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Determining Marketing Channel Preferences among Smallholder Tilapia and Catfish Farmers in the Rwenzori Region

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Abstract

This study analyzes the marketing channel preferences of smallholder farmers engaged in Tilapia and Catfish supply chains within the Rwenzori Region. The regional focus and selection of these two fish species are attributed to the South Initiative project, led by the Faculty of Business and Management Sciences and funded by VLIR-UOS Belgium. The project aimed to enhance the business practices of small-scale Tilapia and Catfish farmers in the Rwenzori Region. Four primary marketing channels were investigated: wholesalers, retailers, semi-processors, and farm gate. Data were collected through a field survey involving 302 smallholder fish farmers, utilizing purposive and snowball sampling techniques with assistance from district fishery officers. Analysis involved descriptive statistics and multinomial logit regression models using SPSS version 23. Results indicate higher market participation among wholesalers and semi-processors. The regression model reveals age, fish type, and business type as significant predictors of marketing channel choices, with statistically positive and negative beta coefficients observed across three of the four channels. This research offers valuable insights into the marketing decision-making processes of smallholder fish farmers, potentially enhancing the efficiency and effectiveness of the fisheries industry in Uganda. Moreover, the study's practical and managerial implications provide a basis for informed decision-making by policymakers and practitioners in the fisheries sector.

Keywords: Marketing channel, Multinomial logit, smallholder fish farmers, Tilapia, catfish
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1. Introduction

In Uganda, the fishing industry stands out as a significant contributor to economic advancement, accounting for 3% of the national gross domestic product and 12% of the agricultural sector. Consequently, smallholder fish farmers hold pivotal importance in the context of national, regional, and global food security and nutritional strategies. Their role is instrumental in reshaping food systems and mitigating hunger and malnutrition, as emphasized by Saugat et al. (2020). In addition, the 2030 development agenda established in 2015 by the United Nations encompasses 17 Sustainable Development Goals (SDGs), accompanied by 169 targets. These goals are designed to steer the actions of national, regional, and international agencies toward achieving sustainable development in the coming decade (UN, 2015). Notably, SDG 2 focuses on eradicating hunger in all its forms, along with addressing food and nutritional insecurity. At a global level, Africa emerges as a net importer of fish and fish products, catering to the needs of growing urban populations, as highlighted by Awuo et al. (2019). Enhancements in logistics and market distribution channels, alongside the expansion of aquaculture production and technological advancements, have facilitated the growth of regional fish trade (Anderson et al. 2017Masuku et al., 2001).

Furthermore, enhanced control measures in the harvesting process of capture fisheries and throughout the production stages of aquaculture have empowered producers to better comprehend consumers' requirements in terms of both quality and quantity. However, smallholder fish farmers in Uganda continue to grapple with low incomes due to limitations in implementing robust market linkages for their fish farming enterprises. Therefore, enhancing the efficiency of the marketing system holds significant potential in contributing to the achievement of sustainable development goals related to poverty alleviation, food security, nutrition, and the sustainable

management of natural resources (Gassner et al., 2019; Viana et al., 2022; Bhendarkar et al., 2023). As the market structure deviates from conditions of perfect competition, participants in the cold chain industry often pursue economic rent, leading to increased incentives for output and prices. Existing literature on marketing systems in developing nations underscores notable inefficiencies, including the prevalence of exploitative middlemen, significant spatial and temporal price disparities, challenges in contract enforcement, extensive wastage, fragmented marketing channels, considerable price differentials, and information asymmetry, particularly within cold supply chains such as fresh fish (Chand, 2012; Barrett and Mutambatsere, 2008; Acharya, 2006).

