DETERMINANTS OF LIVELIHOOD OUTCOMES IN THE USIPA VALUE CHAIN:
INSIGHTS FROM MALAWIAN RETAILERS

By

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ABSTRACT

Small-scale fisheries account for 90% of employment in capture fisheries worldwide (FAO, WorldFish & Duke, 2023). In Malawi, small-scale fisheries play a key role in food security and livelihoods by providing nutritious, affordable foods and a variety of employment opportunities via participation in the fish value chain (Cooke et al. 2021). Fish trade plays a key part in the functioning of the fish value chain and is especially important because of the high level of female participation (Manyungwa et al. 2019). Despite the importance of fish trade, fisheries research has primarily focused on harvest activities and has neglected actors in the broader fish value chain including processors, logistics providers, wholesalers, and retailers (Smith & Basurto, 2019). Consequently, fish retailers have been understudied, resulting in knowledge gaps regarding fish retailers' livelihoods. This thesis fills this gap by assessing variation in livelihood outcomes for fish retailers in Malawi.

This thesis utilizes a mixed methods approach using both quantitative and qualitative methodologies to understand variation in livelihood outcomes for fish retailers in Malawi. First, econometric modeling is conducted in StataIC using market survey data to explore which variables influence marketing margins and net daily profit for fish retailers. Second, qualitative focus group data are assessed in Nvivo to offer insight into retailer's decision-making and to provide a more nuanced understanding of fish retailer's challenges, specifically considering issues of complex gender dynamics and price volatility. By bringing qualitative focus group data into conversation with econometric analyses, this mixed-methods approach provides a detailed understanding of the drivers of variation in livelihood outcomes for fish retailers in Malawi.

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LIST OF SYMBOLS AND ABBREVIATIONS

SSF   Small-Scale Fisheries

SSA   Sub-Saharan Africa

LIFD   Low-Income Food-Deficit

MK   Malawian Kwacha

GDP   Gross Domestic Product

OLS   Ordinary Least Squares

2SLS   Two Stage Least Squares

IV   Instrumental Variable

CV   Coefficient of Variation

SES   Social-Ecological Systems

SDG   United Nations Sustainable Development Goals

LUANAR   Lilongwe University of Agriculture and Natural Resources

INTRODUCTION

Globally, approximately 120 million people are employed in small-scale fisheries (SSF) value chains, and nearly half of these jobs are held by women (FAO, 2020). The post-harvest sector employs 2-3 times as many workers as the primary fishing sector, yet post-harvest activities remain largely understudied compared to harvest activities (Smith & Basurto, 2019; FAO & WorldFish 2008). This thesis addresses the lack of research on postharvest actors in small-scale fisheries value chains by assessing fish retailer's livelihoods in an empirical case study of usipa (*Engraulicypris sardella*) trade in Malawi. More specifically, this thesis explores how two key issues – gender dynamics and price volatility – impact livelihood outcomes for usipa retailers in Malawi.

Malawi is a land locked country in sub-Saharan Africa bordered by Mozambique, Tanzania, and Zambia, yet it is rich with vast aquatic resources from its many inland lakes including Lake Malawi (Lago Nyassa/Niassa), one of the African Great Lakes (Figure 1). Small-scale fisheries account for 90% of fishing vessels in Malawi and SSF play a key role in food security and livelihoods for Malawians by providing nutritious, affordable foods and a variety of employment opportunities via participation in the fish value chain (Cooke et al., 2021). Local freshwater fish provides over one quarter of animal protein consumed in Malawi, and fish value chains meaningfully contribute to livelihoods by accounting for USD454 million annually, equivalent to over 7% of national Gross Domestic Product (GDP) (Torell et al., 2020). Other studies have revealed that these figures may be much higher given that official fish catches in Malawi may be underreported by up to 65% (Fluet-Chouinard et al., 2018).
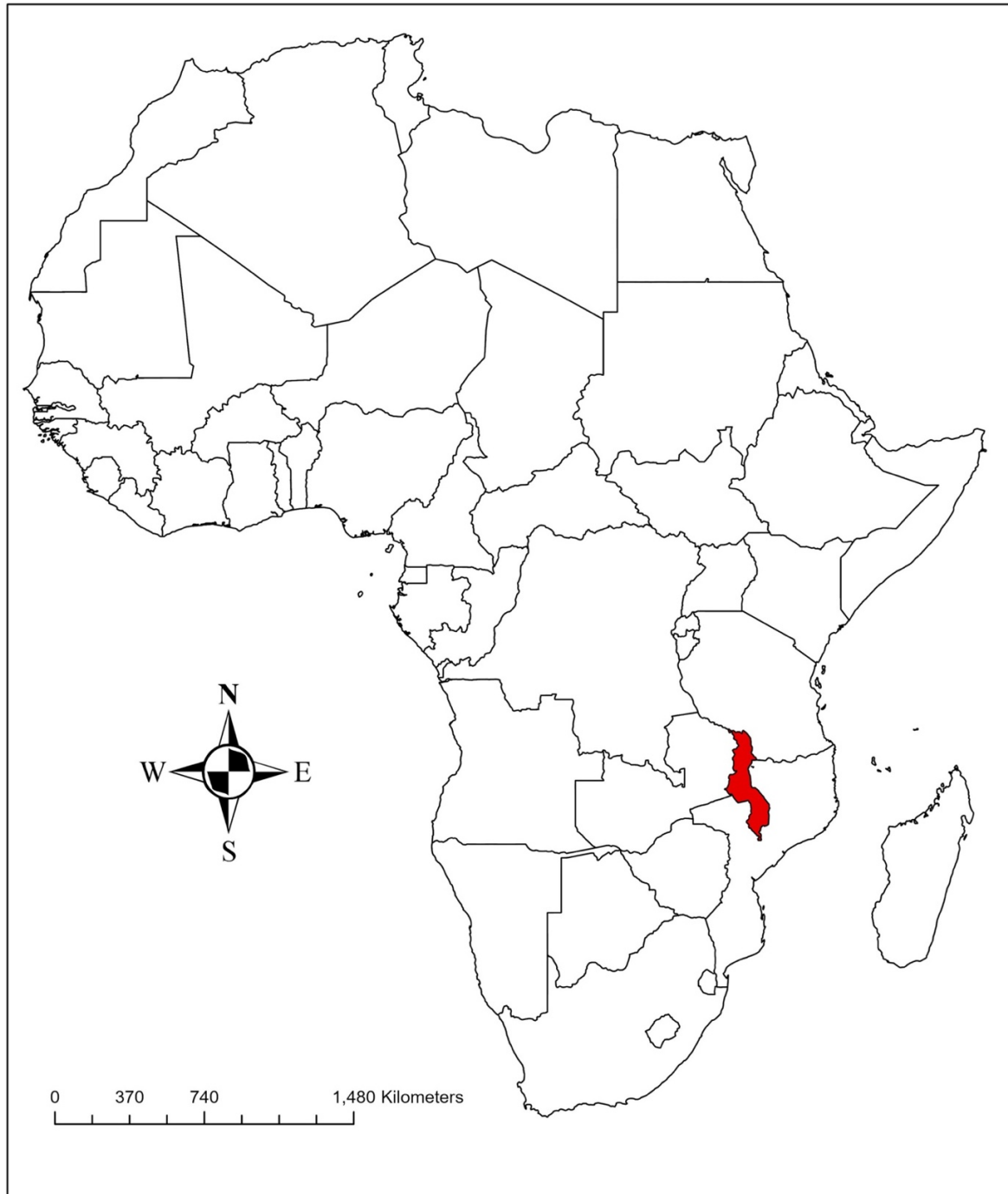
Figure 1. Map of Africa with Malawi highlighted in red.

Trade of the native Lake Malawi sardine, usipa (*Engraulicypris sardella*), has been selected for this thesis because it plays a critical role in food and nutrition security and livelihoods throughout Malawi. Usipa makes up the largest proportion of national catch,

accounting for over 70% of total annual landings (Makwinja et al., 2018). Usipa has been found to be broadly affordable and available at most fish markets in Malawi, including rural markets (Bennett et al., 2022). Affordable aquatic foods are especially important given that Malawi is one of the poorest countries in the world with just over half of Malawians living below the poverty line (IMF, 2017). Small pelagic fish, such as usipa, are micronutrient rich and provide consumers with vital lipids, minerals, and essential vitamins (Isaacs, 2016; Nolle et al., 2020). Furthermore, women primarily participate in the trade low value fish species, including small pelagic species like usipa, making it a relevant species for research focused on women's livelihood outcomes (Lwenya and Abila, 2001; Frocklin et al., 2013).

This thesis relates to the United Nations Sustainable Development Goals (SDG), specifically SDG (1) No Poverty, and SDG (5) Gender Equality. SDG (1) No Poverty is addressed by identifying strategies employed by profitable usipa retailers to inform evidence-driven policies, projects, programs, and or interventions aimed at improving earnings for all fish traders in Malawi and strengthening the usipa value chain. Strengthening fisheries value chains in Malawi has been identified in the literature as one of the key pathways for achieving poverty reduction in the country (Cooke et al. 2021). Inland fisheries value chains can be important contributors to SDG (1) No Poverty, particularly in Low-Income Food-Deficit (LIFD) countries like Malawi (Lynch et al. 2017).

This thesis contributes to SDG (5) Gender Equality by elevating women fish retailer's stories and lived experiences and identifying challenges women face in the usipa value chain in Malawi. Despite the key roles women play in fish value chains, their contributions remain largely unrecognized and their challenges unconsidered (FAO, 2014). Gender inequalities persist in small-scale fisheries and limit livelihood benefits for many women engaged in the sector and

their households. Women in SSF are overrepresented in unpaid activities and underrepresented in governance and decision-making activities (FAO, WorldFish & Duke, 2023). Highlighting barriers to success for women in SSF can inform policies, projects, programs, and or interventions that consider women's unique circumstances and provide women with the necessary resources to prosper in the usipa value chain. In centering women's voices, this research aims to not only contribute to the goal of SDG (5) Gender Equality, but also go one step further and move the conversation towards gender equity.

There remains a gap in the literature regarding the factors that drive variation in livelihood outcomes for different fish retailers. This thesis, consisting of two chapters, employs a mixed methods approach to address this gap. Chapter one investigates gendered livelihood outcomes by considering the following research questions: (1) Do livelihood benefits differ for women and men usipa retailers? and (2) What factors drive variation in livelihood outcomes for usipa retailers in Malawi? Chapter two investigates the impacts of price volatility on small-scale usipa retailer's livelihood outcomes. Operationalizing spatial arbitrage as an indicator of adaptive capacity to price volatility, chapter two explores the following research questions: (1) What is the relationship between price volatility and livelihood outcomes? and (2) What is the relationship between adaptive capacity and livelihood outcomes?

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CHAPTER 1. A GENDERED ANALYSIS OF FISH TRADERS' LIVELIHOODS IN MALAWI

Abstract

Women play key roles in fish value chains, especially post-harvest processing and marketing of fish products. However, gender inequalities in small-scale fishery value chains persist around the globe, limiting livelihood benefits for many women and their households. Despite a growing recognition of these inequalities, the role of different factors in shaping these inequalities remain largely untested. To address this gap, this study uses a mixed methods approach to explore the factors that drive variation in fish traders' livelihood outcomes among usipa (*Engraulicypris sardella*) retailers in Malawi. We find that (1) there is a statistically significant difference in marketing margins between female and male usipa retailers, with female retailers earning less (2) there remains dominant discourse among men that gender does not impact economic benefits from usipa trade, whereas women tend to discuss gender as a barrier, and (3) the primary constraints for all retailers in usipa trade, which manifest differently for women and men, are (a) lack of formal financial services, (b) poor transportation, (c) price volatility, (d) lack of storage, and (e) gender-based violence.

Introduction

Worldwide, approximately 120 million people are employed in small-scale fisheries (SSF) value chains or subsistence activities, 97% of which are in the Global South (FAO, 2020). At least 45 million women participate in small-scale fisheries value chains globally, which is around 40% of all those engaged (FAO, WorldFish & Duke, 2023). Women are particularly prominent in the post-harvest fisheries sector where they play key roles as processors and traders of fish products (Frocklin et al., 2013; FAO, 2020; Manyungwa-Pasani et al., 2020). In many

sub-Saharan African countries, women are employed in the post-harvest fisheries sector at a higher rate than in the general labor force, making this sector critical for household income, food security and nutrition (Lynch et al., 2017). Given the importance of women in small-scale fisheries, gender equality and equity have been recognized as a guiding principle fundamental to SSF development by the Food and Agriculture Organization of the United Nations (FAO) in the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries. Similarly, working towards gender equality and equity in the small-scale fisheries sector links directly to Sustainable Development Goal (SDG) 5, Gender Equality.

Despite global acknowledgement of the need to prioritize gender equality and equity in SSF, several challenges persist for women in the sector. First, women remain underrepresented in governance and decision-making processes (Williams, 2008; Manyungwa et al., 2019; FAO, 2020; Torell et al., 2021; FAO, WorldFish & Duke, 2023). Second, women are overrepresented in unpaid and underpaid activities in small-scale fisheries (FAO, WorldFish & Duke, 2023). Women in SSF earn an inequitable share of benefits because they generally own fewer assets, are disproportionately involved in less profitable nodes of value chains, and have limited opportunities to advance within their roles due to limited access to capital (Lwenya and Abila, 2001; Frocklin et al., 2013; FAO, 2014; Manyungwa-Pasani et al., 2017; Nagoli et al., 2019; Adam et al., 2021; Moreau and Garaway, 2021). Third, women's participation in and benefits from SSF are constrained by gender-based violence. Fish-for-sex trade, a form of gender-based violence in which women fish traders are forced to exchange sex with fishermen to gain access to fish resources, has been well documented in many small-scale fishing communities in sub-Saharan Africa (Béné & Merten, 2008; Fiorella 2015; Medard et al, 2019; Moreau & Faraway, 2021). These exploitative relationships are facilitated by asymmetric power dynamics, conditions

of poverty, and a gendered economy that limit women's alternative employment opportunities (Fiorella et al., 2019; Merten and Haller, 2007). However, it is important to note that fish-for-sex is not necessarily perceived as exploitative or shameful by the women who engage in it themselves, rather some women view the fish they receive from fishermen as gifts from lovers (Béné & Merten, 2008; Merdard et al., 2019; Moreau and Garaway, 2021). These key issues for women in SSF emphasize the need for greater policy commitments to be made to gender equality and equity in SSF (Lawless et al., 2021).

