of fish. Women with preferences for farmers supply channel record higher fish purchase cycle of 3.133 per week while also recorded the high (53.5%) ownership of refrigeration assets. In addition, the heath permit was to operate was highly (76%) obtained by enterprises with preference for trader supply channels while only 56% of the women with preference for intermediary companies had the heath permit licence. The findings also show that women entrepreneurs with preference for lake supply channel purchased more tilapia (80.97Kgs) than the other channels. Specifically, women enterprises with preference for intermediary companies only purchased 15Kgs. In terms of the cost of tilapia fish, enterprises with preference for Vertically integrated company and Intermediary companies paid Ksh 323 for Kg of tilapia fish but selection of Vertically Integrated company and Intermediary companies had less cost on the transportation cost. In contrast, preference for the supplies from the lake would cost enterprises Ksh 216.28 per Kg but the transport cost of 525.62 was incurred. Sourcing tilapia from famers suppliers earned women entrepreneurs (33%) bulk discount and free delivery discount 26%. Irrespective of supply source, most of the micro enterprises were opened for business for 6 days.

Table 1: Summary statistics of variables, by tilapia supply channel choice

	Farmers	Intermediary companies	Supplier from lake	Trader broker	Vertically integrated company	Wet Market
	Mean(Std. dev)	Mean(Std. dev)	Mean(Std. dev)	Mean(Std. dev)	Mean(Std. dev)	Mean(Std. dev)
Age of the entrepreneur owning SME	41.6(12.44)	39.041(9.408)	39.759(9.058)	41.57(10.85)	38.993(7.83)	38.15(7.856)
Education years of entrepreneur owning SME	12.73(2.374)	10.37(2.831)	9.909(3.214)	9.18(3.57)	10.719(2.912)	11.17(2.531)
Experience of entrepreneur owning SME	5.467(4.809)	7.425(5.842)	9.272(7.245)	11.82(10.4)	8.182(7.378)	8(5.944)
Health permit certificate 1=yes 0=otherwise	0.6(0.507)	0.562(0.5)	0.69(0.463)	0.76(0.43)	0.626(0.486)	0.614(0.488)
Number of SME fish retail branches	0.133(0.352)	0.384(0.615)	0.396(0.551)	0.53(0.56)	0.273(0.668)	0.274(0.465)
SMEs has regular customer list	0.733(0.458)	0.808(0.396)	0.674(0.469)	0.56(0.5)	0.878(0.329)	0.701(0.459)
Number of day's SME is operated in a week	6.2(0.561)	6.37(0.54)	6.206(0.814)	6.36(0.87)	6.381(0.502)	6.427(0.551)
Tilapia fish purchase cycle in	3.133(1.457)	2.178(1.531)	1.949(1.442)	1.82(1.37)	1.878(1.477)	1.942(1.416)
Size of fish do you purchase	0.533(0.516)	0.534(0.502)	0.588(0.493)	0.77(0.424)	0.604(0.491)	0.523(0.501)
Sized fish purchased	0.4(0.507)	0.795(0.407)	0.842(0.365)	0.798(0.404)	0.813(0.391)	0.863(0.344)
No Kgs of Tilapia on average purchased	63.13(83.54)	15.295(16.58)	80.97(428.78)	20.52(20.55)	43.712(98.532)	21.361(29.72)
Average cost for a 1 Kg of Tilapia	290(125.47)	323.41(74.99)	216.28(158.86)	254.43(146.33)	323.31(55.27)	322.6(172.5)