Regarding production, Uganda ranks as Africa's third-largest aquaculture producer, trailing behind Egypt and Nigeria, and is the second-largest in Sub-Saharan Africa (Adeleke et al., 2021). Total production has seen a substantial increase from a mere 31 tons in 1984 to 123,897 tons in 2020 (Egessa & Sándor, 2022). Prior to 2012, catfish emerged as the primary species cultivated in ponds. This popularity stemmed from advancements in breeding technology among hatchery operators, the rapid growth rate characteristic of catfish, and their ability to subsist on organic matter readily available at the household level (Egessa & Sándor, 2022). Furthermore, catfish are prevalent in various water systems across Uganda, particularly those associated with swamps (Rutaisire, 2007). Regarding production, Uganda ranks as Africa's third-largest aquaculture producer, trailing behind Egypt and Nigeria, and is the second-largest in Sub-Saharan Africa (Adeleke et al., 2021). Total production has seen a substantial increase from a mere 31 tons in 1984 to 123,897 tons in 2020 (Egessa & Sándor, 2022). Prior to 2012, catfish emerged as the primary species cultivated in ponds. This popularity stemmed from advancements in breeding technology among hatchery operators, the rapid growth rate characteristic of catfish, and their ability to subsist on organic matter readily available at the household level (Egessa & Sándor, 2022). Furthermore, catfish are prevalent in various water systems across Uganda, particularly those associated with swamps (Rutaisire, 2007). However, with the rise and increased focus on tilapia cage aquaculture in Uganda, coupled with its favorable international market position, there has been a shift in production dynamics, with tilapia surpassing catfish in terms of output (Egessa & Sándor, 2022). Tilapia has now become the predominant cultured species in the country, consistently outstripping catfish production since 2016. Estimates for 2020 indicate a production of 37,488 tons for African catfish and 86,011 tons for tilapia (Kasozi et al., 2017; Egessa & Sándor, 2022). Despite common carp being among the earliest fish species introduced into Ugandan aquaculture, challenges such as insufficient fingerling production, inadequate extension services, farmer perceptions, and unfavorable post-independence government policies have hindered its growth (Kasozi et al., 2017; Adeleke et al., 2021). Since 2012, there have been no reported productions of redbelly tilapia, indicating a seeming abandonment of the species by farmers. This lack of popularity is attributed to its slow growth rate (Kasozi et al., 2017).

This research paper makes a dual contribution. Firstly, it fills a gap in empirical studies by including evidence from Uganda, a significant player in the Tilapia and Catfish market in Africa, despite being often overlooked in previous research on market channel preferences for smallholder farmers (Arinloye, D. D. A., et al., 2015; Pham, T. T., Theuvsen, L., & Otter, V 2019; Chiv, R., et al., 2020; Mdoda, L., Mvelase, L. M., & Maziya, M. 2024; Lynn, Z. 2024; Teame, G. T., & Yacob, M. P. 2023; Yacob, M. P. 2023; Villacis, A. et al., 2024; Kazungu, I. 2024; Emana, B., Emana, B., etal., 2015). Secondly, by assessing two distinct types of fish supply chains, it offers researchers in this field a valuable comparative perspective, enhancing the understanding of this research discipline Thus, this research paper delves into exploring the selection of marketing channels among smallholder fish farmers in the Rwenzori region of Uganda. Notably, the study focuses on the Tilapia and Catfish supply chains, as these aquaculture species are widely favored by fish consumers in Uganda. Tilapia, recognized as one of the most extensively domesticated fish, exhibits remarkable adaptability to various environmental conditions and biological differences, both in aquaculture and natural habitats.

Additionally, Tilapia is renowned as a freshwater fish commonly consumed in developing countries (Hossain et al., 2022; Samaddar et al., 2022). The paper aims to elucidate the preferred marketing channels among smallholder fish farmers, thereby making a substantial contribution to the literature on fish marketing. It provides insights into the local market choices of smallholder farmers concerning Tilapia and Catfish. Particularly, it sheds light on the production quantities of Tilapia and Catfish among the selected smallholder fish farmers. The subsequent sections of the paper are structured as follows: Section 2 delineates the primary variables. Section 3 outlines the data collection, sampling methods, and data analysis procedures. Section 4 presents the empirical findings and subsequent discussions, while Section 5 concludes the study, drawing policy implications from the empirical results and highlighting limitations that warrant further investigation.

