

Article



Are Fish Markets in Central Malawi Profitable and Efficient? Performance of *Diploxatodon* spp. (Ndunduma) Markets in Salima and Lilongwe Districts

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Abstract: The production of underexploited small fish species has surpassed that of bigger and more valuable species, such as *Oreochromis species*. However, profitability and efficiency of the key players in the marketing chain and system associated with these small fish species are yet to be understood. Therefore, this article aims to analyze the profitability and efficiency of *Diplotaxodon* spp. (an example of a small fish species) fish marketing systems in Malawi. The analysis was based on data collected in 2019 through field surveys from 265 respondents, which included fishers, processors, wholesalers, and retailers. Gross margin, return on capital employed (ROCE), and the Acharya and Agarwal's market efficiency index were used in our empirical strategy. The results reveal that *Diplotaxodon* spp. trading was profitable to all actors. Firm-level efficiency showed that all actors used their capital efficiently, except for fishers, who had lowest return on capital employed, while retailers had the highest return on capital employed. All marketing channels identified were inefficient, due to high marketing margins and low fisher's share of the consumer price, attributed to high transportation cost. The study concludes that, unless efforts are taken to improve efficiency of Ndunduma marketing system, through improving marketing margins and fisher's share of consumer price, *Diplotaxodon* spp. will continue to be under-exploited, thereby sustaining or exacerbating the fish supply gap.

Keywords: Diploxatodon spp.; Lake Malawi; market efficiency; market performance; Ndunduma

1. Introduction

The performance of markets remains pivotal in the analysis of Africa's fish marketing systems, owing to its effect on the distribution of benefits among actors in the value chain, and aids in tracing market inefficiencies that characterize small-scale African fisheries [1,2]. Therefore, the analysis of fish market performance is crucial for the development and implementation of policies and programs aiming at developing fisheries and aquaculture sectors [3]. This is because market performance affects the cost of fish to consumers, fishers' income level, and profits the profits of fish traders and speculators. In view of contributions of fisheries to economic development for countries that rely on fisheries, some governments have developed, and are implementing, policies and programs are politically important to fish prices, fishers', intermediaries' incomes, and relations with trading partners [3].

One such important sector is capture fisheries, which contribute to the economic development of many countries. The success of capture fisheries largely depends on an efficient marketing system [2]. An efficient marketing system would ensure that fish reach consumers in the right quantity, place, and time [3]. One such country that requires a good flow of fish, from the point of production to the rural population, where it is needed most by the majority, is Malawi.



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1.1. Fisheries Industry in Malawi

As it is globally, the fisheries sector is also important to Malawians, despite the fisheries being small, as compared to other sectors of Malawi's economy. The sector contributes about 7.2% to the gross national product and generates annual gross production revenue of approximately 170.34 million USD [4,5]. The significance of the industry to Malawi's economy is three-fold. Firstly, it is a source of nutrition, where fish contribute nearly 60% of the dietary animal protein intake, as well as 40% of the animal protein supply [6]. Fish is highly nutritious, in comparison to other cheap sources of protein, such as beef, poultry, and pork. Many Malawians are poor, and fish contributes significantly to their daily nutritional requirements [7,8]. Secondly, the fish value chain supports over 1.5 million people in fish auxiliary activities, such as fish selling, processing, engine repairing, boat making, and net making, among others [6]. Thirdly, the fisheries sector is a source of forex earner; for instance, in 2017, Malawi exported 36,147 live ornamental fish, valued at 204,765 USD [9]. However, the statistics for 2020 revealed reduced numbers, mainly attributed to the effects of COVID-19; in total, 23,985 live ornamental fish fetched 180 million USD [6].

Despite Malawi's current annual fish production, estimated at 170,844 metric tons, this represents a 10% increase, in comparison to 2019. Out of this, 95 percent came from inland fisheries, while 5% was from aquaculture [6]. Inland fisheries are dominated by small-scale fishers and account for 85% to 90% of the total landings [10–12]. However, population growth, coupled with climate change and unsustainable methods of fishing, has led to the overall decline of the fisheries [7,13,14]. Therefore, in order, to increase fish production, there is a need to promote less exploited offshore deep-water fishing, and one of the targeted fish species is *Diplotaxodon* spp., locally known as Ndunduma [15]. Despite this fish species being in a category of small fish species, its production has increased and largely contributed to overall fish catches, and its marketing system is not known.

1.2. Diplotaxodon spp. (Ndunduma) Production in Malawi

Diplotaxodon spp., locally known and hereafter referred to as Ndunduma, is one of the many fish species found in Lake Malawi [16,17]. Although captured in other lakes, such as Malombe and Chiuta [18], Lake Malawi provides the largest catch of Ndunduma [6], and its abundance was estimated at 87,000 metric tons. The abundance of Ndunduma species, especially in the pelagic zone, is largely due to its tendency to live offshore. Unfortunately, these areas are under-exploited by small-scale fishers [15]. Mangochi, Salima, Nkhotakota, and Nkhata-Bay are major districts along Lake Malawi, where Ndunduma is captured [19]. Pivotal to the overall rise of Malawi fish production is attributed to an increase in Ndunduma production, which increased by 1335%, from 350 metric tons in 2010 to 4672.19 metric tons in 2018 [6].

Given that Ndunduma is relatively cheap and affordable to many Malawians, increasing its production implies an increase in its demand. Simultaneously, its beach value (money paid to fishers) also increased from 73.6 million MWK in 2010 to 3.6 billion MWK in 2021. This is attributed to an increase in both the production and price at all nodes of the value chain, due to its increase in demand. Currently, the species is being under-exploited, despite its potential, being estimated at 33,000 tons per year. The annual Ndunduma production was 3503 metric tons in 2020, and it is projected to increase to 3573 in 2022 [6]. However, these fishers are failing to exploit this potential, due to a lack of appropriate technologies [15,16], in comparison to the current catches of less than 4000 metric tons per year [6]. This entails that only 10% of the potential is being realized.