This study further explores the challenges women and men face in small-scale fisheries in the empirical context of usipa (*Engraulicypris sardella*) trade in Malawi. Fish trade plays a key part in fish value chains in Malawi and is an important livelihood activity for women and men in the country (e.g., Williams, 2008; Harper et al., 2013; Manyungwa et al., 2019; Manyungwa-Pasani et al., 2020; Lawless et al., 2021; Torell et al., 2021). Previous literature has found that gendered inequities negatively affect women's participation in fisheries value chains, governance, and decision-making in Malawi (Nagoli et al., 2019; Manyungwa et al., 2019; Manyungwa-Pasani et al., 2020; Torell et al., 2021). However, these previous studies have only looked at social norms and structural variables that disadvantage women and have yet to quantitatively test their impacts on livelihood outcomes. This study, therefore, addresses this gap and builds on the previous literature by examining the implications of a range of factors that contribute to the observed variation in livelihood outcomes between women and men fish retailers using both quantitative and qualitative methods.

Using a mixed methods approach, we investigate gendered livelihood outcomes for usipa retailers in Malawi by answering the following research questions: (1) Do livelihood benefits differ for women and men in small-scale usipa trade? and (2) What factors drive variation in

livelihood outcomes for fish retailers in Malawi?

Study Area

Malawi, a country with vast, rich aquatic resources in the African Great Lakes Region, is bordered by Mozambique, Tanzania, and Zambia (Figure 1). Small-scale inland fisheries account for 90% of fishing vessels in Malawi, primarily on Lake Malawi (Lago Nyasa/Niassa) (Cooke et al., 2021). Small-scale fisheries play a key role in food security and livelihoods for Malawians by providing nutritious, affordable foods and a variety of employment opportunities via participation in the fish value chain (Cooke et al., 2021; Bennett et al., 2022). Affordable aquatic foods are especially important given that Malawi is one of the poorest countries in the world with just over half of Malawians living below the poverty line (IMF, 2017). In Malawi, local freshwater fish provides over one quarter of animal protein consumed in the country and fish value chains contribute to livelihoods by accounting for over 7% of national Gross Domestic Product (GDP) (Torell et al., 2020). Other studies have revealed, however, that these figures may, in fact, be much higher given that official fish catches in Malawi may be underreported by up to 65% (Fluet-Chouinard et al., 2018).

In this study, we examine gender dynamics in Malawian fish trade, specifically usipa (*Engraulicypris sardella*) retail. The trade of the native Lake Malawi sardine has been selected for this study because women primarily participate in the trade of low value species, especially small pelagic species like usipa (Lwenya and Abila, 2001; Frocklin et al., 2013). Further, small pelagic species make important contributions to food security and nutrition in low- and middle-income countries, like Malawi, as an affordable and plentiful source of essential micronutrients, i.e., vitamins and minerals (Isaacs, 2016; Robinson et al., 2022).

Methods

Data Collection

This study utilizes a mixed method approach that uses qualitative focus group data to help explain quantitative findings from market survey data (Steckler et al., 1992). In using both quantitative and qualitative methods, we answer different research questions that build upon and strengthen one another to enable a systematic analysis of factors that contribute to variation in livelihood outcomes for women and men.

Surveys

Most fisheries data to date are not disaggregated by sex, resulting in "gender-blind" fisheries management, policy, and research (Focklin et al., 2013; Harper et al., 2013; Lawless et al., 2021; FAO, Duke University & WorldFish, 2023). This study fills this gap and contributes a rich sex-disaggregated quantitative data set obtained through market surveys.

Market surveys were carried out in Malawi by a team of enumerators from October 2019-January 2020 using KoBo toolbox. The market surveys collected relevant demographic and socioeconomic information about the fish traders themselves, information about the retail markets where surveys were conducted, and critical economic information about each transaction including quantity, buying price, selling price, processing method, transport costs, and market fees.

A total of 604 usipa traders (271 female; 333 male) at 72 formal open air retail markets were surveyed (Figure 2). The 72 markets were identified through a value chain mapping approach in which enumerators followed traders from the three largest beach sites on Lake Malawi through each phase of the value chain until retail markets were reached where usipa was sold direct to end consumers. At the 72 usipa retail markets, the 604 traders were identified

through a convenience sampling approach, given no sampling frame was available for informal

fish traders. Convenience samples are often utilized in contexts that lack a sampling frame and in

locations where informants are moving in and out of public spaces quickly, such as the open-air

fish markets in Malawi (Peek, 2009).
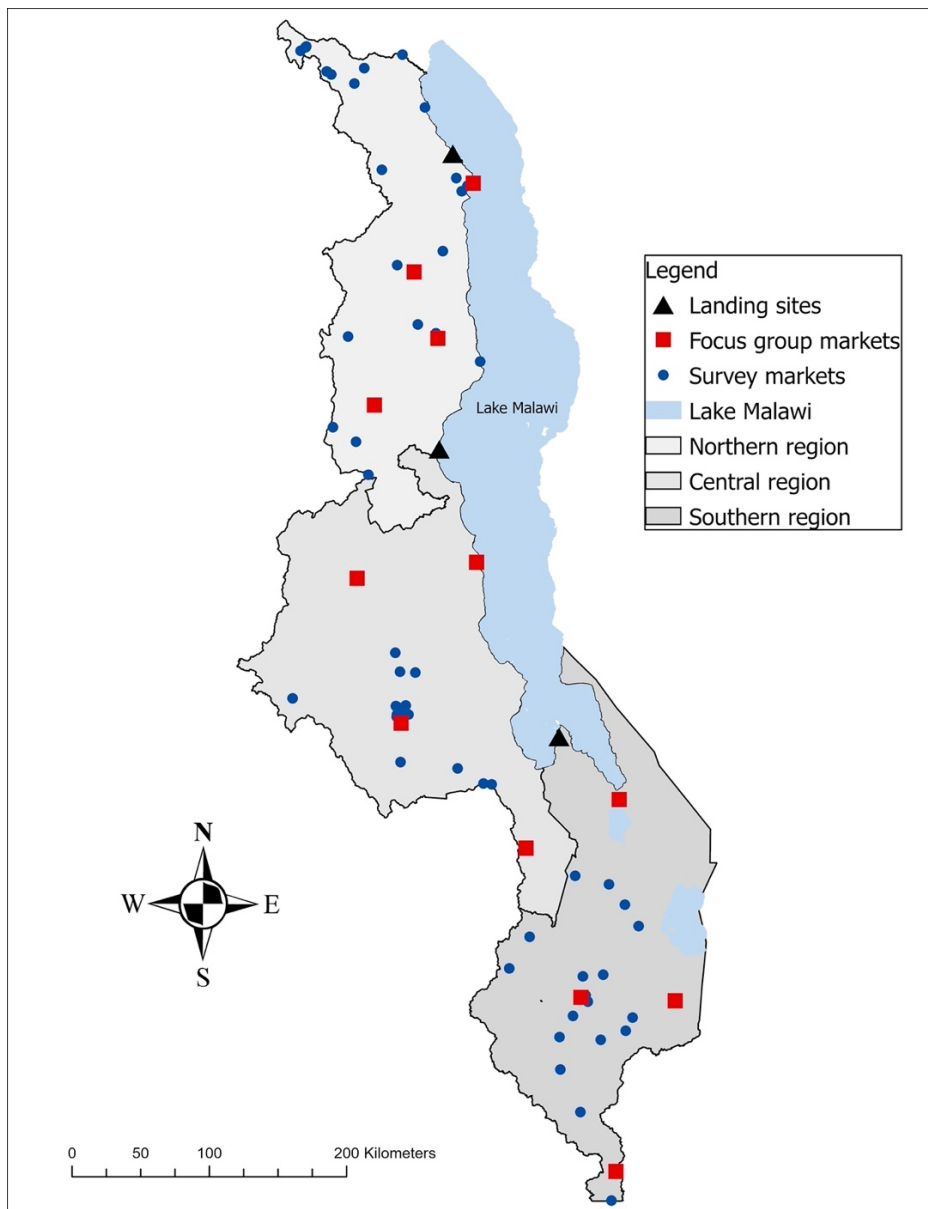
Figure 2. Map of sampling sites.

<u>Focus Groups</u>

Sex and gender are different yet related; sex is based on biological indicators, whereas gender is shaped by social norms, power dynamics, and institutions (Lau et al., 2021). While meaningful, quantitative sex-disaggregated analysis cannot substitute qualitative gender research on context-specific, socio-cultural dimensions that shape people's lived experiences (Lau et al., 2021). Solely using sex-disaggregated data instead of gender research can risk identifying gender inequalities as the result of innate sex differences and may unintentionally reinforce gender stereotypes (Lau et al., 2021).

It is, therefore, fundamental for quantitative sex-disaggregated data to be complemented by qualitative gender data. The Gendered Value Chain Framework is one tool to integrate gender analysis thinking with economic analysis (Kruijssen et al., 2021). The Gendered Value Chain Framework examines value chain composition, performance, governance, constraints, and opportunities (Table 1).

Table 1. Key Components of a Gendered Value Chain Analysis (Based on Kruijssen et al., 2021)

Component	Definition
Gendered Composition	Considers how tasks and roles are divided among different types of people and how that is influenced by social and gender norms
Gendered Performance	Studies how economic benefits are distributed between different groups of people
Gendered Governance	Examines which actors have control and decision-making power
Gendered Constraints/Opportunities	Determines potential interventions to help overcome barriers and take advantage of opportunities

This study utilized the Gendered Value Chain Framework to develop a focus group discussion questionnaire and facilitate a comprehensive gender analysis of the retail node of the usipa value chain in Malawi (Kruijssen et al., 2021). Feminist researchers have argued that focus groups are an appropriate methodology to shift power from the researcher to research participants by allowing focus group participants to take control of the conversation (Pollack, 2003; Hollander, 2004). Further, the focus group format better facilitates conversations on the social cause of individual struggles such as sexism and racism (Pollack, 2003; Hollander, 2004).

Thirty-six focus group discussions were conducted in January of 2022 that involved a total of 212 participants ranging from 18 to 66 years old. Exactly half of the focus group participants were women (n=106), and half were men (n=106) to allow for a comparative analysis that considers the perspectives of both women and men. Each of the 36 focus groups was homogenous by gender, i.e., all women discussions and all men discussions. In designing and implementing focus group research, segmentation based on homogeneous demographic characteristics has been found to make participants more comfortable and willing to answer research questions honesty, particularly regarding sensitive topics such as gender dynamics in the workplace (Peek, 2009).

A team of twelve research assistants were trained and supervised by research partners at Lilongwe University of Agriculture and Natural Resources (LUANAR) in Malawi. Research assistants were trained on research ethics, use of Open Data Kit (ODK) software, and data collection protocols to ensure a consistent approach across all focus groups. Each focus group discussion was facilitated by two research assistants, one leading the discussion and another recording the discussion using ODK, with the consent of all focus group participants. Each discussion was conducted in the local languages and lasted for 1-2 hours.

Focus groups were conducted in a total of twelve markets in eleven districts in all three political regions of Malawi, north, central, and south (Figure 2). At least one women focus group and one men focus group was conducted at each market. Nine of the twelve focus group markets were selected based on descriptive analysis of the previously described market survey dataset. The variable that indicated the number of traders selling fish at each market was used as a rough indicator of the overall size of each market. The market with the minimum, median, and maximum number of traders were selected for each region to account for variation in the types of traders and scale of operation at different size markets in all three regions of Malawi. At least one urban market and one rural market was included in each region. Three additional markets were included, one in each region, after being identified as important by local experts in Malawi. Within the selected twelve markets, a convenience sampling approach was utilized to identify individual traders to participate in the focus groups.

The focus groups were conducted after the onset of the COVID-19 pandemic, while the quantitative data was collected prior to the COVID-19 pandemic. Research has shown that COVID-19 disrupted fish value chains in developing countries, including Malawi (Belton et al., 2021; Nyiawung et al., 2022; Monirul Alam et al., 2022; Chiwaula et al., 2022). However, we argue that the focus groups discussions are still reflective of the quantitative findings in this study because focus group participants did not bring up the COVID-19 pandemic themselves when asked about the key challenges they face as fish traders.

Analysis

The mixed methods gendered analysis was conducted by first using quantitative methods, followed by qualitative methods that help explain the quantitative findings. The quantitative analysis utilized market survey data to examine gendered value chain performance at the retail

node of the usipa value chain by assessing differences in marketing margins between sexes. The qualitative analysis, using focus group data, investigated gendered value chain composition, performance, governance, constraints, and opportunities at the retail node to provide gendered insight into the factors that may be driving differences in marketing margins for usipa retailers in Malawi.

Quantitative Analysis

The statistical software StataIC version 16.1 was used to quantitatively analyze usipa retailers' marketing margins disaggregated by sex. First, net daily income was calculated in Malawian Kwacha (MK), the local currency (Equation 1).

$$NI = Revenue - Cost$$

$$= \left(\left(selling\ price\ \frac{MK}{mulu} * mulu\ sold \right) - fish\ lost\ or\ spoiled\ MK \right.$$

$$\left. - fish\ kept\ for\ own\ consumption\ MK \right)$$

$$- \left(\left(buying\ price\ \frac{MK}{5\ liter\ pail} * 5\ liter\ pails\ bought \right) + transport\ costs\ MK \right.$$

$$\left. + market\ fees\ MK + other\ costs\ MK \right)$$

Where NI denotes net daily income (1)

The typical buying and selling units for fish retailers in Malawi are non-standard, therefore random market surveys recorded the weight of select transactions in the standard unit of grams (n=52). For usipa retailers, the typical buying unit is a five-liter pail, whereas the typical selling unit is a mulu (meaning mound or handful). Conversions between the two nonstandard units utilized the median weight in grams. Conversion factors were calculated for

each of the four processing types (fresh, parboiled, smoked, and sundried) separately, given that the conversion rates range from 18 mulu per five-liter pail for sundried usipa to 26 mulu per five-liter pail for parboiled usipa.