1.1 Overview of the Key variables

A marketing channel is delineated as a collection of interlinked organizations or activities that facilitate and ensure a product's availability for utilization or consumption by consumers or business users (Mansfield, 2003). Similarly, Lake (2007) characterizes a marketing channel as a structured network comprising individuals, agencies, and institutions collaborating to execute all functions necessary to link producers with end customers, thereby accomplishing the marketing objective. In contrast, Kotler et al. (2014) conceptualize a marketing channel as a method employed by manufacturers or producers to market commodities directly to consumers, either with or without intermediary involvement. A marketing channel is delineated as a collection of interlinked organizations or activities that facilitate and ensure a product's availability for utilization or consumption by consumers or business users (Mansfield, 2003). Similarly, Lake (2007) characterizes a marketing channel as a structured network comprising individuals, agencies, and institutions collaborating to execute all functions necessary to link producers with end customers, thereby accomplishing the marketing objective. In contrast, Kotler et al. (2014) conceptualize a marketing channel as a method employed by manufacturers or producers to market commodities directly to consumers, either with or without intermediary involvement. For the purpose of this study, four marketing channels were evaluated, namely: farm gate consumers, retailers, wholesalers, and semi-processors (such as those engaged in deep frying or smoking). This selection was made considering the recognition that perfect market conditions are seldom observed in reality, particularly in developing countries (Nxumalo et al., 2019). Respondents were encouraged to indicate the most preferred transactional form of marketing channel for their Tilapia or Catfish supply chain.

Wise and Baumgartner (1999) assert that marketing channels play a pivotal role for producers involved in cold or perishable supply chains, becoming increasingly appealing as value and profits gravitate downstream. At this juncture, channel actors often reap greater profits than the producers themselves (Shiimi et al., 2012). Consequently, producers, including fish farmers, grapple with insufficient knowledge about the final demand for their products, making the development of effective marketing strategies increasingly challenging. This challenge stems from the relative inactivity of intermediaries or middlemen in disseminating market insights to upstream partners. Intermediaries frequently obscure changing market conditions from upstream firms, hindering these farms' ability to develop fully customer-oriented, market-driven strategies. Several recent studies have operationalized the key indicators of marketing channels, as illustrated in Table 1 below.

Table 1: Operationalizing marketing channel constructs

Author Name & year	Marketing channel Construct	Context
Kirim et al,. (2011)	Farm gate consumers	Maize value chain
Soe, W. P. P., et al,. (2015)		Paddy Rice value chain
Ketema, S., & Lika, T. (2023)		Wheat value chain
Thamthanakoon, N., et al,. (2022)		Rice value chain
Gajdić, D. (2023)		
Navarro-del Aguila, I., & de Burgos-Jiménez, J. (2022).	Retailers	Agri-food chains
Ketema, S., & Lika, T. (2023)	Semi processors	Paddy rice value chain
Twinokwesiga, K. (2023).		Milk value chain
Kumar, Janmejay, et al.(2023)		Areca nuts chain chain
Ma-Azu, A. J., et al., (2022)		Rice farmer
Navarro-del Aguila, I., & de Burgos-Jiménez, J. (2022).	Wholesalers	Agri-Food Supply Chains
Kumar, Janmejay, et al.(2023)		Areca nuts value chain
Ma-Azu, A. J., et al., (2022)		Rice farmers

2. Methods and Materials

The selection of research methods for this study depended on the research problem and its nature. Both qualitative (exploratory) and quantitative (descriptive and inferential) research methods were employed, chosen in accordance with the research questions, problems, and purposes of the study.

2.1. Study area

The study was conducted in the districts of Bundibugyo, Kyenjojo, Kasese, Kyegegwa, and Kabarole, located in

the western region of Uganda, specifically within the Rwenzori Region. This region encompasses nine districts,the selection of these particular five districts was influenced by their abundance of freshwater resources conducive to fish farming activities. Smallholder fish farmers in five districts were organized into five groups. Due to the absence of a sample frame, a proportion of seventy fish farmers from each district was chosen using purposive and snowball sampling methods. This yielded a total sample of 302 respondents, resulting in a response rate of 86.2%. The distribution of respondents across the districts was as follows: 111 farming households in Bundibugyo, 66 in Kyenjojo, 46 in Kasese, 44 in Kyegegwa, and 35 in Kabarole district.

2.2. Target Population

The target population for this study comprised farmers engaged in fish farming as their primary economic activity, collaborating with Mountains of the Moon University on the South Initiative fish project. This project aimed to improve their business practices in areas such as record-keeping, marketing strategies, business plan development, and financial literacy.