Transport cost in Ksh	406(747.40)	280.55(491.31)	525.62(158.86)	408.59(489.6)	186.3(353.3)	229.01(305.34)
Prepayment discount 1=yes 0=otherwise)	0.067(0.258)	0.096(0.296)	0.045(0.209)	0.061(0.24)	0.05(0.219)	0.071(0.257)
Bulk/volume discount 1=yes 0=otherwise	0.333(0.488)	0.205(0.407)	0.227(0.42)	0.263(0.442)	0.237(0.427)	0.145(0.353)
Free delivery 1=yes 0=otherwise	0.267(0.458)	0.137(0.346)	0.048(0.214)	0.101(0.303)	0.209(0.408)	0.033(0.18)
Ownership of refrigeration/ deep freezer 1=yes 0=otherwise	0.533(0.516)	0.247(0.434)	0.206(0.405)	0.202(0.404)	0.381(0.487)	0.228(0.421)
Training on food and hygiene 1=yes 0=otherwise	0.133(0.352)	0.356(0.482)	0.401(0.491)	0.646(0.481)	0.36(0.482)	0.311(0.464)

4.2 Key purchasing Criteria of Tilapia fish supply

The section outlines the key purchasing criteria (KPC) that influence women entrepreneurs' selection of fish supply channels. Figure 2 highlights that the most critical factor is the timely availability of fish stock, prioritized by 32.3% of respondents. High quality ranks second at 23.7%, followed by the cleanliness and appearance of the fish at 15.5%, and the availability of a variety of fish species at 8.24%. The emphasis on food hygiene reflects growing consumer concerns about food safety and pesticide contamination in fresh fish supply chains(Visciano, 2024). In addition, ensuring cleanliness and proper handling practices is essential to meet consumer expectations and regulatory standards. Notably, the sale of processed and filleted fish received the lowest KPC rating, attributed to the labor-intensive nature of processing and higher costs, making it less affordable for many customers.

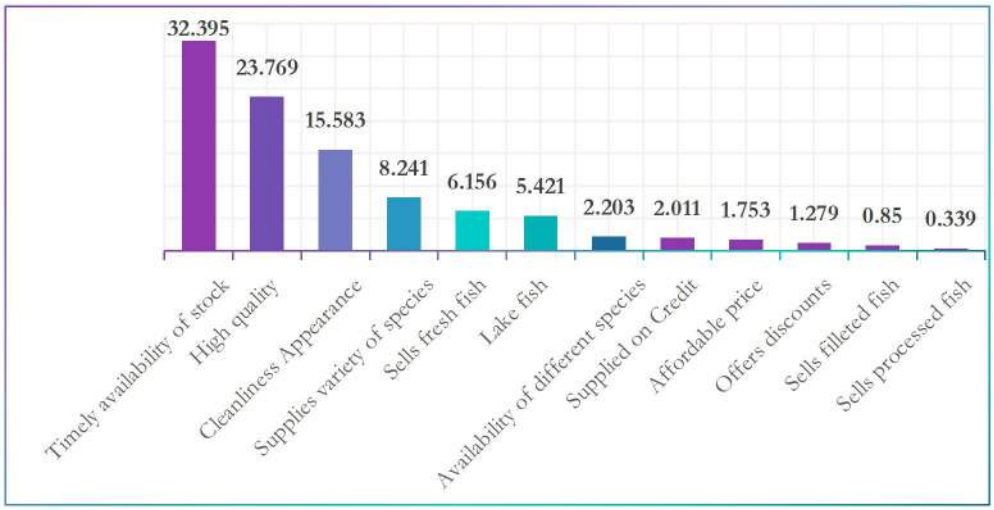

Figure 2: Key purchasing Criteria that determine supply of fish ‘

4.3. Determinants for market channel choice

The parameter estimates of the choices of fish market supply used by women entrepreneurs are presented in Table 2. Note that the base group for comparison is farmers supply channel. Considering that the magnitudes of the coefficients from MNL model are difficult to interpret, we therefore use the marginal effects to interpret the determinants of women choices of fish supply.

The study indicates that the marginal effect of the cost per kilogram of tilapia purchased is positive and significant mainly for vertically integrated companies and intermediary supply channels. This suggests that women entrepreneurs are price-sensitive and prefer affordable options when stocking fish for their enterprises, leading to a stronger preference for these two suppliers. Research indicates that women in fisheries often operate with limited capital and face financial constraints, making cost a critical factor in their purchasing decisions. Additionally, studies have shown that women in the fish value chain often engage in small-scale trading activities, such as fish and shellfish vending, processing, and selling value-added products, typically operating with modest capital investments(Tigabu & Wube, 2018). These financial limitations necessitate a focus on affordability when selecting suppliers, aligning with the study's observation that women entrepreneurs prefer vertically integrated companies and intermediary supply channels offering competitive prices.