One limitation of the dataset is that surveys were conducted mid-day before retailers had the opportunity to sell their entire lot of fish. Therefore, to avoid artificially deflated calculations for net daily income by using the quantity sold at the time of the survey, the quantity sold at the end of the day was estimated by converting the quantity of usipa purchased from 5-liter pails to mulu. While acknowledging that not all retailers always sell all their fish in one day at market, this approach is based on the fact that the majority of markets in Malawi do not have storage for fish that is not sold by the end of the day. Because of this, we observed in the field that retailers attempt to sell all their fish in one day, even if it means lowering their prices later in the day, to avoid theft overnight. Further, many retailers live far away from the markets where they sell their fish, therefore they prefer to sell in one day so they can travel home and avoid lodging costs. Due to data limitations from the surveys being conducted at only one point in time for each transaction, mid-day prices were applied to the whole lot of fish.

Outlier analysis was applied to net daily income for usipa retailers. Calculated values of individual retailers' net daily income greater than the higher outlier threshold were removed from further analysis, as well as values less than the lower outlier threshold (Equation 2).

$$Lower\ outlier = Q1 - (1.5 * IQR);\ Higher\ outlier = Q3 + (1.5 * IQR)$$

$Where\ Q1\ denotes\ the\ first\ quartile, Q3\ the\ third\ quartile, and\ IQR\ the\ interquartile$

$range$ (2)

To gain a more accurate picture of profits disaggregated by sex, marketing margins per unit (mulu) were calculated to standardize and account for the different volumes handled by different

retailers (Equation 3).

$$MM = NI/V$$

$Where\ MM\ denotes\ marketing\ margin, NI\ net\ income, V\ sales\ volume\ of\ usipa$ (3)

A two-side t-test was implemented on marketing margins between female and male retailers. The null hypothesis is that the mean marketing margin is equal for the two groups, female and male. The distribution of margins was further examined by comparing the interquartile range for female and male retailers.

An ordinary least squares (OLS) regression was implemented on marketing margins to assess the impact of sex on margins while controlling for other relevant explanatory variables (Equation 4).

$$Marketing\ Margin_i = X_i\beta + \epsilon_i$$

$Where\ x_i\ are\ usipa\ trader\ demographic\ characterisitcs\ and\ market\ variables, \beta\ are$
$coefficents\ to\ be\ estimated, and\ \epsilon_i\ is\ the\ error\ term$ (4)

The Chow Test F-statistic was utilized to test whether the OLS regression parameters differ between the two groups, female and male (Chow, 1960). First, the independent variable for sex, a dummy variable where female equals one and male equals zero, was removed from the OLS regression model previously described. Then, a combined model was run in which female and male retailers were treated the same. Next, the model was run only on female retailers. Finally, the model was run only on male retailers. The following formula for the Chow Test was utilized to determine if the regression parameters differ between the two groups, female and male (Equation 5).

$$F = \frac{[SSR_{combined} - (SSR_{female} + SSR_{male})]/k}{(SSR_{female} + SSR_{male})/(n-2k)}$$ (5)

In addition to the statistical analysis that examines differences in marketing margins for female and male retailers (value chain performance), focus groups were conducted to provide qualitative insight into gender dynamics and other social and structural factors that explain differences in marketing margins between retailers (value chain composition, governance, constraints, and opportunities). Qualitative data adds nuance to the quantitative findings and provides a critical narrative to understand how relationality determines the opportunities and constraints of different women and different men by recognizing gender and its effects as socially constructed phenomena (Lawless et al., 2021; Galappaththi et al., 2021).

Focus group data were transcribed and translated into English by research partners at Lilongwe University of Agriculture and Natural Resources (LUANAR) in Malawi. The data were analyzed with Nvivo qualitative software using the constant comparison analysis method in which key themes are identified from coded information. Constant comparison utilizes three stages of analysis: open coding, axial coding, and selective coding (Onwuegbuzie, 2009). During open coding, transcripts and notes from the 36 focus group discussions were sectioned into smaller units and a code was assigned to each unit. In axial coding, the codes were grouped into categories. Finally, selective coding was conducted in which a theme was identified that expressed the content of each group to interpret and summarize overall qualitative findings.

Results

Quantitative Findings

Analysis of survey results reveal that there is nearly equal participation in fish trade between female and male retailers (45% female; 55% male). Yet, summary statistics indicate that, on average, female usipa retailers make lower per unit marketing margins when compared

to male usipa retailers, with average margins of 26.03 and 46.29 MK/mulu, respectively (Table 2). A two-sided t-test revealed that the difference between average marketing margins for female and male retailers is statistically significant (p=0.0011). Further, the majority of female retailers earn less than male retailers with an interquartile range of 1.82-60.66 MK/mulu and 15.34-83.88 MK/mulu, respectively. In addition to female retailers earning less per unit than male retailers, female retailers trade smaller quantities of usipa, on average. Female retailers purchase an average of 9.49 five-liter pails to trade, whereas male retailers purchase an average of 10.42 five-liter pails to trade, however this difference is not statistically significant (p = 0.3695).

Table 2. Marketing Margin Summary Statistics

	Average	Average
	Marketing Margin (MK/Mulu)	**Sales Price (MK/Mulu)**
All Traders	36.79	225.42
Male	46.29	237.91
Female	26.03	211.44
	p = 0.0011	p = 0.0000

Using the independent variables described in Table 3, an ordinary least squares (OLS) regression was conducted on marketing margins (Table 4).

Table 3. Independent Variables Summary Statistics

	Description	Median	Mean	Standard Deviation
Female	Female=1; Male=0	0	0.47	0.49
Primary Livelihood	Primary Livelihood=1; Secondary Livelihood=0	1	0.91	0.28
Education	No Schooling=0; Some Primary=1; Completed Primary=2; Some Secondary=3; Completed Secondary=4	2	2.09	1.04
Number of Traders	Continuous	20	53.23	98.50
Processing Type	Sundried = 1; Not Sundried = 0	1	0.75	0.43
	Parboiled = 1; Not Parboiled = 0	0	0.22	0.42
	Smoked = 1; Not Smoked = 0	0	0.02	0.14
	Fresh = 1; Not Fresh = 0	0	0.003	0.06
Month	October=1; November=2; December=3; January=4	2	1.65	0.59
Easting	Continuous	33.86	34.05	0.65

Table 4. OLS Regression Models on Marketing Margins

Marketing Margin	Pooled		Females		Males	
	Coeff.	P > |t|	Coeff.	P > |t|	Coeff.	P > |t|
n	511		239			272
Female	-19.45	0.001*	N/A	N/A	N/A	N/A
	(5.88)					
Primary livelihood	16.77	0.127	8.38	0.491	50.04	0.038*
	(10.97)		(12.14)		(23.94)	
Education	2.80	0.322	-0.16	0.971	4.55	0.242
	(2.82)		(4.25)		(3.88)	
Number of traders	-0.10	0.003*	-0.09	0.038*	-0.14	0.024*
	(0.03)		(0.04)		(0.06)	
Processing method						
Sundried	325.44	0.000*	357.99	0.000*	309.94	0.000*
	(46.42)		(61.42)		(71.34)	
Parboiled	322.54	0.000*	339.92	0.000*	278.61	0.000*
	(50.38)		(61.90)		(72.01)	
Smoked	350.53	0.000*	288.52	0.000*	291.19	0.000*
	(46.07)		(75.62)		(75.22)	
Fresh (Base)	(Omitted)					
Month	15.79	0.005*	9.18	0.278	17.71	0.021*
	(5.55)		(8.43)		(7.63)	
Easting	-17.11	0.001*	-8.61	0.283	-23.18	0.001*
	(5.23)		(8.01)		(7.05)	
_cons	244.15	0.169	-49.86	0.852	455.43	0.061
	(177.21)		(267.43)		(241.78)	

The coefficients on the pooled regression model indicate the following relationships between trader characteristics and marketing margins. The female dummy variable has a negative statistically significant effect on marketing margins, indicating that being a female in usipa trade has a negative effect on a retailer's marketing margins (p=0.001). The primary livelihood dummy variable denotes whether usipa trade is a retailer's primary livelihood activity and indicates a retailer's resource investment in usipa trade against other livelihood activities. The primary livelihood variable was found to have a positive but insignificant impact on marketing margins in the pooled model (p=0.127). While the education variable has a positive coefficient, it was not statistically significant (p=0.322). This may indicate that the skills and knowledge required for success in small-scale usipa trade are obtained outside of formal education (e.g., social capital).

Pooled model results indicate the following relationships between transaction or market characteristics and marketing margins. The total number of a traders at a retail market has a negative statistically significant effect on marketing margins (p=0.003). This result is in line with economic theory which suggests that increased competition drives prices down, subsequently lowering margins. The model also indicates that the processing method has a statistically significant effect on marketing margins. Using fresh usipa as a base, the dummy variables for sundried, parboiled, and smoked are all positive and statistically significant (p=0.000). Controlling for temporal variation, the month variable was found to be statistically significant (p=0.005). The positive relationship between month and marketing margins indicates that the later a transaction was recorded in our sampling period, the higher the margin. Given that Malawi's rainy season begins around November, this relationship may be attributed to decreasing catch and increasing prices as the rainy season progresses. Controlling for spatial

variation, the easting/longitude variable is negative and statistically significant (p=0.001). This indicates that marketing margins tend to be higher for retailers selling at markets located in western Malawi. Markets in the west are further away from Lake Malawi, which runs along the eastern border of the country, therefore prices may be higher in the west to account for additional transportation costs.

Based on the Chow test, the null hypothesis of equality of regression parameters across the two groups (female and male) is rejected at the 10% significance level. In other words, the same regression model that explains marketing margins for female retailers cannot also be applied to male retailers, and vice versa; the difference in regression parameters between female and male retailers is statistically significant.

In the male only regression model, all independent variables except education are statistically significant, but this does not hold true in the female only model. These differences indicate that gender dynamics may be overshadowing the influence of other relevant independent variables such as resources invested in usipa retail activities (primary livelihood), time (month), and place (easting), which are significant for male retailers but not for female retailers. Similarities between the female and male regression models indicate that processing method is a key variable driving marketing margins for all retailers.

In summary, the quantitative analysis showed that female usipa retailers earn lower marketing margins than their male counterparts and that this difference in marketing margins by sex is statistically significant when analyzed two different ways. First, the difference between average marketing margins for female and male retailers was found to be statistically significant with a t-test. Second, a regression model found that the effect of the female dummy variable was negative and statistically significant on marketing margins. Further, a Chow Test revealed that

the regression parameters for female and male usipa retailers differ, indicating that distinct factors shape margins for female and male retailers. The quantitative results present a convincing story of the unequal distribution of livelihood benefits from usipa trade between female and male retailers.

Qualitative Findings

To build on quantitative analysis of value chain performance for usipa retailers, qualitative analysis of gendered value chain composition, performance, governance, constraints, and opportunities was conducted.

<u>Value Chain Composition</u>

Value chain composition considers how tasks and roles are divided among different types of people and how that is influenced by social and gender norms. When analyzing focus group data regarding gendered composition, two key themes emerged: (1) gendered division of labor, and (2) gender norms.

Both focus groups composed entirely of women and focus groups comprised entirely of men discussed a clear gendered division of labor throughout the usipa value chain. There was large agreement among the focus groups that men primarily participated as fishers, processors are primarily women, and women and men both engage in fish trade – wholesale and retail. While generalized gender roles emerged from the focus group data, there was large variation in participation across space, with different actors dominating different roles across the three geographic regions of Malawi. Women fish retailers are more prominent in the northern region than in the central and southern regions where the largest urban markets are Lilongwe and Blantyre.

Each region in Malawi is culturally unique. Although Chichewa is the national language of Malawi, the Chitumbuka language is largely spoken in the northern region by the Tumbuka tribe and the Chiyao language is largely spoken by the Yao tribe in the south. There are also notable differences between regions regarding marriage. Child marriage is most prevalent in the north with over half of women marrying before the age of 18 (Makwemba et al., 2019). Further, patrilineal systems are more common in the north while matrilineal systems are more common in the south (Makwemba et al., 2019).

The second theme that emerged from both women and men focus group discussions is the role of gender norms in shaping the gendered division of labor in the usipa value chain. For example, men talked about not allowing their wives to participate in fish trade because it reflects poorly on the entire family when people assume women engage in fish-for-sex trade. However, there was also much discussion regarding changing gender norms and increasing acceptance of women's participation in usipa trade. Women did not historically participate as fish traders, but women have become increasingly engaged in fish trade over the past few decades. Today, women and men are almost equally represented in the fish trade profession; quantitative survey data indicates that 45% of fish traders are female and 55% are male.

Man at Kasungu Market: "I guess things have changed, people have positive attitudes towards female traders unlike the old days."

Value Chain Performance

When discussing the role of gender in determining how economic benefits are distributed between women and men, two opposing themes were illuminated: (1) gender is not a factor, and (2) gender influences economic benefits. It is important to note the men primarily responded that gender does not impact economic benefits, whereas women tended to discuss gender as a barrier

and acknowledged differing economic benefits between women and men in fish trade. Women discussed several factors as driving gendered differences in economic returns including differences in access to capital, differences in scale of operation, and differences in time allocation to fish trade. Compared to men, women spend a disproportionate amount of time on household activities, such as childcare, which limits the time they can spend on fish trade.