2.3. Sampling and data collection Procedures

Data collection utilized a two-stage sampling approach, incorporating purposive sampling followed by convenience sampling techniques (Poole et al., 2003; Teddlie and Yu, 2007). Purposive sampling was employed to identify districts where fish farmers are predominantly located. Within these selected districts, a non-probability convenience sampling technique was utilized to determine the sample size (Robinson, 2014; Teddlie and Yu, 2007). The choice of convenience sampling was driven by factors such as the absence of a population size (sampling frame), as well as time and budgetary constraints (Poole et al., 2003). Data collection was conducted through a survey utilizing semi-structured questionnaires. The primary objective of the study was to gain insight into the marketing channel preferences and their potential correlation with the socioeconomic characteristics of smallholder fish farmers. Various methods were employed during data collection, including direct questioning, indirect questioning, detailed discussions, and observations. For instance, marketing channel choices, such as farm gate sales, were identified through methods such as observing customers procuring fish directly at the farmer's gate.

2.4. Data analysis and Multinomial logit model specification

The data were analyzed using the Statistical Package for the Social Sciences (SPSS), employing both descriptive and inferential statistics. Descriptive statistics were utilized to analyze qualitative data, while inferential statistics were employed to examine relationships between variables for instance fish farmers' choices of marketing channels were assessed on a Likert scale to determine the correlation with the socioeconomic characteristics. Data were summarized using means, frequencies, percentages, and coefficients, and presented in tabular format.

The study posited that a fish farmer holds market preferences defined over a set of alternatives. The choice variable (dependent variable) encompassed more than two unranked or unordered options, while the independent variables included characteristics of the alternatives as well as respondent demographics such as gender, age, education, type of fish, state of fish sold (fresh or semi-processed), and business type. McFadden (1974) pioneered the use of the multinomial logit model (MNL) to elucidate urban commuters' mode of transportation choice, employing the random utility model. The MNL was selected due to its closed-form choice probabilities formula, rendering it easily interpretable. This model was favored as it permits the analysis of decisions across multiple categories in the dependent variable, thus facilitating the determination of choice probabilities for different channels. Additionally, the MNL is computationally more straightforward compared to multinomial probit, which poses challenges in computing multivariate normal probabilities for dimensions greater than two (Greene, 2002).

We assumed that the utility of socioeconomic characteristics i in selecting marketing channel J is represented by Uij, which is a linear stochastic function of exogenous household characteristics X and endogenous household choices Z:

$$Uij = \alpha X + \beta Z + \varepsilon$$

The parameter estimates from the multinomial logit (MNL) model only indicate the direction of the independent variables' effect on the dependent (choice) variable. Therefore, these estimates do not reflect the actual magnitude of change or the probabilities. According to Greene (2002), marginal effects are defined as "the

expected change in the probability of a particular marketing choice being selected in response to a unit change in an independent variable from the mean"The following model was specified for the analysis of market channel choice:

$$DMchoice=\beta_0+\beta_1 Gender+\beta_2 Age+\beta_3 Education+\beta_4 fish\ type+\beta_5 fishstate+\beta_6 Businesstype+\varepsilon_i$$

In the context of smallholder fish farming, the selection of market outlets, including farm gate consumers, wholesalers, retailers, and semi-processors, is denoted as DM choice. Here, β1 to β6 represent coefficients corresponding to individual explanatory variables, while εi symbolizes the error term. Various factors were proposed to impact farmers' decisions regarding their preferred marketing channel. The selection of these explanatory variables was primarily guided by overarching hypotheses and partly informed by empirical observations in existing literature (Mutura, J.K. et al., 2015). Consequently, positive or negative coefficients were derived, reflecting the anticipated influence of specific variables on the choice of market channels.

3. **Empirical Results and discussions**

3.1. **Socioeconomic characteristics descriptive results**

The socioeconomic characteristics scrutinized and discussed encompass gender, age, education, fish species, state of fish sold (fresh or semi-processed), and business structure. The findings reveal a predominance of male fish farmers (88.4%), with only 11.6% being female. Regarding age, individuals between 26 and 35 years old constitute the majority (26.2%), indicating a substantial proportion of youth engaging in fish farming. Education-wise, primary level attainment (basic education) accounts for the highest percentage (26.8%) among farmers. Annex 1 illustrates that the majority of farmers cultivate tilapia fish (79.1%), while a smaller fraction (20.9%) focus on catfish, possibly influenced by prevailing attitudes and dietary perceptions. Furthermore, concerning the state of fish sold, the data illustrates the proportion of fish sold in various states by farmers. It indicates that 60.1% sell fresh fish, whereas 28.4% sell smoked fish, 8.9% sell deep-fried fish, and 2.3% utilize deep ice freezers for preservation or value addition. As for business structure, sole proprietorship constitutes the primary form (77.6%), with group informal partnerships accounting for 22.4% of the total.