The marginal effect of the quantities of tilapia purchased is positive and significant for vertically integrated companies, intermediary companies, and farmers' supply channels. This observation implies that higher quantities and the regular availability of tilapia fish are associated with increased interest from women in these three supplier types. Women entrepreneurs and consumers often prioritize consistent supply and sufficient stock levels to meet their business needs. Conversely, the quantities of tilapia available have a negative and significant effect for suppliers from the lake supply channel, suggesting that the low and irregular supply of tilapia in these channels may deter women entrepreneurs sourcing from lake supplies. A study on market dynamics in fisheries notes that fish traders and consumers are highly dependent on suppliers that ensure consistent and adequate fish quantities (Manyungwa et al., 2019). This is particularly true for vertically integrated companies and farmers who typically offer steady supplies compared to lake-based suppliers with fluctuating availability. Further Studies by WorldFish Center indicate that lake supply channels often suffer from seasonal variations, overfishing, and regulatory constraints, leading to inconsistent supply levels(Daw et al., 2009). This negatively affects fish traders, who rely on stable and predictable supply chains for their operations.

The study reveals that intermediary companies, farm suppliers, and vertically integrated companies significantly influence the cost of transporting tilapia fish from the supply chain to the retail channel. This finding suggests that women entrepreneurs prefer these suppliers due to the lower transportation expenses incurred, as these suppliers often have established retail outlets that reduce logistical costs. A study on supplier selection emphasizes that transportation costs are a critical factor influencing customers' choice of suppliers(Gattorna et al., 1996). The research indicates that minimizing transportation expenses is essential for efficient supply chain management, affecting the overall cost structure and profitability of women owned enterprises.

The study indicates that owning a deep freezer has a positive and significant effect on the selection of farmers and vertically integrated business supply channels for tilapia fish. Possessing assets like deep freezers enables women-owned fish micro-enterprises to preserve fish supplies from these suppliers effectively. Additionally, freezers facilitate the storage of fish, accommodating purchasing cycles and influencing the choice of farmers as suppliers. The intervention solar-powered freezers to fishing communities have improved fish preservation, reduced spoilage, and enhanced the livelihoods of women in these communities(Adam et al., 2024). A study on the role of women fishers in indigenous fish processing and preservation in Manipur highlights that women actively engage in processing and preserving fish to prevent

spoilage(Majumdar et al., 2023). The use of preservation methods, including freezing, is crucial for maintaining fish quality and extending shelf life(Abedi & Zhu, 2017).

Table 2 :Determinants of marketing choices for women fish entrepreneurs: Multinomial logit model (First stage of MESRMLR)