> *Woman at Limbe Market: "Men do better in business normally. Just because they have more capital than women. Us women also have more responsibilities."*

> *Man at Chikwawa Market: "There is no difference between male and female traders. We all work hard in ordering and selling to customers. It all depends on the amount of capital and one's hardworking at the business."*

Given that the quantitative findings affirm that there are significant differences in economic benefits from usipa trade for women and men, the consensus among men in the focus group discussions that gender does not impact economic performance illuminates a disconnect between perceptions and reality. A similar disconnect was highlighted when men discussed economic benefits as a function of capital yet did not acknowledge that women generally have lower access to capital than men. This disconnect highlights why it is critical to listen to the stories and lived experiences of women who have insight into the factors that they personally understand to impact their own economic outcomes.

Value Chain Governance

Value chain governance examines which actors have control and decision-making power and which actors do not. When assessing gendered value chain governance in the retail node of

the usipa value chain, the following themes were identified from the data: (1) power dynamics, (2) societal expectations and perceptions, and (3) social capital.

In discussions of power and control in usipa trade, it became clear that men felt they had more power over their own business decisions than women. Men claimed to have complete control over decision making regarding how to spend money they earned from fish trade. To support this finding, women felt that they have less control than men when it comes to making decisions regarding how to spend money earned from their own fish trading business. For instance, women typically bring their earnings home to the family and discuss with their husbands how to manage their money, however men do not typically discuss their earnings with their wives. This came up several times as a key point of contention for families engaged in fish trade, with several focus groups citing this power struggle as a source of marital problems for many fish traders. It is also important to highlight differences in power and control among different women. Several women focus groups agreed that single women have more power and control over their own business decisions compared to married women.

Woman at Karonga Market: "Our men want us to show them our money while

they don't show us theirs."

We also find evidence from the focus group discussions that women and men usipa traders feel they bear the weight of different expectations regarding their earnings. Men discussed the cultural expectation that men are the breadwinners in their household. Therefore, men feel they are expected to earn more money than their wives. Women discussed the societal expectation that women should spend their earnings on the needs of their household, particularly food and the educational expenses of their children. Women felt that this expectation

disadvantages their businesses because men do not have to spend their earnings on household needs, rather men are able to further invest their earnings into their businesses.

> *Man at Mzimba Main Market: "Yes because of culture, men are on*
>
> *disadvantage because you are supposed to be a bread winner at home."*

Analysis of the focus group data revealed that fish traders generally feel underappreciated in Malawi. Given that fish trade generates very small income and requires very little capital to participate, i.e., low barriers to entry, fish traders are generally viewed in a negative light as some of the poorest members of society. However, this general societal perception of fish traders manifests differently for women and men. A woman focus group participant effectively summarized societal perceptions of women and men fish traders into one word each; men are "useless", whereas women are "whores". The shameful, derogatory connotation associated with the word "whore" for women, in contrast with the word "useless" for men, reveals how complex gender dynamics are entangled in fish trade.

Finally, the importance of social capital emerged as a key theme for fish traders. Both women and men emphasized the importance of their social networks and relationships in their success as fish traders. Traders often call their friends and kin at various markets each day to gain access to information on the ever-changing market prices. However, it is important to note that women felt they had less social capital compared to men given that they typically spend less time at the markets each day, and thereby have less opportunity to socialize. Due to their obligations in the household, primarily childcare, women discussed the fact that they often arrive at the fish markets later in the morning and leave earlier in the evening compared to men.

<u>Value Chain Constraints</u>

Value chain constraints are analyzed to determine potential interventions to help overcome barriers. The following barriers were identified from the focus group data: (1) lack of formal financial services, (2) poor transportation, (3) price volatility, (4) lack of storage, and (5) gender-based violence.

The most discussed constraint by all fish traders was lack of access to formal financial services, i.e., capital and loans. Both women and men understand that to improve their business, they need to obtain more capital. However, loans to acquire capital are difficult to come by for the rural poor in Malawi. The focus group discussions revealed that small groups of traders, particularly women, often come together to create informal financial groups to overcome this challenge by lending among themselves.

Woman at Mzimba Main Market: "Between ourselves we give each other

business or lend small money to run business…we don't have any opportunity

from NGOs or any financial institutions providing us to loans."

Another key constraint identified by the focus group discussions is poor transportation. Fish traders, both women and men, acknowledged that transporting their fish is very costly and unreliable. In addition, the focus group data revealed that women often cannot travel as far as men to access the most profitable markets. Some women feel they are geographically constrained due to the irregularity of transportation coupled with household responsibilities, particularly childcare, which requires them to remain closer to home.

Man at Jette Market: "We have poor transport that does not enable us to do

the business we want. Transport costs are very high and not easily found."

Another key theme identified from the focus group data is the volatility of fish prices. Both women and men traders discussed the challenges of ever-changing fish prices both at beach landing sites and markets. Without timely and reliable market information available on the going retail price, fish traders assume great risk when purchasing fish as they may be forced to sell at a loss. While volatile fish prices are reflective of the varying supply that is inherent to a capture fishery, many focus group participants expressed a desire for interventions to regulate the market for fish and facilitate greater price stability.

Man at Chikwawa Market: "We need those in authority in the fish department

to set a fix price."

Another recurring theme discussed in the focus groups was the lack of adequate storage facilities. Many traders expressed a need for access to storage, particularly cold storage, to reduce post-harvest fish losses.

Woman at Jette Market: "Sometimes we carry fresh fish going to afar off

places, so we are asking for a place to store our fish."

Finally, a complex issue raised by women focus groups was the prevalence of gender-based violence. Women in our focus group discussions identified fish-for-sex trade as a key barrier to their success in fish trade. They agreed that women and men in fish trade face different obstacles in their business because women are proposed to gain access to fish resources. While fish-for-sex trade involves both women and men, it is telling that only women focus groups identified this as a primary challenge constraining their success in fish trade.

Woman at Jette Market: "The fishermen sometimes bribe us, they want us to

be intimate with them in order for them to sell us anything, if we say no then

they do not sell us."

Furthermore, several women cited gender-based violence as a key factor determining which fish species they sell. When high value species are in low supply, fishermen can use the resource scarcity to leverage power over women buying the fish and require sexual relationships. However, when lower value fish species like usipa are landed in high quantities, the fish can go to the highest bidder without sexual obligations. Therefore, to avoid engaging in fish-for-sex to gain access to high value species, women often settle for lower value species such as usipa.

> *Woman at Karonga Market: "Better ourselves who buys usipa, but our fellows*
>
> *who buys mbuvu, they cry too much, because they sell to only those who*
>
> *exchange sex with them…that's why we go for usipa because once usipa*
>
> *arrives at this lake it's in plenty amount so they sell on auction, the one who*
>
> *has enough money gets fish."*
>
> *Woman at Karonga Market: "The way I am so old now no one can lust after*
>
> *me, so even if I go to buy big fish they will not give to me because they cannot*
>
> *have sex with me."*

Although both women and men participate in fish-for-sex trade, the consequences are not equally felt; women bear the majority of social shame and isolation.

> *Woman at Karonga Market: "Men even if they chase women skirts, people say*
>
> *nothing about them, they say because they are men they can take any women*
>
> *they want. Their stories don't go far. Women are the ones whose rumors*
>
> *spread being harlots."*

Local institutional innovations have begun to address the issue of gender-based violence in Malawi. One focus group discussion provided insight into a community where the local committee has already established rules against fish-for-sex transactions. A fine of MK15000

(approximately USD21) is imposed on individuals that are found to have engaged in fish-for-sex. These local procedures may be used as a model for similar regulations to be implemented elsewhere in Malawi and more broadly in the African Great Lakes region. However, it is important to consider the equity of such regulations regarding how fines are applied across women and men.

Man at Jette Market: "We have rules here that we should not have sexual relationships within us especially if we are married. So that controls us. We have a committee that has rules in place once there's a sexual relation there's a fine to pay MK15000."

Value Chain Opportunities

Value chain opportunities are analyzed to determine potential interventions that can take advantage of current opportunities. The only opportunity, or theme that emerged from the focus group discussions in a positive light, is the enforcement of the closed fishing season to protect spawning fish. However, this opportunity focuses directly on fishing rather than on the post-harvest sector. Closed season regulations in Malawi are based on the type of fishing equipment rather than species. Beach seines, gill nets, and trawlers currently have closed seasons, but chilimira, the primary gear used to catch usipa, does not.

Woman at Chikwawa Market: "We are just grateful for the government's enforcement of the closed season, such programs are very welcome as they ensure sustainability."

Table 5. Summary of Key Findings

Gendered Value Chain Component	Themes Identified
Composition	1) Gendered division of labor 2) Gender norms
Performance	1) Gender is not a factor (according to men focus groups) 2) Gender influences economic benefits (according to women focus groups)
Governance	1) Gendered power dynamics 2) Gendered expectations and perceptions 3) Social capital
Constraints	1) Lack of formal financial services 2) Poor transportation 3) Price volatility 4) Lack of storage 5) Gender-based violence
Opportunities	1) Closed season

Discussion

Drawing on both quantitative evidence and the lived experiences of the traders whose livelihoods depend on usipa trade in Malawi, this study contributes to the literature in multiple ways. First, we contribute extensive sex-disaggregated data to a data-poor sector, small-scale inland fisheries (FAO, Duke University & WorldFish, 2023). Second, we contribute to the literature by exploring gender dynamics in the post-harvest fisheries sector, specifically fish retail activities. Fisheries research has primarily focused on harvest activities and has neglected actors in the broader fish value chain including processors, logistics providers, wholesalers, and retailers (Smith & Basurto, 2019). By evaluating the differences in livelihood outcomes between women and men retailers, we provide comparative insight into gender dynamics in the post-

harvest fisheries sector in Malawi. Further, we provide an empirical application of the gendered

value chain framework (Kruijssen et al., 2021). The framework guided integration of quantitative

and qualitative methods and enabled this study to go one step beyond other studies that have

identified key constraints for actors in the small-scale fisheries sector (e.g., Kimani et al., 2020)

by comparing constraints between women and men.

The five key constraints for usipa retailers in Malawi identified in this study include: (1)

lack of formal financial services, (2) poor transportation, (3) price volatility, (4) lack of storage,

and (5) gender-based violence. The constraints identified in this study come directly from focus

group discussions where fish traders themselves identify their personal barriers to success in

usipa trade. Future research is warranted into each of these five key areas and should aim to

identify potential interventions to facilitate real improvements in fish retailers' livelihoods.

We recommend that future research include fish traders themselves; by listening to the

struggles and experiences of fish traders, we can better understand their needs and thereby

develop more effective and useful development interventions that support existing local

institutional innovations. For instance, the lack of access to formal financial services has led to

self-formed groups, primarily of women, that lend amongst one another to help each other

overcome this constraint. These existing informal financial groups are built on long standing

relationships and trust. Therefore, these groups present an opportunity to serve as entry points for

potential interventions (Oloko et al., 2022).

Additional work should build on this study to further investigate sources of capital for

fish retailers and how they differ between women and men. The quantitative analysis in this

study revealed that the difference in volume of usipa traded between female and male retailers is

not statistically significant, while qualitative findings indicate that women have less access to

capital than men. Current literature also indicates that women have less access to capital than men in the context of small-scale fisheries (e.g., Frocklin et al., 2013; Thorpe, A., 2014; Torell et al., 2021). Therefore, the quantitative finding that there is no significant difference in capital between women and men in this study could be an important finding that changes existing knowledge. This discrepancy between our quantitative findings, qualitative results and the current literature warrants future investigation to better understand the current situation regarding access to capital in Malawi.

Poor access to critical infrastructure, including storage and transportation, have been identified as key constraints for fish retailers in our study, which aligns with current literature (Kimani et al., 2020). Introduction of storage facilities have been identified as a key avenue to increase adaptive capacity in small-scale fisheries (Schuhbauer et al., 2017; Nyiawung et al., 2022). Improved access to roads is recognized as key to increasing market access and improving livelihood outcomes for actors in small-scale fisheries value chains (Béné et al., 2010; Kimani et al., 2020). Further, improved infrastructure, including storage and transportation, have the potential to reduce post-harvest losses (Kimani et al., 2020). A recent study in Malawi found that found the lack of cold chains contributes to physical and quality losses in 69% of fish at the marketing node of the value chain, resulting in both economic and nutritional losses (Torell et al., 2020). We recommend that future research into the impacts of improved infrastructure on livelihood outcomes collect time series data to enable temporal analysis, a key limitation of this study.

Our finding that price volatility is a key constraint for actors in small-scale fisheries value chains is consistent with current literature that recognizes capture fisheries to be more volatile than aquaculture and agriculture generally (Dahl & Oglend, 2014). Small pelagic species, such as

usipa, have been found to be the most volatile of all species groups (Pincinato et al., 2020). While price volatility is widely recognized in the literature, there remains an important but uninvestigated gap on testing the impact of price volatility of livelihood outcomes (Darpeix, 2019).

Gender-based violence has been identified as a primary constraint for post-harvest actors in small-scale fisheries in this study, which is supported by current literature (Béné & Merten, 2008; Fiorella et al., 2015; Medard et al, 2019; Moreau & Faraway, 2021). Our qualitative results indicate that although both women and men participate in fish-for-sex trade, the consequences are not equally felt. Women bear the majority of social shame and isolation, despite the fact that a study on Lake Victoria found that more men than women engage in transactional sex (Fiorella et al., 2015). In the context of gender-based violence, it is important to remember that "in listening to the story of one, we learn about the conditions of many" (Delgado et al., 2012). Recognizing individual challenges as a collective experience can help to expose broader injustices, understand actual reality in communities, and facilitate solidarity building for marginalized women (Delgado et al., 2012).

Our qualitative finding that women often trade low value species to avoid engaging in fish-for-sex, has implications for our quantitative finding that there is a significant difference in marketing margins between women and men, with women earning less. Our quantitative analysis was based on trade data for one low value species, usipa. Therefore, the gap in margins between women and men fish traders across the entire sector may be much greater, given that men tend to sell high value species and women tend to sell low value species. Future research should examine differences in livelihood outcomes between women and men across difference species.

Conclusion

Utilizing a mixed methods approach, we find that: (1) there is a statistically significant difference in marketing margins between female and male usipa retailers, with female retailers earning less (2) there remains dominant discourse among men that gender does not impact economic benefits from usipa trade, whereas women tend to discuss gender as a barrier, and (3) the primary constraints for all retailers in usipa trade, which manifest differently for women and men, are (a) lack of formal financial services, (b) poor transportation, (c) price volatility, (d) lack of storage, and (e) gender-based violence.