3.2. Preferred marketing channel

As indicated in Table 2, the distribution of smallholder fish farmers across different market channels is examined. The results highlight that the most preferred marketing channel is wholesaling, accounting for 34.1% of participation. It's noteworthy that wholesalers typically traverse from one fish farmer to another, procuring fish to semi-process and distribute in bulk. During periods of low fish production, these buyers also vend fresh fish to semi-processors. This finding aligns with Ma-Azu et al.'s (2022) study, which observed that 88% of smallholder rice farmers in Ghana engaged with the wholesaler market channel. Semi-processors constitute 28.1% of participation, with approximately 85 smallholder fish farmers involved in this marketing channel. They acquire fresh fish directly from farmers and enhance value through traditional preservation methods like smoking or deep frying. Notably, about 20.9% of retailers partake in this channel, enabling them to mitigate marginal costs, as many sell directly to end consumers at retail prices. Conversely, around 16.9% of fish farmers sell to farm gate consumers, comprising nearby households or restaurant proprietors who procure directly from farmers for consumption. The limited involvement in this channel is likely attributed to the premium status of fish as a delicacy, with fewer households or restaurant patrons able to afford it.

Table 2: Smallholder farmers' marketing channel choice

Marketing Channels

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Wholesalers	103	34.1	34.1	34.1
	Farm gate consumers	51	16.9	16.9	51.0
	Semi processors	85	28.1	28.1	79.1
	Retailers	63	20.9	20.9	100.0
	Total	302	100.0	100.0	

Source: VLIR-UOS South Initiative-MMU Survey primary data

3.3. Multinomial logit regression model results

Multinomial Logit regression employing maximum likelihood estimation was employed to ascertain the determinants influencing the selection of various marketing channels (DMChoice). The dependent variable encompasses four distinct values representing different marketing channel choices: 1) wholesalers, 2) farm gate consumers, 3) semi-processors, and 4) retailers (Katchova and Miranda, 2004; Katchova, 2010). Model fit assessment produced likelihood ratio chi-square tests with significant statistics, signifying that the full model demonstrates a significant fit to the data. Multinomial Logit regression employing maximum likelihood estimation was employed to ascertain the determinants influencing the selection of various marketing channels (DMChoice). The dependent variable encompasses four distinct values representing different marketing channel choices: 1) wholesalers, 2) farm gate consumers, 3) semi-processors, and 4) retailers (Katchova and Miranda, 2004; Katchova, 2010). Model fit assessment produced likelihood ratio chi-square tests with significant statistics, indicating that the full model demonstrates a significant fit to the data, with $x2(18) = 40.402$ and $p < 0.005$, it suggests that all predictors for the dependent variables are mutually exclusive.

The goodness-of-fit analysis, as presented in Annex 2, includes the results of deviance and Pearson chi-square tests, which assess the model fit to the data. The deviance test yields an insignificant result of $x2(513) = 486.016$, $p = 0.799$, indicating a satisfactory fit. Conversely, the Pearson chi-square test produces significant results of $x2(513) = 571.357$, $p = 0.038$, suggesting a lack of fit for the model. Ideally, both tests should yield insignificant p-values for the model to demonstrate a good fit. However, it's important to acknowledge that they may not always concur, as observed in our case (Greene, W.H., 2003).

Moreover, the likelihood ratio tests assessed the overall contribution of each independent variable to the dependent factor. Employing the conventional threshold of $\alpha = 0.050$, the results confirm that age ($p = 0.010$), type of fish ($p = 0.037$), state of fish ($p = 0.041$), and business type ($p = 0.004$) are significant predictors in the model. The overall classification accuracy of the model stands at 68.9% a relatively commendable fit, with 72.5% for wholesalers, 51.7% for farm-gate consumers, 63.3% for semi-processors, and 68.9% for retailers as market channel users.