	Farmers	Intermediary companies	Supplier from lake (wild catch)	Trader	Vertically integrated company	Wet Market
	Marginal effects (SE)	Marginal effects (SE)	Marginal effects (SE)	Marginal effects (SE)	Marginal effects (SE)	Marginal effects (SE)
Age of the entrepreneur owning SME	0.003***(0.001)	-0.006*** (0.003)	0.001(0.003)	-0.04(0.002)	0.007643**(0.004)	-0.005(0.004)
Education years of entrepreneur owning SME	0.003(0.004)	-0.008(0.006)	-0.003(0.008)	0.001(0.005)	-0.009(0.01)	0.017(0.011)
Experience of entrepreneur owning SME	-0.004(0.003)	0.005*(0.003)	0.003(0.004)	0.009(0.003)	0.012*** (0.005)	0.007(0.005)
Health permit certificate 1=yes 0=otherwise	0.173(6.086)	0.045(0.096)	-0.034(1.089)	0.001(0.340)	-0.245(2.811)	0.06(1.760)
SMEs has regular customer list	0.006(0.024)	-0.042(0.037)	-0.008(0.051)	-0.001(0.033)	0.354*** (0.008)	-0.308*** (0.064)
Number of day's SME is operated in a week	0.008(0.02)	0.063**(0.031)	0.012(0.037)	-0.031(0.027)	-0.118(0.045)	0.065**(0.047)
Bulk/volume discount 1=yes 0=otherwise	0.007(0.006)	-0.005(0.012)	-0.018(0.014)	-0.001(0.01)	-0.014(0.017)	0.030*(0.018)
Size of fish do you purchase Large size	0.029*(0.018)	0.053(0.035)	-0.06(0.041)	0.097*(0.044)	0.001(0.052)	-0.121** (0.054)
Sized fish purchased Medium size	-0.004(0.023)	0.003(0.038)	0.136***(0.071)	-0.021(0.034)	-0.151*** (0.071)	0.037(0.08)
No Kgs of Tilapia on average purchased	0.062**(0.003)	-0.006*** (0.002)	-0.001*(0.008)	-0.002(0.001)	0.003***(0.001)	0.001(0.002)
Training on food and hygiene 1=yes 0=otherwise	-0.022(0.022)	-0.058(0.038)	0.066*(0.04)	0.006(0.003)	0.049(0.057)	-0.094*(0.062)
Average cost for a Kg of Tilapia	0.034(0.012)	0.006*(0.043)	-0.006(0.037)	0.003(0.003)	0.001***(0.005)	0.001(0.001)
Transport cost in Ksh	0.011(0.007)	0.021**(0.009)	0.005(0.009)	0.013(0.007)	0.001***(0.018)	-0.282(0.018)
Ownership of refrigeration/ deep freezer 1=yes 0=otherwise	0.051*(0.03)	-0.049(0.038)	-0.027(0.045)	0.014(0.033)	0.102**(0.055)	-0.092(0.06)
Observations	15	73	374	99	139	241
Joint Wald χ^2 (5)	16.14					
Joint IV Wald χ^2 (75)	147.54					
Prob > chi2	0.0000					
Pseudo R2	0.2590					

4.4 Determinants of profits revenues from women owned SMEs

This section presents the results of the Second-Stage MESR model, which analyses the determinants factors influencing the net returns of women-owned enterprises based on their choice of tilapia fish supply channels. As previously noted, the analytical framework aims to illustrate how different supply channels impact net returns of women owned SMEs. The reference category for comparison in this analysis is farmers operating within the traditional marketing channel. The estimated variances are all bootstrapped with 100 replications to account for heteroscedasticity, as suggested by Bourguignon et al. (2007).

The selectivity terms (_m1 to _m6) in Table 3 provide insights into how different factors influence the choice of fish supply channels and their impact on net profitability for women-owned enterprises. Selectivity terms help account for possible sample selection bias in the estimation of tilapia fish net profit determinants. The first selectivity term is (_m1) is positive and significant for farmers tilapia fish supply channel and negative for all other fish supply channels. This suggests that unobserved factors increase profitability when selecting farmers as the main tilapia supply source but decrease profitability when choosing intermediary companies, suppliers from the lake, trader brokers, and vertically integrated companies. The _m2 is positive and significant for the intermediary companies and vertically Integrated Companies. Further results show strong negative effect for supplier from lake. The study findings suggest that selecting lake suppliers is less profitable when considering unobserved factors, whereas vertically integrated and intermediary companies suppliers provide a more profitable option for women entrepreneurs. Likewise, _m5 is positive and significant for Vertically Integrated Companies meaning that choosing intermediary companies as main tilapia fish suppliers could strongly boost profitability for women owned enterprises. Negative across most terms (_m1, _m2, _m3, _m4), suggesting that choosing lake suppliers for tilapia fish may not be the most profitable option for women owned enterprises.