This research plays an important role in uplifting women's stories and lived experiences and sheds light on the factors driving differences in livelihood outcomes between women and men usipa retailers in Malawi. These gendered insights can be used as the basis for interventions to improve livelihood outcomes for all fish traders.

This study reveals that despite the increased engagement of women in fish trade, significant gendered constraints endure. Our research emphasizes the broader point that increasing equality in participation between genders does not necessarily translate to equity in livelihood outcomes between genders. This key message and the mixed methods framework used in this study can be applied beyond the case of small-scale fisheries in Malawi and are relevant for gender research more broadly.

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CHAPTER 2. PRICE VOLATILITY, ADAPTIVE CAPACITY, AND LIVELIHOOD OUTCOMES: EVIDENCE FROM SMALL-SCALE FISH RETAILERS IN MALAWI

Abstract

This study investigates the impacts of price volatility on small-scale fish retailers' livelihood outcomes. While other studies have explored the impacts of price volatility on actors at each end of the value chain – producers and consumers – this study examines the impacts of price volatility on actors in the middle of the value chain – retailers. We employ a resilience lens through which spatial arbitrage is understood as an indicator of adaptive capacity to price volatility. These concepts are explored using the empirical case of small-scale usipa (*Engraulicypris sardella*) trade in Malawi. Using a mixed methods approach, this study investigates the relationship between price volatility and livelihood outcomes and the relationship between adaptive capacity and livelihood outcomes. We find that (1) there is a significant negative relationship between price volatility and net daily income, (2) there is a significant positive relationship between spatial arbitrage and net daily income, (3) retailers who engage in spatial arbitrage experience less price volatility than retailers who do not arbitrage, (4) women and men retailers participate in spatial arbitrage at similar levels, but women record lower levels of net daily income, and (5) access to capital drives retailers' ability to engage in spatial arbitrage. These findings provide insight for effective adaptive management to improve livelihood outcomes for fish retailers in Malawi.

Introduction

Small-scale itinerant traders face a multitude of challenges, inherent uncertainty, and risk in their profession. This risk and uncertainty are largely due to poor infrastructure and price volatility, which is exacerbated by a lack of access to market information. Price volatility is an

important factor throughout food value chains influencing costs, trade, income, and food security (Deb et al., 2022). In the midstream of food value chains, price volatility causes uncertainty for processors, traders, and logistics providers, causing inefficiencies in the market (Piot-Lepetit, 2011). At the consumer end of the value chain, food price volatility can result in adverse food security and nutrition outcomes, particularly for the rural poor (Estruch & Grandelis, 2013; Bellemare et al., 2013). On the macroeconomic scale, food price volatility can erode long-run economic growth due to reductions in productive capital and limitations on productivity gains linked to a population's health and education (Strauss & Thomas, 1998; Timmer, 2000; Dawe & Timmer, 2012; Darpeix, 2019). While some critics have argued that the rhetoric surrounding food prices conflates volatility with high price levels (Barrett & Bellemare, 2011), price volatility has nonetheless received significant attention in the literature and earned a prominent place on policy making agendas around the world, given its broad economic, food security, and nutrition consequences (IMF & UNCTAD, 2011; Piot-Lepetit, 2011; Kornher & Kalkuhl, 2013).

For over half a century, scholars have been conducting research related to price volatility. There are two main strands of the price volatility literature that have evolved together, one driven by financial scholars and another driven by agricultural economists. Within these strands, the literature has evolved in waves. In the first wave, academics simply sought to measure price volatility accurately. Thus, scholars investigated how to measure bond price volatility and stock price volatility and explored its causes (e.g., Hopewell & Kaufman, 1973; Yawitz, 1977; Livingston, 1979; Leroy & Porter, 1981; Shiller, 1981; Engle, 1982; Marsh & Merton, 1986; Kleidon, 1986; West, 1988).

Second, scholars began to explore the relationship between market linkages and price volatility and introduced the idea of volatility spillover. For example, agricultural economists

during this wave of the literature considered how price volatility in an input market can spillover to an output market (e.g., Apergs & Rezitis, 2003; Rezitis, 2003; Buguk, 2003). Much of this literature was prompted by the Oil Crisis of the 1970s, which drove agricultural economists to investigate the relationship between oil price volatility and food price volatility with an emphasis on stabilization policies and interventions (e.g., Newbery, 1981; Newbery & Stiglitz, 1982; Deaton & Laroque, 1992). In parallel with the agricultural economists, financial scholars also examined the relationship between market linkages and price volatility, for example between the commodity futures market and the stock market in the United States and examined the international transmission of price volatility in equity markets, driven by the October 1987 international stock market crash (e.g., Roll, 1989; Bessembinder & Seguin, 1992; Darrat & Rahman, 1995; Huchet-Bourdon, 2011).

Third, scholars began to investigate the effects of price volatility rather than just its causes. Spurred by the 2008 financial crisis, agricultural and development economists for the first time began to investigate the effect of food price volatility on the food security outcomes of consumers (Gilbert & Morgan, 2010; Dawe & Timmer, 2012; Minot, 2014; Wossen, 2018; Darpeix, 2019). While some scholars have begun to explore the impacts of price volatility on farmers' welfare (e.g., Bellemare et al., 2013), there remains a critical gap in the literature on the effect of food price volatility on the behavior and livelihood outcomes of downstream actors such as retailers. In fact, the impact of food price volatility on livelihoods in the developing world has been identified as an important but under-investigated topic in the price volatility literature (Darpeix, 2019).

We address this gap by evaluating the relationship between price volatility and net daily income in the empirical case of small-scale usipa (*Engraulicypris sardella*; a small pelagic fish

native to Lake Malawi) retailers in Malawi. Using a mixed methods approach, this study seeks to answer the questions: (1) What is the relationship between price volatility and livelihood outcomes? (2) What is the relationship between adaptive capacity and livelihood outcomes?

The usipa market in Malawi is an ideal case to study price volatility for several reasons. First, despite global progress with the integration of cell phones over the past three decades, access to market information via cell phones has remained a complex challenge in much of sub-Saharan Africa (Munyua et al., 2009; Manyati & Mutsau, 2021). This is an important point because traders' inability to access timely and reliable market information has been found to exacerbate price volatility (Clapp, 2009; Munyua et al., 2009). A lack of market information creates market inefficiencies including excess price dispersion, allocation inefficiencies, and suboptimal arbitrage (Jenson, 2007).

Second, usipa is formally sold almost exclusively on the domestic market within Malawi. This is critical because internationally traded food products tend to have more stable prices (Minot, 2014). Third, usipa is currently only produced by capture fisheries, not aquaculture. Fish prices in capture fisheries are more volatile than in aquaculture (Dahl & Oglend, 2014). Further, prices for small pelagic fish species, such as usipa, are the most volatile of all fish species groups and are becoming more volatile (Dahl & Oglend, 2014; Pincinato et al., 2020). Market information challenges, the lack of a formal international market for usipa, poor infrastructure, and daily fluctuations in supply inherent to a small pelagic capture fishery have all enabled extreme price volatility to persist in the market for usipa in Malawi. Malawians' understanding of fish price volatility is reflected in a common Chichewa phrase "nsomba ilibe mtengo," which translates to "fish don't have a price".

We contribute to the literature in several ways. First, we add to a dearth of information on

the effects of price volatility on downstream actors in food value chains. Our study addresses this gap by evaluating the impact of price volatility on retailer's livelihood outcomes. Second, this study provides insight into price volatility in capture fisheries, which has been far less investigated than agricultural commodities (Dahl & Oglend, 2014; Belton & Thilsted, 2014; Asche et al., 2015; Dahl & Jonsson, 2018). Further, capture fisheries are particularly important as it remains the most affordable source of animal protein and micronutrients to many people in low- and middle- income countries (Bennett et al., 2022; Robinson et al., 2022). Fourth, we integrate concepts from the price volatility literature with the social-ecological systems (SES) literature.

Operationalizing Social-Ecological Resilience

In this study, we operationalize price volatility as a shock to small-scale usipa retailers with implications for resilience. Resilience can be defined as the capacity of a system to experience shocks while maintaining the same function, structure, feedbacks, and identity (Walker et al., 2006). Vulnerability, or susceptibility to harm, accounts for a systems level of exposure and sensitivity to shocks (Smit & Wandel, 2006). The bridge between the concepts of resilience and vulnerability is known as adaptive capacity (Engle, 2011). Adaptive capacity is the ability of a system to prepare for shocks and change in advance or adjust and respond to shocks after the fact (Smit et al., 2001; Engle, 2011). Though only a portion of total resilience, analyzing adaptive capacity is critical to understanding where interventions can be most effectively made to improve the resilience of the system. Finally, adaptation, or a deliberate change in anticipation of or in reaction to external stressors, is the process of utilizing adaptive capacity (Nelson et al. 2007). In our case, resilient traders can adapt in response to price volatility to remain profitable. In contrast, traders who are unable to adapt, i.e., have low adaptive capacity, are vulnerable to

price shocks and are often forced to sell at a loss.

In considering the ability of different groups of small-scale usipa retailers to adapt to price volatility, we use the concept of spatial arbitrage as an indicator of adaptive capacity. Spatial arbitrage[1] is defined as a process in which a product is purchased and resold in different geographic locations to exploit a price discrepancy (Overby & Clarke, 2012). Assessment of spatial arbitrage provides insight into trade flows and contributes to understanding a retailer's response to price volatility. When price volatility causes short-run prices at a given market to plumet or spike, a trader can use spatial arbitrage as a tool to respond to price volatility and travel to another market to buy or sell at better prices. The literature has shown that traders with greater access to capital tend to take advantage of spatial arbitrage more often, travel further distances, and obtain better marketing margins (Minten & Kyle, 1999). In this way, access to capital is the main factor that divides retailers into two categories: arbitrageurs and sellers. Arbitrageurs, who have greater capital, travel from the market where they purchase their product to a distinct selling market to find better prices and take advantage of spatial price variation (Overby & Clarke, 2012). Sellers, who have less access to capital, buy and sell their product in the same market, limiting their ability to respond to price volatility. Due to their ability to access alternative markets and better prices, arbitrageurs are better able to adapt to price volatility. Therefore, we hypothesize that arbitrageurs earn greater net daily income than sellers on average.

Understanding which groups of people are most vulnerable to price volatility is important to inform adaptive management, especially in the context of climate change. In the context of this case study on usipa price volatility, it is expected that price volatility will increase as

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[1] This study focuses only on spatial arbitrage rather than traditional arbitrage over time. Although we acknowledge that temporal arbitrage may be a relevant factor influencing livelihood outcomes, especially due to the well-known challenge of storage in the system, data limitations prevent this study from exploring arbitrage over time.

fisheries resources become more limited and production becomes more variable due to anthropogenic stressors including climate change and overfishing. In the setting of Malawi, it is important note that the effects of climate change on global fisheries are expected to be most severe in the Global South (Cojocaru et al., 2022). It has been projected that the impacts of climate change on fisheries in Africa will greatly increase the vulnerability of people on the continent and will adversely affect income and food security of African households (Lam et al., 2012; Wossen et al., 2018), and usipa is particularly important for food security among low-income and rural populations in Malawi (Bennett et al., 2022). The literature indicates a need for policy and development interventions to increase household resilience to climate variability and related price volatility (Wossen et al., 2018).

Study Area

Malawi is a landlocked country in sub-Saharan Africa bordered by Zambia, Tanzania, and Mozambique, and is home to over 18 million people (World Bank, 2021). Lake Malawi, one of the African Great Lakes, spans over 350 miles from north to south along the country's eastern border and is over 50 miles wide (World Bank, 2021). In total, over one-fifth of the country's surface area is comprised by surface waters (McCracken, 1987). Small-scale fisheries in Lake Malawi, and several other smaller inland lakes, provide livelihoods throughout the value chain to over 200,000 Malawians and contribute USD454 million annually, equivalent to 7.2% of Malawi's GDP (Simmance et al., 2021; Torell et al., 2020).

In addition to livelihood contributions, fish resources meaningfully contribute to food security and nutrition in Malawi. Fish accounts for over 20% of animal protein consumed by Malawi's population (Donda & Njaya, 2007). Small pelagic fish, like the lake sardine usipa, are considered to play a direct role in food and nutrition security given they are accessible and

affordable to the majority of the population in Malawi and are rich in micronutrients, i.e.,

essential lipids, minerals and vitamins (Isaacs, 2016; Nolle et al., 2020; Bennett et al. 2022).

Furthermore, usipa makes up the largest proportion of national catch, accounting for over 70% of

total annual landings (Makwinja et al., 2018). Considering the magnitude of usipa catch and its

notable contributions to food security, nutrition, and livelihoods in Malawi, usipa, specifically

usipa retailers, have been selected for the focus of this study.

Methods

This study employs a mixed methods approach in which qualitative methods are used to

help explain quantitative findings (Steckler et al, 1992).

Data Collection

Surveys

Market survey data used in the analysis for this paper were collected in Malawi over a

four-month period, from October 2019 through January 2020. The surveys focused on the retail

node of the fish value chain and collected data on 604 usipa traders (474 arbitrageurs; 130

sellers) at 72 fish markets. From the 72 markets where traders were surveyed selling usipa

(selling markets), an additional 31 markets were identified as markets where the same surveyed

traders reported to have bought their fish (buying markets), for a total of 103 markets (Figure 3).

The markets that are a part of the survey represent a sample of the formal usipa markets in

Malawi, but likely did not capture the extent of informal markets throughout the country. Within

the formal markets surveyed, the sampling approach for individual traders was a convenience

sample. Convenience samples are often utilized in research contexts where interviews occur in

locations in which informants are moving in and out of public spaces, such as the open-air fish

markets in Malawi, and are often used in the absence of a complete sampling frame (Peek,

2009).