3.4. Socioeconomic factors influencing marketing channel choice

Only three variables exhibited significantly estimated coefficients and odds ratios that influenced the marketing channel choices of smallholder fish farmers, with differing effects based on the marketing channels (see Table 3). Age demonstrated both a positive and significant effect regarding the selection of either farm gate consumers or retailer marketing channels, with significance levels at 5%. It increased the likelihood that fish farmers sold to farm gate consumers and retailers by approximately 2.622% and 0.302%, respectively. This implies that for every one-unit increase in age, the odds of a farmer choosing farm gate consumers changed by a factor of 2.622%, and by 0.302% for the retailer market choice.

****, ** and * = statistically significant at the 1%, 5% and 10% level, respectively.*

Table 3: MNL estimation Results for smallholder fish farmers in Rwenzori Region

Variables	Marketing Channel								
	Wholesalers [a] vs Farm gate consumers			**Wholesalers[a] vs semi-processors**			**Wholesalers[a] vs Retailers**		
	β	*Std.Err*	*P=v*	*β*	*Std.Err*	*P=v*	*β*	*Std.Err*	*P=v*
Constant	2.157 (-)	1.239	**0.005**	-2.893 (-)	1.000	**0.023**	-0.422 (-)	1.155	.715
Age	0.964 (2.622)	0.487	**0.048**	-0.263 (0.768)	.495	.594	-1.198 (0.302)	.687	**.031**
Gender	0.207 (1.230)	0.122	0.090	0.087 (1.091)	.100	.387	0.011 (1.011)	.110	.919
Education Level	-0.082 (0.921)	0.121	0.499	-0.081 (0.922)	.103	.434	0.025 (1.025)	.109	.819
Type of fish	-1.125 (0.325)	0.580	**0.050**	0.398 (1.489)	.348	.252	0.004 (1.004)	.399	.992
Business type	-0.911 (0.402)	0.558	0.103	0.731 (2.078)	.360	**.042**	0.997 (1.981)	.587	**.043**
State of fish sold	-0.067 (0.935)	0.232	0.772	-0.303 (0.738)	.215	.158	0.206 (1.229)	.206	.317
Number of Observations	302								
Likelihood	599.733 (x^2 (18)=40.402; p<0.005								
Deviance	x^2(513df)=486.015;p=0.799								
Classifications: Wholesaler=68.9%; Farm-gate Con.=72.5%; Semi-processors=51.7%; Retailers= 63.3% Overall model= 37.1%									

a. The reference category is: Wholesalers.

This finding corroborates with the studies conducted by Ma-Azu et al. (2022) and Demiss (2022), which found that age significantly influenced the marketing channel choices of rice and potato farmers, respectively. Furthermore, the findings are consistent with those of Harrizon, K., et al. (2016), who revealed that the age of the household head was statistically significant at the 10 percent level and positively influenced the decision to participate in a marketing channel. Specifically, a one-unit increase in the age of the household head was associated with a 0.0305 increase in the probability of participation. Older farmers exhibited a greater likelihood of selling to KTDA compared to younger farmers. This tendency can be anticipated, as younger farmers typically demonstrate greater receptivity to new ideas and are less risk-averse.

Additionally, the type of fish demonstrated a negative and significant impact at the 5% level. This regression coefficient suggests that the predictor significantly discriminates between wholesaler and farm gate consumer market channels, exerting a negative effect. This implies that it diminishes the likelihood that a farmer sells to farm-gate consumers by odds ratios of approximately 0.325%.

The final set of coefficients compares wholesalers (the reference category) with retailers. In this segment of the output, only age and business type (sole proprietorship and group partnership) were both positively significant. This suggests that older farmers were more inclined to sell to wholesalers rather than retailers. These findings substantiate the study conducted by Djalalou-Dine A. A. et al. (2015), which highlighted the significance of farmers' household characteristics in influencing their selection of marketing channels. The research indicated that young farmers tend to prefer selling to urban market outlets, whereas older farmers favor rural market outlets. However, there exist conflicting explanations regarding the relationship between age.