The findings in Table 4 indicate that health permit certificate has a consistently positive and statistically significant influence on the selection of fish supply channels, particularly favoring farmers and vertically integrated companies. This suggests that regulatory compliance through health certification plays a crucial role in enhancing the profitability of women-owned micro-enterprises by enabling them to access more reliable and higher-value supply chains. The analysis presented in Table 3 reveals that possessing a health permit certificate has a consistently positive and statistically significant impact on the selection of fish supply channels, particularly farmers and vertically integrated companies thus enhancing net returns for women-owned micro-enterprises.

This suggests that regulatory compliance through health certification plays a crucial role in enhancing the profitability of women-owned micro-enterprises by enabling them to access more reliable and higher-value supply chains. The finding is in line with the results by Bertram (2021) and Hendriks (2022) emphasizes the importance of health certifications in maintaining biosecurity and ensuring the quality of fish products, which directly influences the choice of supply channels by enterprises. The analysis also indicates that the quantity of fish purchased from farmers, vertically integrated companies, and intermediary companies has a positive and significant effect on the profitability of women-owned enterprises. This finding highlights the crucial role these suppliers play in enhancing the financial performance of such businesses. Study on women-owned fish processing businesses by Yudhanto, Rochima, and Rivani (2023) found

that effective resource utilization, including strategic supplier relationships, significantly contributes to improved business performance. The research emphasizes the importance of aligning with reliable suppliers to ensure consistent product quality and availability, thereby boosting profitability.

The frequency of business operations, measured by the number of days a business remains open, significantly influences the profitability derived from various fish supply channels, including farmers, wet markets, and vertically integrated companies. Operating more days allows women-owned enterprises to increase sales opportunities, better meet customer demand, and enhance revenue streams. Entrepreneurial orientation, which includes proactiveness and willingness to invest time, correlates with improved business performance(Bantigue, 2018). The analysis further indicates that owning assets such as deep freezers positively and significantly impacts the net returns of women-owned micro-enterprises when selecting supply channels involving farmers and vertically integrated companies. Possession of deep freezers enables the women enterprises to preserve fish quality over extended periods, allowing for bulk purchases and reducing dependency on daily market fluctuations. A study on fish traders in Ibaka, Nigeria, highlights that traders owning assets like deep freezers experience improved business outcomes(Udong, 2011).

The analysis indicates that the average cost per kilogram of tilapia is a positive and significant factor influencing the net returns of women-owned enterprises, particularly when sourcing from vertically integrated companies. This suggests that fair tilapia prices from fish suppliers is associated with increased profits for fish retail businesses. The study by Benson (2024) vertical integration, controlling multiple stages of the supply chain allows companies to enhance efficiency and reduce costs. For women-owned enterprises, sourcing from vertically integrated suppliers can lead to better profit margins due to streamlined operations and consistent product quality.