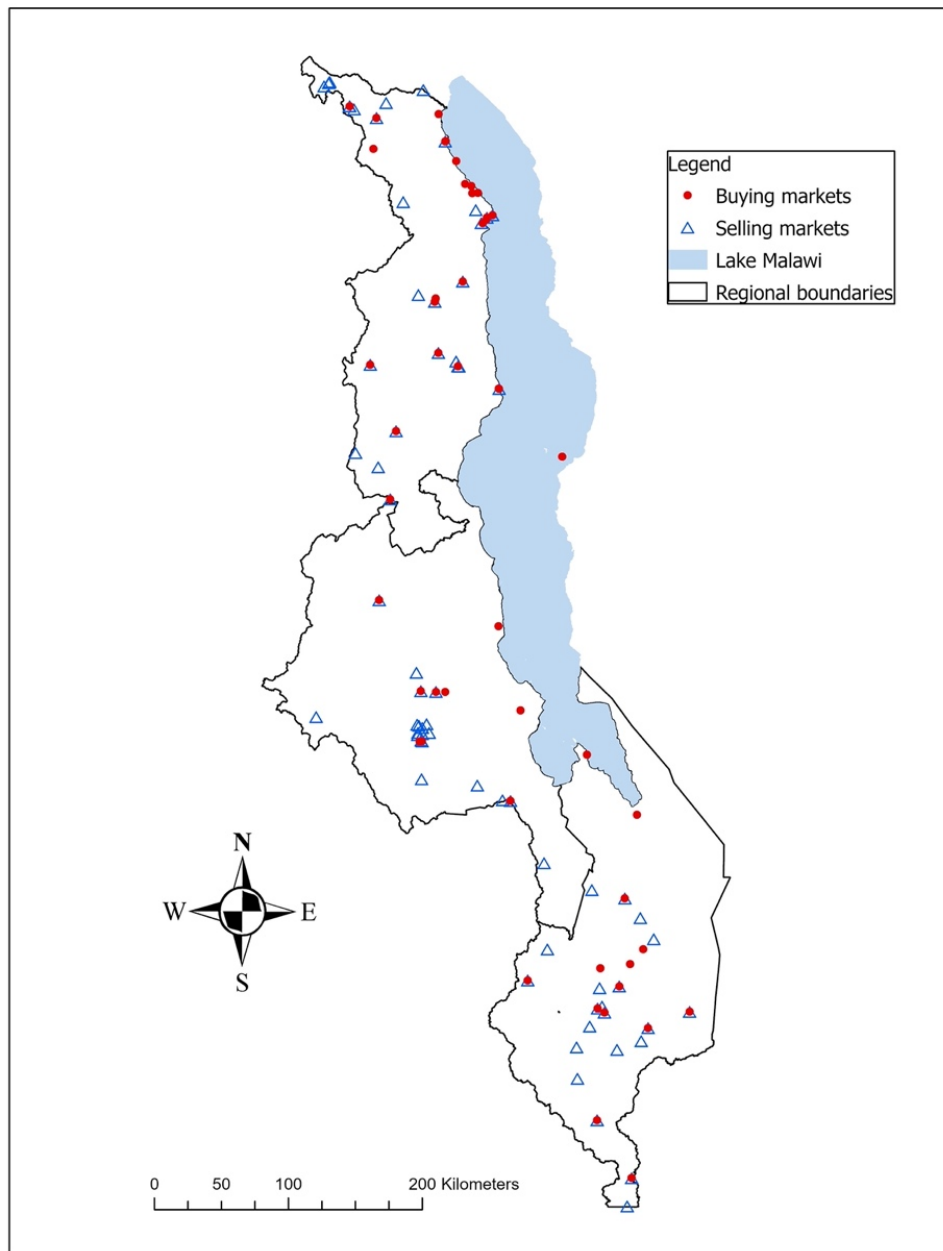*Figure 3. Map of fish markets where surveys were conducted (selling markets) and markets where surveyed traders reported buying their fish (buying markets).*

The surveys were composed of three parts. First, the surveys collected socioeconomic

information about the traders themselves such as gender, age, and meals consumed per day.

Second, they collected information about the market such as urban or rural, and latitude and

longitude. Third, they collected economic information about the traders' transactions such as market fees, transport costs, and buying and selling prices and quantities. The survey data collected transaction information on usipa in four different processing forms: fresh, sundried, parboiled, and smoked.

<u>Focus Group Discussions</u>

Focus group discussions were conducted in January of 2022 by research partners based in Malawi from Lilongwe University of Agriculture and Natural Resources (LUANAR). The focus group discussions sought to provide qualitative insight into usipa trader's decision-making. A total of 36 focus group discussions were conducted that involved a total of 212 participants (106 women and 106 men), ranging from 18 to 66 years old. The composition of each focus group was homogenous by gender, i.e., all women discussions and all men discussions. Each discussion was conducted in the local languages and lasted for one to two hours.

Focus groups were conducted at a total of twelve markets throughout Malawi, four in each region, north, central and south (Figure 4). First, nine focus group markets were selected based on descriptive analysis of the previously described market survey dataset. The variable that indicated the total number of traders at each market was used as a rough indicator of the overall size of each market. The minimum, median, and maximum number of traders (size of market) was selected for each region to account for variation in the types of traders at different markets in all three regions of Malawi; at least one urban market and one rural market was included in each region. After the initial systematic selection of the nine focus group markets, three additional markets were chosen after being deemed critical regional markets by local experts in Malawi. Within the twelve focus group markets, a convenience sample was utilized to recruit individual traders to participate in the discussions.
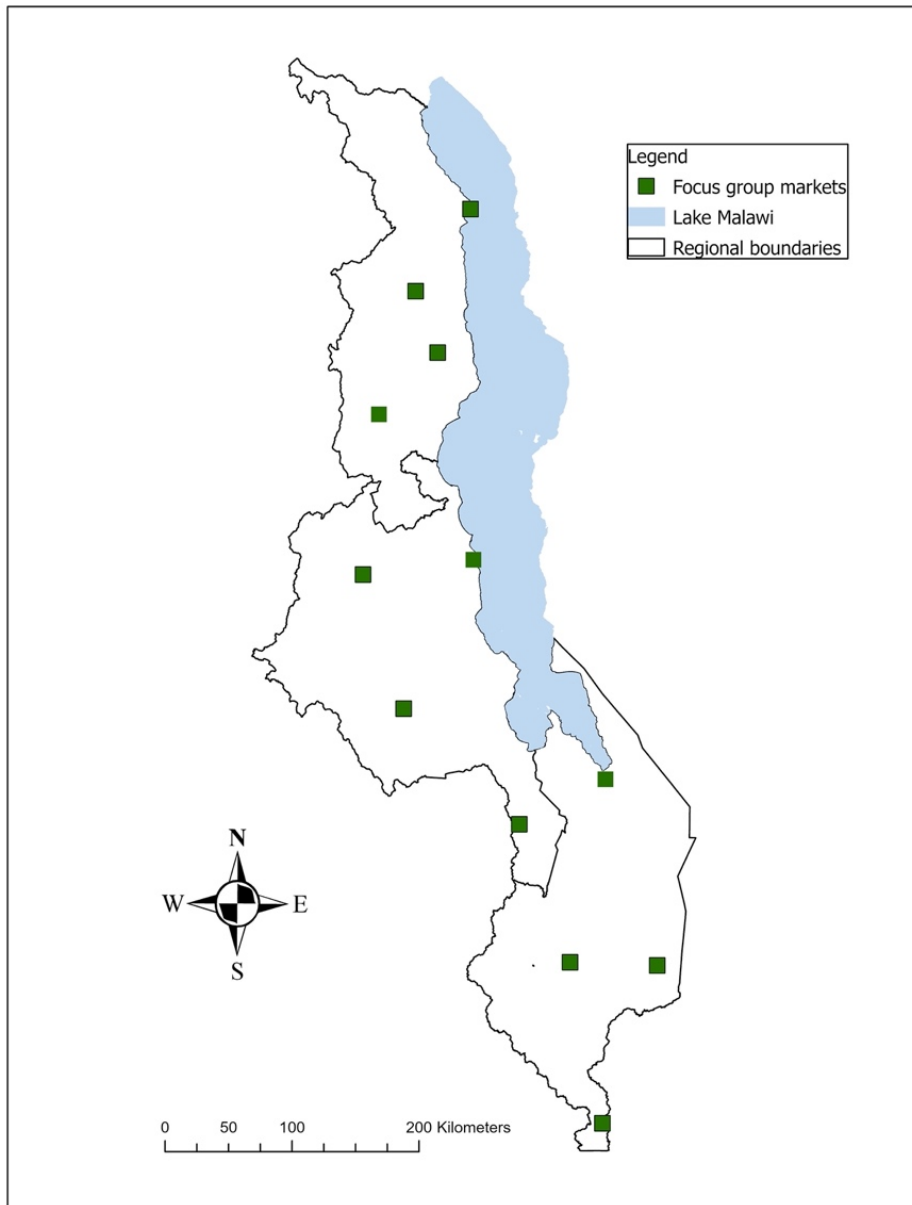
Figure 4. Map of fish markets where focus group discussions were held.

Analysis

<u>Quantitative Analysis</u>

Market survey data were analyzed using StataIC version 16.1 to address both research questions: (1) What is the relationship between price volatility and livelihood outcomes? And (2) What is the relationship between adaptive capacity and livelihood outcomes?

The coefficient of variation in selling price was calculated to understand usipa price volatility at retail markets and the coefficient of variation in buying price was calculated to understand usipa price volatility at beach landing sites or wholesale markets for fish retailers in Malawi. The coefficient of variation (CV) shows the extent of variability relative to the mean of the population (Equation 6). The smaller the CV, the less dispersed the data; the larger the CV, the more dispersed the data.

$$Coefficient\ of\ Variation\ (CV) = \frac{\sigma}{\mu}$$

Where σ is the standard deviation, and μ is the mean (6)

The coefficient of variation is a useful measure of volatility because it adjusts for the fact that, holding everything else constant, standard deviation (or variance) will increase as the mean increases. This is important in our context because mean increases would be expected to increase net income. For example, if a retailer's buying and selling price both doubled, then revenue less the cost of purchasing fish (holding all other trading related costs fixed) would double. The coefficient of variation has been used in the literature to measure food price volatility (Bellemare, 2014).

To investigate different groups of usipa retailers' exposure to price volatility based on their varying adaptive capacity, we calculated the coefficient of variation in both buying and selling price for arbitrageurs (those who buy and sell in different markets) and sellers (those who buy and sell in the same market) separately to allow for comparison between the two groups.

Given that greater CV indicates greater dispersion in usipa prices, we hypothesized that the group of traders with greater CV is more vulnerable to price volatility, and thereby earns lower net daily income (NI) on average. To test this hypothesis, we calculated NI for retailers in our market survey data in the local currency, Malawian Kwacha (MK) (Equation 7).

$$NI = Revenue - Cost$$

$$= \left(\left(selling\ price\ \frac{MK}{mulu} * mulu\ bought\right) - fish\ lost\ or\ spoiled\ MK\right.$$

$$\left. - fish\ kept\ for\ own\ consumption\ MK\right)$$

$$- \left(\left(buying\ price\ \frac{MK}{5\ liter\ pail} * 5\ liter\ pails\ bought\right) + transport\ costs\ MK\right.$$

$$\left. + market\ fees\ MK + other\ costs\ MK\right)$$

Where NI is net daily income (7)

The typical buying and selling units for fish retailers in Malawi are non-standard, therefore random market surveys recorded the weight of select transactions in the standard unit of grams (n=52). For usipa traders, the typical buying unit is a five-liter pail, whereas the typical selling unit is a mulu (meaning mound or handful). Conversions between the two nonstandard units utilized the median weight in grams. Conversion factors were calculated for each of the four processing types (fresh, parboiled, smoked, and sundried) separately, given that the conversion rates range from 18 mulu per five-liter pail for sundried usipa to 26 mulu per five-liter pail for parboiled usipa.

The quantity of usipa in mulu that a retailer purchased, excluding any fish lost, spoiled or kept for own consumption, was used as the quantity sold in Equation 7. We used this approach because the market surveys recorded the quantity of fish that traders bought but did not record quantity of fish sold at the end of the day because surveys were conducted throughout the day before traders had the opportunity to sell their entire lot of fish. While recognizing that every trader does not always sell the entirety of their fish in one day at market, which may result in

overestimations of revenue, this approach was utilized because most markets in Malawi do not have storage for fish that is not sold by the end of the day. We observed in the field that traders tend to sell all their fish in one day, even if it means lowering their prices later in the day, to avoid having their fish stolen overnight. Further, many usipa traders do not live close to the markets where they sell their fish, therefore they prefer to sell in one day so they can travel home and avoid additional lodging costs.

A non-parametric Mann-Whitney U-test was run on net daily income between relevant groups of traders, i.e., arbitrageurs and sellers, male and female. The null hypothesis for the Mann-Whitney U-test is that the two populations are equal.

To determine the significance of the effect of price volatility and adaptive capacity on livelihood outcomes while controlling for other relevant independent variables, we ran an ordinary least squares (OLS) regression followed by a two stage least squares (2SLS) regression on net daily income. To avoid issues of endogeneity with selling price being in both sides of the equation – on the left-hand side of the equation as a part of the net daily income calculation and on the right-hand side as a part of the coefficient of variation in selling price calculation, i.e., the price volatility independent variable – we created an instrumental variable (IV). The IV for coefficient of variation in selling price is an integer rank variable which ranks the coefficient of variation in selling price by district from lowest to highest, then assigns an integer rank to each individual trader in the sample based on their retail district. To account for heteroscedasticity, we employed robust standard errors in the regression models.

Qualitative Analysis

Focus group data were analyzed with Nvivo12 qualitative software to provide further insight into research question (2) What is the relationship between adaptive capacity and

livelihood outcomes? Understanding spatial arbitrage as an indicator of adaptive capacity, focus group discussions sought to understand differences in decision-making between arbitrageurs and sellers to discern underlying factors that influence livelihood outcomes. To gain insight into usipa trader's decision-making the following questions were asked: Do you sell fish at the same market where you buy fish? Explain your answer. How do you choose where (which market) to sell the fish?