4. Conclusions and policy implications

This study has explored the participation of smallholder fish farmers in marketing channels. Utilizing recent survey data comprising 302 fish farmers from five districts in the Rwenzori region of Uganda, our analysis revealed that the predominant choice of market channel for the majority of farmers is wholesalers. The empirical findings corroborate the idea that farmers prefer selling to wholesalers due to their specialization in fish distribution and their status as regulated, reliable, and monitored market outlets. Additionally, the study highlights that most fish farmers operate as sole proprietors. However, it is essential for them to operate in groups to attract support from governmental and donor sources. The formation of fish farmer groups is poised to enhance the fish value chain and facilitate strategic fish interventions such as capacity building, the establishment of funds, and demand-driven production. Both new and existing fish farmer groups would benefit from training in business development and technical group dynamics specific to fish farming businesses. This approach would foster greater cohesion among farmer groups and encourage active participation in activities, including marketing initiatives.

Regarding gender perspectives, the socioeconomic data reveals a low involvement of women in fish farming within the Rwenzori region. This underscores the need for international organizations like the UN, which advocate for Sustainable Development Goals (SDGs), to invest in training programs tailored for women in fish farming. Tilapia and catfish emerge as the primary species cultivated, driven by high demand and their significant contributions to food security and nutritional needs. Given that fish farming is often feasible near households, encouraging women's participation could serve as a strategy for economic empowerment. However, such efforts must be accompanied by secure rights to resources like farmland (Lentisco and Lee, 2015). Consequently, it's imperative to encourage more young women to engage in this sector. Policymakers should focus on equipping young people with farming skills from an early age to promote both fish farming and efficient market channels.

In conclusion, the findings of this study underscore that age, type of fish, and business structure significantly impact the choice of market outlet. The aquaculture industry in Uganda is delineated into three primary sectors: smallholder fish farmers, medium-scale commercial fish farmers, and large-scale commercial fish farmers. Notably, tilapia and catfish emerge as the dominant species across all sectors (Egessa, R., & Sándor, Z. J., 2022). Therefore, future research endeavors may consider incorporating farm age and income into the Multinomial Logit (MNL) model as part of socioeconomic characteristics to elucidate the determining factors of marketing channel choices (wholesale, farm-gate consumers, retailers, and semi-processors) among medium or large-scale fish farmers.

A prospective avenue for future research could involve the utilization of probability sampling or representative sampling techniques, contingent upon the availability of a suitable sampling frame. Such an approach would facilitate the generalization of results and aid stakeholders in enhancing their marketing decision-making processes. Furthermore, reconsidering the number and nature of factors, along with their respective levels, may enable other researchers to explore additional dimensions of fish farmer marketing channel choice decisions. This could enhance the statistical robustness of the study by incorporating diverse factors and their levels. Nevertheless, this paper has made a significant contribution by fostering increased interest among smallholder fish farmers in the scientific research community, particularly within the Rwenzori region.

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Annex 1: Respondents' socioeconomic characteristics

Variables	Frequency (fx)	Percentage (%)
Districts		
Kabarole	35	11.6
Kyenjojo	66	21.9
Kasese	46	15.2
Bundibugyo	111	36.8
Kyegegwa	44	14.6
Total	***302***	***100***
Gender		
Male	267	88.4
Female	35	11.6
Total	***302***	***100***
Age		
16-25	42	13.9
26-35	79	26.2
36-45	58	19.2
46-55	56	18.5
56-65	44	14.6
66 and Above	23	7.6
Total	***302***	***100***
Education Level		
None	53	17.5
Primary Level	81	26.8
O Level Secondary	72	23.8
A Level Secondary	51	16.9
Tertiary	20	6.6
University	25	8.3
Total	***302***	***100***
Type of Fish		
Tilapia	239	79.1
Cat fish	63	20.9
Total	***302***	***100***
State of fish sold		
Fresh fish	182	60.1
Dried/smoked fish	86	28.4
Deep fried fish	27	8.9
Fronzen	7	2.3
Missing	1	0.3
Total	***302***	***99.7***
Business type		
Sole proprietor	235	77.6

Partnership	68	22.4
Total	***302***	***100***

Annex 2: Goodness of fit model

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	571.357	513	.038
Deviance	486.016	513	.799