Table 3: Determinants of Tilapia Fish profitability: Second-stage MESR model

	Farmer	Intermediary companies	Supplier from lake	Trader/ brokers	Vertically integrated company	Wet Market
	Coeff(SE)	Coeff(SE)	Coeff(SE)	Coeff(SE)	Coeff(SE)	Coeff(SE)
Age of the entrepreneur owning SME	8.980(6.390)	-0.0475** (0.023)	0.007(0.015)	-0.006(0.020)	0.025***(0.013)	-0.021**(0.013)
Education years of entrepreneur owning SME	16.92(17.07)	-0.054(0.052)	-0.010(0.040)	0.001(0.048)	-0.036(0.034)	0.054*(0.034)
Experience of entrepreneur owning SME	17.35**(8.49)	0.0418*(0.028)	0.021(0.018)	0.009(0.027)	-0.048***(0.018)	0.025(8900)
Health permit certificate 1=yes 0=otherwise	250.3***(99.18)	0.372(0.293)	0.050(0.239)	0.135(0.305)	0.575***(0.203)	0.3746*(0.198)
SMEs has regular customer list	-0.024(0.044)	0.074(0.159)	-0.209*** (0.065)	0.210*(0.109)	-0.017(0.055)	-0.085** (0.042)
Number of SME fish retail branches	166.4**(81.09)	0.411(0.247)	-0.005(0.196)	-0.333(0.269)	0.4529**(0.167)	0.2333*(0.155)
Tilapia fish purchase Cycle	-13.02(30.68)	-0.020(0.096)	-0.074(0.074)	-0.009(0.097)	-0.046(0.060)	0.0986*(0.057)
Size of Tilapia fish do you purchase Small	-167.8(93.06)	0.293(0.291)	-0.210(0.221)	0.8715***(0.382)	0.055(0.186)	-0.36192**(0.176)
Sized Tilapia fish purchased Medium	65.86(123.56)	-0.081(0.338)	0.640**(0.357)	-0.259(0.332)	-0.481**(0.249)	0.143(0.248)
Kgs of Tilapia on average purchased	10.19***(1.94)	0.045** (0.016)	0.002(0.003)	-0.007(0.007)	0.005**(0.003)	-0.005(0.003)
Training on food and hygiene 1=yes 0=otherwise	-151.813*(98.85)	-0.302(0.307)	0.337*(0.220)	0.6222**(0.291)	0.165(0.205)	-0.302(0.199)
Average cost for a Kg of Tilapia	1.7625*(0.92)	0.005(0.003)	-0.003(0.002)	0.001(0.003)	-0.003(0.002)	0.002(0.002)
Transport cost in Ksh	1.1042***(0.27)	0.001*(0.001)	0.002***(0.001)	0.003***0.001)	-0.001***(0.001)	-0.0015***(0.001)
Ownership of refrigeration/ deep freezer 1=yes 0=otherwise	-56.64(101.37)	-0.513(0.327)	-0.176(0.244)	0.220(0.323)	0.492**(0.199)	-0.288(0.193)
Bulk/volume discount 1=yes 0=otherwise	-156.8(718.96)	0.674***(0.202)	-0.218(0.162)	-0.133(0.196)	0.161(0.143)	-0.2080*(0.130)
_cons		-5.962(2.201)	-0.807(1.740)	0.145(2.222)	2.236(1.578)	-0.675(1.480)
Selectivity terms						
_m1	0.342** (0.028)	-0.39791(0.045)	-0.527 (0.066)	-0.4443 (0.039)	-0.431(0.043)	-0.418(0.04)
_m2	2.09127(0.258)	0.085*(0.128)	-0.348 (0.079)	0.101(0.13)	0.564*** (0.127)	-0.206(0.13)
_m3	11.25(-1.586)	-0.782(0.272)	-0.449*** (0.307)	0.293(0.322)	0.184(0.31)	0.108(0.32)
_m4	-0.505(0.534)	11.08(0.734)	-0.147(0.489)	-9.03(0.594)	0.382(0.442)	1.454412(0.33)
_m5	0.71(0.02)	0.672(0.03)	-0.590(0.039)	0.641(0.025)	0.650***(0.028)	0.658(0.027)
_m6	0.124(0.032)	1.089(0.14)	0.706(0.056)	1.106(0.144)	0.569(0.072)	0.108 (0.897)
Observations	15	73	374	99	139	241

***, **, * represent 1%, 5%, and 10% significance level, respectively. SE denotes standard errors.

4.5 Impacts of Tilapia Fish Supply Channel Choice on Outcome Variables

The estimates for the average treatment effects on the treated (ATT), which shows the causal effects of fish supply channel choice on profit returns, are presented in Table5. The aim is to determine tilapia fish supply channels offer the highest net profitability to women owned enterprises. The analysis indicates that women-owned enterprises experience varying impacts on net profits based on their choice of tilapia fish suppliers. Specifically, sourcing from farmers results in a 25% increase in net profits, while partnering with intermediary companies leads to an 8.69% increase. Notably, engaging with vertically integrated companies yields the highest profit enhancement, with a 27.84% increase. Research by Gonçalo and Alencar (2014) on supplier selection strategies emphasizes that choosing suppliers with high value to the organization can significantly impact profitability. Strategic items, which have a large impact on profit and a high supply risk, require careful supplier selection to optimize financial outcomes. Studies highlight that fish marketing demands proficient distribution and preservation skills, economic and sociocultural competence, and a high degree of mobility. These factors influence the effectiveness of different supply channels and, consequently, the profitability of women-owned enterprises.