The focus group data were analyzed using the constant comparison analysis method in which key themes (e.g., supply and demand, costs, access to capital, spatial constraints, social capital) were identified from coded information. Constant comparison consists of three stages of analysis: open coding, axial coding, and selective coding (Onwuegbuzie, 2009). During open coding, transcripts and notes from the focus group discussions were sectioned into smaller units and a code was assigned to each unit. In axial coding, the codes were grouped into categories. During selective coding, a theme was identified to express the content of each group to interpret and summarize the overall qualitative findings.

Results

Quantitative Findings

Analysis of the coefficient of variation in selling price for arbitrageurs and sellers reveals that sellers in retail markets experience greater price volatility in both sales and purchase prices than do arbitrageurs (Table 6). The high coefficient of variation in buying prices may also indicate that arbitrageurs and sellers have different levels of bargaining power. Arbitrageurs were found, on average, to purchase a five-liter pail of usipa for MK3165, compared against an average of MK3931 for sellers. These findings support our hypothesis that sellers are exposed to more price volatility than arbitrageurs because they are less able to adapt to price volatility.

Arbitrageurs can reduce their exposure to price volatility by traveling to other markets to obtain better prices, whereas sellers do not have the ability to adapt to volatile prices at market.

Table 6. Coefficient of Variation for Sellers and Arbitrageurs

	Arbitrageurs	**Sellers**	**Total**
Coefficient of variation$_{selling\ price}$	0.321	0.664	0.390
Coefficient of variation$_{buying\ price}$	0.541	1.186	0.860

A Mann-Whitney U-test [2] on net daily income reveals that arbitrageurs earn significantly greater net daily income on average than sellers (p = 0.0314), with mean net daily incomes of MK17,305 and MK10,446, respectively. However, the median net daily income is greater for sellers than for arbitrageurs. This highlights the fact that there are several high values that are pulling up the mean net daily income for arbitrageurs. After investigating these high values, we determined that there are too many of them (14% of the arbitrageur data) to be true outliers. Rather, they appear to be an important part of the spatial arbitrage story. The high values are driven, in part, by the fact that arbitrageurs, on average, operate in larger volumes than sellers with mean quantities of 16.03 and 10.59 five-liter pails of usipa for arbitragers and sellers, respectively. This result aligns with literature indicating that arbitrageurs tend to be more capitalized than sellers (Minten & Kyle, 1999). Greater access to capital enables arbitrageurs to trade larger quantities than sellers, which contributes to economies of scale benefits and greater overall net daily income. When controlling for volume, a Mann-Whitney U-test on per unit marketing margins still indicates that the difference in mean margins between arbitrageurs and

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[2] A nonparametric Mann Whitney U-test is used in place of a t-test because it is not based on the assumption that the sample came from a t-distributed population. Given the convenience sampling approach utilized in the collection of the survey data, the Mann Whitney U-test is more appropriate in this case study.

sellers is statically significant (p = 0.0005).

When considering access to capital in the Malawian context, it is important to note that women tend to have less access to capital than men broadly and in the context of small-scale fisheries (Torell et al., 2021). Price volatility has been found to disproportionately affect women because coping strategies that consist of changes in time allocation are most felt by women who are more time constrained due to reproductive activities and domestic work (Estruch & Grandelis, 2013). Because of this, we hypothesized that more men would act as arbitrageurs and more women would act as sellers. Interestingly, however, this is not what we found. Descriptive statistics of our sample reveal that although there are more male arbitrageurs than female arbitrageurs (n=258 male, n=216 female), this discrepancy is because there are more male retailers than female retailers in the profession overall. Proportionally, a similar percent of female retailers are arbitrageurs (79.7%) compared to male retailers (77.5%) (Table 7). Despite nearly equal proportions of female and male retailers participating as arbitrageurs, we find that female retailers compared to male retailers overall earn significantly lower net daily income from a Mann-Whitney U-test (p = 0.005). Within the category of arbitrageurs, we also find that female arbitrageurs earn significantly lower net daily income than male arbitrageurs (p = 0.0013). This reveals that although women are arbitraging as much as men, women are not benefitting from arbitrage as much as men. This is an important finding because it reveals that differences in participation in spatial arbitrage between female and male retailers is not what explains the difference in net daily income between female and male traders overall.

This finding illuminates the role of more complex gender dynamics that influence the success of women and men retailers whether they engage in spatial arbitrage, such as differing childcare responsibilities. Investigation into the characteristics of female fish traders who act as

arbitrageurs compared to female traders who act as sellers reveals that arbitrageurs are often younger or older than sellers. For instance, the minimum age of a female arbitrageur in our survey data is 18, whereas the minimum age for a female seller is 19 years old. The maximum age of a female arbitrageur is 65, compared against 55 for female sellers in our dataset. We hypothesize that this dispersion of female traders by age can be explained by the fact that female traders with children are more likely to act as sellers to remain close to home, whereas young female traders without children and older female traders with grown children have more flexibility and are able to engage in arbitrage and travel farther from home to sell their fish.

Table 7. Participation in Spatial Arbitrage by Sex

		n	**%**
	Total	**271**	**44.9%**
Female	*Arbitrageur*	216	79.7%
	Seller	55	20.3%
	Total	**333**	**55.1%**
Male	*Arbitrageur*	258	77.5%
	Seller	75	22.3%
Total		**604**	**100%**

We ran an OLS regression to explore variables associated with net daily income (Table 8). We found that CV is negatively associated with net income but is not significant at the 5% level (p = 0.113).

As noted above, a concern about regressing net income on CV is that CV is an endogenous righthand side variable. To address this issue, we conducted a two stage least squares regression (2SLS) on net daily income (Table 8) using an integer rank instrumental

variable (IV) for the coefficient of variation in selling price. A weak identification test was conducted to determine the strength of the instrumental variable where the null hypothesis is that the IV is a weak instrument. The calculated Cragg-Donald Wald F-Statistic (F= 7836) was greater than the Stock-Yogo critical value (10% critical value= 16.38). Therefore, we were able to reject the null hypothesis that the IV is a weak instrument and satisfy the relevance condition of the instrument. The exclusion restriction condition is met in that the effect of the IV on net daily income is not direct as an integer rank variable but only works through the endogenous CV.

Using the strong IV, the 2SLS model is the superior specification as it addresses the endogeneity issue of the CV. The overall results are quite robust with both the OLS and 2SLS models giving very similar results as the sign on the coefficients (positive or negative) did not change for any variables between models and the level of significance only changed for the instrumented IV and northing.

The 2SLS regression reveals that price volatility has a significant negative effect on net daily income with a negative coefficient on the instrumental variable for price volatility (p = 0.044). The negative relationship causally indicates that price volatility reduces retailers' net daily income. This supports our descriptive findings that sellers experience greater price volatility than arbitrageurs with a larger coefficient of variation, while sellers earn significantly less net daily income than arbitrageurs. Further supporting this result, the 2SLS regression found spatial arbitrage to have a significant positive impact on net daily income with a positive coefficient on the arbitrageur dummy variable (p = 0.002).

Table 8. Regressions on Net Daily Income

Net Daily Income	OLS Results		IV – 2SLS Results	
	Coefficient (Robust Standard Error)	P > |t|	Coefficient (Robust Standard Error)	P > |t|
CV	-26714.72	0.113	-32099.79	0.044*
	(16808.13)		(15888.85)	
Arbitrageur	7508.754	0.002**	7594.817	0.002**
(1=Arbitrageur, 0=Seller)	(2455.672)		(2465.189)	
Female	-4670.861	0.175	-4603.987	0.181
(1=Female, 0=Male)	(3440.495)		(3440.331)	
Experienced	8289.306	0.005**	8418.493	0.004**
(1=More experienced than or equal to the median, 0=Less experienced than the median)	(2909.872)		(2933.65)	
Primary livelihood	10631.9	0.006**	10552.61	0.006**
(1=Fish trade is primary livelihood, 0=Fish trade is secondary livelihood)	(3855.747)		(3827.891)	
Highest education level	4306.731	0.009**	4381.869	0.008**
(0=No schooling, 1=Some primary, 2=Completed primary, 3=Some secondary, 4=Completed secondary)	(1651.833)		(1639.513)	
Urban	-206.5595	0.944	-23.5319	0.994
(1=Urban; 0=Rural)	(2918.428)		(2916.717)	
Processing method Sundried	85321.22	0.000***	84862.71	0.000***
(1=Sundried; 0=Not Sundried)	(13275.85)		(13201.21)	
Parboiled	75079.29	0.000***	74660.51	0.000***
(1=Parboiled; 0=Not Parboiled)	(13606.8)		(13560.05)	
Smoked	72271.44	0.000***	71853	0.000***
(1=Smoked; 0=Not Smoked)	(13827.93)		(13796.42)	
Fresh	(omitted)			
(1=Fresh; 0=Not Fresh)				

Table 8 (cont'd)

Easting	-17297.34	0.000***	-17722.64	0.000***
	(4480.358)		(4453.631)	
Northing	-2828.285	0.062	-2970.272	0.048*
	(1510.817)		(1496.997)	
_cons	466031.1	0.001**	479918	0.001**
	(139476.1)		(138589)	

p < 0.05*; p < 0.01**; p < 0.001***

In addition to the significant impacts of the primary independent variables of interest for this study – price volatility and spatial arbitrage – the 2SLS regression model revealed several other relevant relationships between trader demographics and net daily income. The dummy variable for experienced, which indicates whether a trader has at least the median number of years of experience in the usipa business, has a significant positive effect on net daily income (p = 0.004). This indicates that the longer a trader has worked in the usipa business, the better their returns tend to be. The dummy variable for primary livelihood, which indicates whether usipa trade is a retailer's top income source, has a significant positive impact on net daily income (p = 0.006). This reveals that the relative importance of usipa trade to each retailer, an indicator of resources invested, significantly influences their earnings from their business. The model reveals that a trader's highest level of educational attainment has a significant positive impact on net daily income (p = 0.008). This finding indicates that education has a positive return on earnings. The female dummy variable was found not to have a significant impact on a trader's net daily income, although it displayed a negative relationship (p = 0.181). The female dummy variable is likely insignificant because its effects are already present in other right hand side variables. Mann-Whitney U-tests indicate that male retailers have more years of experience than female

retailers (p = 0.0518); male retailers are more dependent on fish trade as their primary livelihood activity compared against female retailers (p = 0.0000); male retailers are more educated than female retailers (p = 0.0577); male retailers sell at urban markets more than female retailers (p = 0.0326); and female retailers sell at markets located in the north more than male traders (p = 0.0000).

The 2SLS model also revealed relationships between the characteristics of a transaction or marketplace and net daily income. Using fresh usipa as a base, the processing method dummy variables for sundried, parboiled, and smoked revealed that the processing form that usipa is sold in has a significant impact on net daily income (p = 0.000). Usipa being sold at an urban market, rather than a rural market, was found not to have a significant impact on net daily income. Finally, controlling for spatial variation, the easting and northing variables, which represent longitude and latitude respectively, have a significant influence on net daily income (p = 0.000; p = 0.048). In the geographic context of Malawi, the further west a market is located, the further away it is from Lake Malawi which runs along the eastern boarder of the country. The necessary transportation of the fish from the lake to markets located in the western part of the country, drives prices up at these more distant markets, explaining the negative coefficient on easting. Similarly, market prices in the northern region in Malawi tend to be lower than in the central and southern regions, which are farther from Lake Malawi.

This analysis reveals that price volatility has a significant negative impact on daily income and that the ability to adapt to price volatility through spatial arbitrage has a significant positive impact on net daily income for usipa retailers in Malawi. We find that sellers have a greater coefficient of variation in selling price and that sellers earn less net daily income on average than arbitrageurs; sellers are more vulnerable to price volatility than arbitrageurs. To

generalize these findings using spatial arbitrage as an indicator of adaptive capacity, we determined that (1) there is a significant negative relationship between price volatility and livelihood outcomes, (2) there is a significant positive relationship between adaptive capacity and livelihood outcomes, and (3) groups of traders with less adaptive capacity are more vulnerable to price volatility (Figure 5).
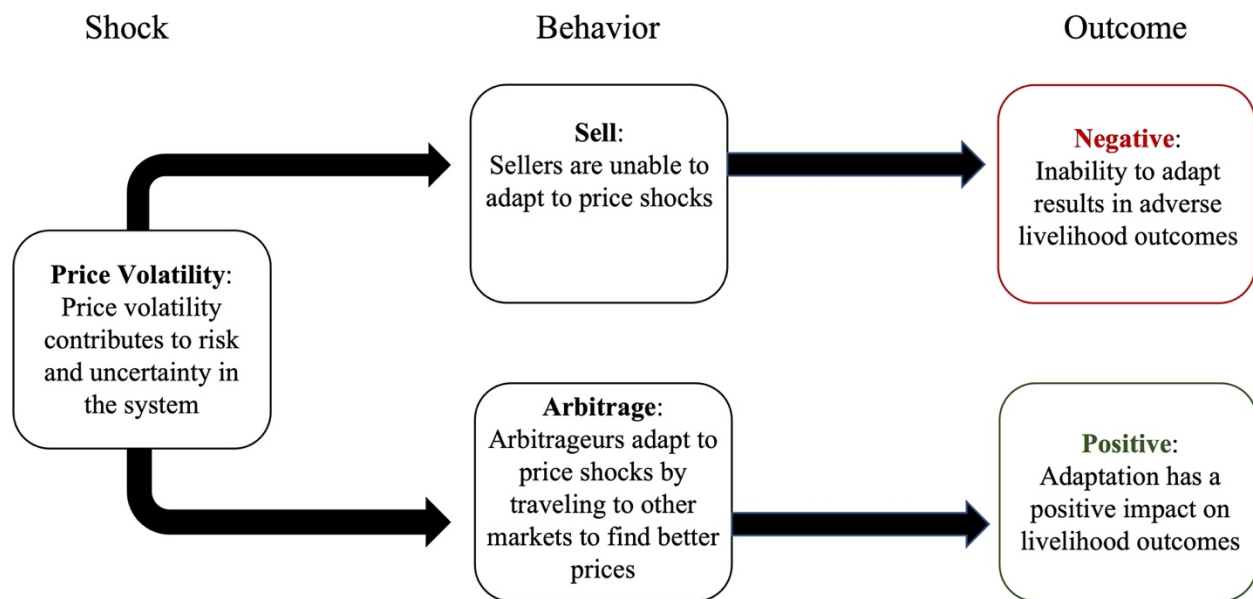
Shock	Behavior	Outcome

Price Volatility: Price volatility contributes to risk and uncertainty in the system

Sell: Sellers are unable to adapt to price shocks

Negative: Inability to adapt results in adverse livelihood outcomes

Arbitrage: Arbitrageurs adapt to price shocks by traveling to other markets to find better prices

Positive: Adaptation has a positive impact on livelihood outcomes

Figure 5. Diagram of usipa retailer's responses to price volatility.