The analysis reveals that selecting suppliers from Lake sources and Wet Markets results in slight declines in net profits, with losses of −1.23% and −1.69%, respectively. This suggests that these supply channels may be less profitable for women-owned enterprises, potentially due to factors such as inconsistent supply, quality fluctuations, or higher operational costs. Research on informal fish markets indicates that reliance on lake-based suppliers is often associated with seasonal supply variability and post-harvest losses, which can negatively impact profitability(Murray et al., 2000). In Sub-Saharan Africa while wet markets provide accessible distribution channels, they often experience high price volatility and food safety concerns, which can reduce overall profits (Overå et al., 2022).

Table 4: Treatment effects estimate across treatment effect estimators

	Decision to choose fish supply channel		ATT	t-value	Change (%)
	Treated	Control			
Outcome variable					
Farmer	1500	1200	0.201	2.60*	25%
Intermediary companies	1135.5	1044.7	0.154	2.54*	8.69%
Supplier from lake	1240.07	1255.5	0.019	-1.29	−1.23%
Trader broker	1334.14	1134.1	0.165	1.02	2.64%
Vertically integrated company	1567.0	1225.7	0.298	2.55*	27.84%
Wet Market	1221.38	1242.43	0.099	-1.79	−1.69%

***, **, * represent 1%, 5%, and 10% significance level, respectively.

5. 0 Conclusion & Recommendation

This paper examines the determinants influencing the decisions of women-owned fish micro-enterprises when choosing fish supply channels, as well as the impact of these supply channels on the net profits (returns) of SMEs in major urban centers in Kenya. The study also evaluates the key purchasing criteria considered by women entrepreneurs when sourcing fish from different suppliers. The research utilizes cross-sectional enterprise-level data collected in 2023 from women-owned micro-enterprises in Kisumu, Nakuru, Nairobi, Trans-Nzoia, Kakamega, and Uasin Gishu counties. The sample consists of 942 randomly selected women-owned micro-enterprises. A comparative analysis of the determinants influencing supply channel choices reveals that women who opted for lake suppliers purchased the highest quantity of fish, averaging 80.97 kg, whereas those sourcing from intermediary companies purchased the least, at 15.295 kg. The results reveled that timely availability of fish stock, high fish quality fish and cleanliness and appearances were rated the three topmost important Key Purchasing Criteria considered by women owned enterprises when stocking tilapia fish from suppliers.

The empirical results indicate that the choice of fish supply channels significantly influences the profitability of women-owned fish micro-enterprises. Sourcing Tilapia fish from Farmers, Intermediary Companies, and Vertically Integrated Companies provides the most stable and profitable supply options for women entrepreneurs. These suppliers offer consistent fish availability, structured distribution networks, and better-quality assurance, all of which contribute to higher net profits. Additionally, regulatory compliance through health certification plays a crucial role in enhancing profitability. Health certifications enable women-owned micro-enterprises to access higher-value and more reliable supply chains, reducing risks associated with food safety concerns and market restrictions. The quantity of fish purchased from farmers, vertically integrated companies, and intermediary companies also has a positive and significant impact on profitability. This suggests that higher purchase volumes contribute to better cost management, improved supplier relationships, and increased revenue potential. Furthermore, ownership of deep freezers strengthens the financial performance of women entrepreneurs by allowing them to preserve fish quality over extended periods. The capability enables bulk purchases, reducing dependency on daily market fluctuations and ensuring greater inventory stability.

Based on these findings, the following recommendations are proposed to enhance the performance and profitability of women-owned fish enterprises. Women entrepreneurs should invest in storage solutions, such as deep freezers, to minimize spoilage and align inventory with demand cycles. Access to affordable financing for storage infrastructure should be expanded to improve business resilience. Stakeholders should introduce capacity-building programs to help women entrepreneurs to enhance their business management, supply chain knowledge, and market positioning.

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