Qualitative Findings

In analyzing the focus group discussions, it was clear that usipa traders understood price volatility to be a major challenge to the success of their business. For instance, a woman at Kasungu Market said that the biggest problem hindering her progress in usipa trade is "unstable prices that change all the time." Another focus group participant echoed this saying that their biggest challenges are "the lack of capital and price fluctuations." Similarly, other traders stated that their biggest issue is "not having a real price for the fish" and "that prices change every day."

Utilizing the same two groups as the quantitative analysis, we characterized each focus

group participant as either a seller or an arbitrageur by analyzing their response to the question, "Do you sell fish at the same market where you buy fish? Explain your answer." This approach allowed for a complementary qualitative analysis in which mixed methods results build upon and strengthen one another. After coding and categorizing the translated and transcribed focus group data using the constant comparison analysis method, several key themes were identified.

When arbitrageurs were asked to explain why they do not buy and sell fish at the same market, two themes emerged from their responses: (1) lack of consumer demand where they buy fish, and (2) lack of supply where they sell their fish. Arbitrageurs overall discussed a spatial mismatch of supply and demand in the market for usipa in Malawi. Arbitrageurs explained that when there are no wholesalers physically present at their selling market, they must go where fish is available, closer to Lake Malawi, to purchase usipa. However, they then lament that markets near the beach do not have the same level of demand. Therefore, they choose to travel further from the lake where they feel pries are better and they have a greater opportunity to profit. This qualitative finding supports the quantitative finding in the regression models that retailers' net daily income increases as they move further west and sell at markets further away from Lake Malawi.

When sellers conversed regarding their reasoning for buying and selling fish at the same market, three themes materialized: (1) presence of wholesalers, (2) reduced costs, and (3) lack of capital. First, sellers discussed the fact that the presence of wholesalers at certain selling markets enables them to buy and sell at the same market without having to travel. The markets where wholesalers are present tend to be the largest urban markets in each region (e.g., Mzuzu in the North, Lilongwe in the Central Region, and Blantyre in the South). Another key reason that sellers choose to buy and sell usipa within the same market is because it reduces costs,

specifically transport costs. Third, sellers acknowledged that their own lack of capital is a factor hindering their ability to sell at other markets. Due to a lack of capital, sellers when compared to arbitrageurs, operate in smaller quantities, which contributes to differences in net daily income. This qualitative theme supports the quantitative finding that arbitrageurs on average purchase larger quantities of usipa to trade than sellers. A usipa retailer explained in a focus group discussion that, "if you have fish in good quantity, you explore other markets for better prices but if you have a small quantity, you can't risk it because the money might just go to transport."

Although women tend to have less access to capital, our quantitative findings revealed that similar proportions of women and men fish retailers engage in spatial arbitrage. Nonetheless, we found statistically significant differences in net daily income between women and men retailers overall and women and men arbitrageurs specifically, with women earning lower net daily income than men on average. This highlights the fact that women and men do not benefit from spatial arbitrage equally, for a varied set of reasons. For instance, several focus groups discussed the gender dimensions of spatial arbitrage and mentioned that men often travel further distances than women, therefore men have access to more markets and potentially better prices. One woman explained that distance is a hindering factor for women because "men easily ride a bicycle to order elsewhere unlike us [women], we return home and have no other options because the distance." In addition, women bear a disproportionate burden of domestic responsibilities, such as childcare, which may limit their ability to arbitrage. Domestic responsibilities may limit women's years of experience as arbitrageurs as our quantitative dataset revealed that middle aged women are typically sellers, whereas young women without children and old women with grown children are more able to arbitrage. Further, domestic responsibilities may limit the physical distance that women are able to arbitrage. One woman explained in regard

to markets where women sell their fish that the "nearer to our homes the better so that we are able to look after our families." The compounding gendered dynamics of access to capital and differing abilities to travel to far markets contribute to differences in overall net daily income for women and men fish retailers.

Further discussion was prompted in the focus groups by the question, "How do you choose where (which market) to sell the fish?". Responses from arbitrageurs resulted in the following key themes: (1) prices, and (2) number of customers. Overall, arbitrageurs talked about choosing to sell at markets with the highest prices and the greatest number of customers possible. It was generally understood by the traders that these two things tend to go hand in hand as increased demand drives up equilibrium price. One trader explained that their decision-making "depends on demand mostly, we follow where the fish is being sold expensively." Similarly, an arbitrageur at Nchisi Market said, "we change locations if the preferred destination is offering better retail prices."

While sellers also consider prices and the number of customers when choosing their market, a few distinct themes appeared, including: (1) location, and (2) market membership. One consideration expressed by sellers regarding which market to buy and sell usipa at was the location of the market. At the decision-making level for retailers, spatial dimensions were considered in the context of a market's proximity to a trader's residential place. The farther away a market is from a trader's home, the less desirable it is for them to sell at that market, illustrating the presence of distance decay. Sellers also noted that if they hold a membership for a specific market space, then they consistently sell at that same market regardless of prices at other markets.

Finally, there is generally a lack of access to market information for all usipa traders,

therefore both arbitrageurs and sellers noted that their social relations influence which markets they sell at. For instance, traders tend to choose to sell at markets where their friends and or kin are also selling because they have access to reliable market information, i.e., retail prices, at these select places through their social networks.

Discussion

This study makes contributes to the climate resilience literature focused on small-scale fisheries. Most of this literature to date has focused on fishing (production), fisheries management, and the livelihoods of fisherfolk. Little attention has been paid to the post-harvest sector and the livelihoods of fish processors, wholesalers, and retailers (Allison et al., 2009; Hanich et al., 218; Macusi et al., 2020; Gianelli et al., 2021; Macusi et al., 2021). By concentrating on fish retailers in the downstream of the value chain, we provide new insight into the resilience of small-scale fisheries actors in the broader fish food system.

This study brings together concepts from the economic literature and social-ecological resilience literature. While much of the social-ecological systems literature integrates economic concepts with resilience theory and acknowledges that conditions of poverty undermine the resilience of social-ecological systems such as fisheries (e.g., Allison et al., 2009; Hodbod & Eakin, 2015; Brown, 2015), the economic concept of spatial arbitrage has yet to be operationalized in the resilience literature.

Policies, programs, and or interventions to address price volatility have been suggested by usipa retailers themselves in focus group discussions. Focus group participants indicated a desire for price stabilization interventions, particularly a government mandated price floor for fish. One focus group participant stated that they would like "those in authority in the fish department to set a fixed price because fish has no fixed price." Similarly, another focus group

participant said they would like "a policy that can direct everyone to have the same price of fish all over so that we can all benefit the same as traders." Above-market price floors are common food price stabilization policies in Eastern Africa for staple crops such as maize, however they are not common for perishable food products like fish (Jayne, 2012). It is important to note that there is evidence that price stabilizations policies may unintentionally exacerbate price volatility (Jayne, 2012; Minot, 2014). Research has shown that maize price volatility is higher in sub-Sahara African countries where the most price stabilization interventions have been implemented (Minot, 2014). It is possible that government interventions create further uncertainty in a system and disincentivize temporal arbitrage, reducing the price smoothing effects associated with temporal arbitrage (Minot, 2014). Further, price stabilization policies call for increased market integration. In a study of an inland fish market in Namibia, increased market integration of fish prices was found to increase the prices that fish traders received over time (Bronnmann et al. 2020). While increased fish prices improve the livelihoods of fish traders, it is important to consider that higher prices for fish traders also mean higher prices for consumers, potentially making fish less accessible to low-income rural populations (Cojocaru et al. 2022). This concern is particularly problematic for usipa given its food security contributions in Malawi (Bennett et al. 2022). While price stabilization policies were explicitly suggested by fish retailers in our focus group discussions, it is important to consider the potential unintended consequences of such policies including exacerbated price volatility and decreased consumer access to fish.

Due to the potential unintended consequences of price stabilization policies, we recommend that interventions focus on building fish traders' adaptive capacity rather than directly addressing price volatility. Interventions designed to increase access to capital for fish traders should be considered as a key avenue to build adaptive capacity. Interventions that aim to

increase access to capital should target sellers to enable them to operate in larger quantities, take on additional transport costs, and explore other markets for better prices. In other words, increasing access to capital enables sellers to become arbitrageurs and improves their ability to adapt to price volatility. Such interventions have the potential to benefit both women and men, given that similar proportions of women and men usipa retailers are currently sellers. Further, interventions to build storage facilities would also improve adaptive capacity in the system by enabling the price smoothing effects of temporal arbitrage. Investment in storage facilities has the potential, therefore, to reduce price volatility without directly implementing an above market price floor.

Conclusion

This study presents an analysis of the impact of price volatility on downstream value chain actors – retailers. Most work in this area has focused on actors at each end of the value chain – producers and consumers – therefore, future work is needed to assess the impact of price volatility on midstream value chain actors such as processors, logistic providers, and wholesalers. The approach used in this study, bringing together concepts from the economic literature and social-ecological resilience literature, can be applied in future work on actors in the midstream of the value chain.

This study finds that (1) there is a significant negative relationship between price volatility and net daily income, (2) there is a significant positive relationship between spatial arbitrage and net daily income, (3) sellers are subject to greater price volatility than arbitrageurs, (4) women and men retailers participate in spatial arbitrage at similar levels, but women record lower levels of net daily income, and (5) access to capital drives retailers' ability to engage in spatial arbitrage. In this context, we find that arbitrageurs earn greater net daily income than

sellers, on average, and arbitrageurs have greater adaptive capacity than sellers. We conclude

that arbitrageurs are more resilient to price volatility than sellers.

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CONCLUSION

This mixed methods thesis provides insight into the retail node in the downstream of the usipa value chain in Malawi. Focusing on post-harvest actors, this thesis contributes to the lack of information on the livelihoods of actors beyond primary production in small-scale fisheries and contributes to Step 2 of "The Rome Declaration: Ten steps to responsible inland fisheries" (Smith & Basurto, 2019; FAO & MSU, 2016). Step 2 – to correctly value inland aquatic ecosystems – is achieved in the case of Lake Malawi by assessing the retail activities in the usipa value chain to improve the economic and social valuation of the important inland fishery (Cooke et al., 2021). Further, this work contributes to the lack of sex-disaggregated data in the small-scale fisheries sector (FAO, Duke University & WorldFish, 2023).

Overall, this work reveals that although many people participate in usipa trade, not everyone is able to attain the same level of benefits (e.g., women and men, sellers and arbitrageurs). This finding emphasizes the point that increasing equality in participation is often not enough to facilitate equity in livelihood outcomes. The insights provided by this thesis can be used as the basis to design interventions to achieve more equitable livelihood outcomes for all fish traders and thus improve the ability of this already important livelihood strategy to improve food security in Malawi.

Chapter one revealed that women retailers are not able to attain the same level of benefits from participation in usipa trade as men usipa retailers. In summary, chapter one found that: (1) there is a statistically significant difference in marketing margins between female and male usipa retailers, with female retailers earning less than male retailers, (2) there remains dominant discourse among men that gender does not impact economic benefits from usipa trade, whereas women tend to discuss gender as a barrier, and (3) the primary constraints for all fish retailers in

usipa trade, which manifest differently for women and men, are (a) lack of access to formal financial services, (b) poor transportation, (c) price volatility, (d) lack of storage, and (e) gender-based violence.

Chapter two found that sellers are not able to attain the same level of benefits from participation in usipa trade as arbitrageurs. Linking this finding to the results of chapter one, I hypothesized that more women acted as sellers whereas more men acted as arbitrageurs. However, this hypothesis did not hold true. Chapter two found that women and men retailers participate in spatial arbitrage at similar levels, indicating that differences in participation in arbitrage cannot explain the differences in earnings between women and men in usipa trade. Rather, it is the role of complex power dynamics, social relations, norms, and constructs. Further, chapter two found that (1) there is a significant negative relationship between price volatility and net daily income, (2) there is a significant positive relationship between spatial arbitrage and net daily income, (3) sellers are subject to greater price volatility than arbitrageurs, and (4) access to capital drives retailers' ability to engage in spatial arbitrage.

Future work should further examine issues of access to capital as it emerged as a key distinguishing factor between both women and men, and sellers and arbitrageurs. Quantitative analysis revealed that the difference in volumes traded between female and male retailers is not statistically significant, however qualitative results indicated that women continue to have less access to capital than men. Future work should further investigate this discrepancy to determine whether the narrative that women have less access to capital than men holds true, or if circumstances have improved.

In addition to access to capital, this thesis has identified four other key challenges for retailers participating in usipa trade in Malawi: (1) poor transportation, (2) price volatility, (3)

lack of storage, and (4) gender-based violence. Future research can explore each of these key areas limiting success for usipa retailers in more depth as avenues to learn about opportunities. There is room for future research to identify potential interventions and model impacts to translate research into action, i.e., real improvements in fish traders' livelihoods. To address the limitations of this study, future work should collect time series data to better understand temporal trends in livelihood outcomes. I recommend that future research into these key areas for livelihood improvement include fish traders themselves; by listening to the struggles and experiences of fish traders, we can better understand their needs and thereby develop more effective and useful development interventions.

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