Despite dismal fish catches, greater attention in Malawi's fisheries focuses on increasing output levels, while knowledge gaps exist in fish marketing systems [12,20]. These gaps reinforce the dominance of fish business intermediaries, which slows down improvements in the welfare of the fishing communities [3]. For that reason, the under-exploitation of Ndunduma fish species in Lake Malawi can be attributed to the activities of these intermediaries. For instance, fishers complain of low prices offered for their fish, while consumers complain of high prices [1], suggesting market inefficiencies. This acts as a disincentive to both the producer and consumer. These inefficiencies in the marketing system are largely contributed to existing market structure and performance [21]. It is against this background that the profitability and performance of *Diplotaxodon* spp. markets in central Malawi were assessed.

Two factors have motivated the conducting of this study. Firstly, given uncertainty about the pricing of fish, such as low prices to the fishers and high prices to the consumers, which describes the fish marketing system in Malawi, needs to be explored. Determining the distribution of profits within *Diplotaxodon* spp. market chain is required, as this influences the development of policies and programs. For instance, low prices to fishers have led to the establishment and promotion of cooperatives, as well as the construction of market-related infrastructure policy. Secondly, the efficiency and profitability of key market actors, as well as the whole marketing system of small, but significant fish species, such as *Diplotaxodon* spp., in the Malawian context, need to be explored. This study can contribute to new findings in the fisheries performance literature. This paper has been laid out as follows. Section 1 provides a brief description of the fisheries sector in Malawi, in general, as well as *Diplotaxodon* spp., specifically in terms of production and marketing overview. Section 2 describes the methodology for the study. Section 3 reports the results and conclusion.

2. Materials and Methods

2.1. Market Performance

Market performance is the economic results that flow from the industry and how well the market performs, in terms of efficiency and progressiveness, given its technical environment. Despite the availability of many tools to measure market efficiency, empirically profitability (gross and net margins) and market channel efficiency are mainly used as a measure of market performance [22–25].

Gross margin is the excess of production cost, and it constitutes the marketing costs and traders margin [26]. However, in situations where both variable and fixed costs information are available, the net profit margin, as a measure of performance, is superior over gross margin. This is because the net profit margin provides the actual profit realized by the business, as it does not only take variable costs into account, as it is with gross margin, but rather it includes a total cost (variable and fixed costs) in its calculation [20]. Therefore, in order to provide the actual profit realized by Ndunduma market actors, this study used the net profit margin in determining the profitability of the marketing system and was calculated as follows:

$$NPM = TAR - (TVC + TFC)$$
(1)

where NPM = net profit margin, TAR = total activity revenue, TVC = total variable cost, and TFC = total fixed cost.

In order to trace what causes low fisher's (producer's) and high consumer's prices, the total gross marketing margins and price spread analysis, along prevailing Ndunduma marketing channels, was employed. The total marketing margins is the difference between final consumer and purchase prices [27]. The total gross marketing margin shows how much has been spent on the marketing of the product, while the price spread is used to show constituents of the total gross marketing margin. The total gross marketing margins for prevailing Ndunduma marketing channels were estimated as follows:

$$TGMM = SP - PP \tag{2}$$

where TGMM = total gross marketing margin, SP = sale price, and PP = purchase price

However, studies that have used gross margin or net profit fail to determine whether the market is performing optimally to society standards, due to the absence of a cut-off point. To address this, firm-level financial efficiency was measured using the return on capital employed (ROCE):

$$ROCE = \frac{\sum_{i=1}^{n} (NP/CI)}{N} \times 100$$
(3)

where ROCE = return on capital employed, NP = net profit, CI = capital invested, and N = number of market participants at the market node.

Capital invested is the summation of working capital and value of fixed asset. Traders' net profit was compared to the interest earned, if their capital were to be saved in a fixed deposit account at a commercial bank. The decision rule, according to [28], states that if ROCE is less than the interest earned on fixed account deposit, it implies trader's operations are not optimal, and the reverse is true.

However, firm-level financial efficiency was supplemented with market channel efficiency [24]. Therefore, the [29] market efficiency index was employed to determine Ndunduma market performance. The market efficiency index was calculated as follows:

$$ME = \frac{PP}{TMC + TMM}$$
(4)

where ME = Acharya and Agarwal's marketing efficiency index, TMC = total marketing cost incurred by the producer and all the intermediaries (MWK/dozen), and TMM = total marketing margin.

When the ME is greater than equal to one (\geq 1), it indicates an efficient marketing channel; whereas, when ME is less than one (<1), it indicates that the marketing channel is inefficient.

2.2. Study Areas, Sampling and Data Collection

The study was conducted in the Salima and Lilongwe districts of central Malawi. The Salima district is located on the south-western arm of Lake Malawi. Based on the information obtained from Salima district fisheries office, Salima is one of the major producers of Ndunduma species, although the district also produces other fish species, such as *Engraulicypris sardella*. It is against this background that Salima was purposively chosen for this study. Salima has three major strata within Lake Malawi, namely Chipoka (3.3), Senga-Bay (4.1), and Domira-Bay (4.2). Collectively, these strata have 34 minor strata. A stratum is a numerical point from which fisheries data are collected from [20]. However, due to large volume of *Ndunduma* landed and accessibility of these strata, data were collected from strata 4.1. Data for fishers, processors, and some wholesalers were collected from the following minor strata: Nguwo, Lifuwu, Chigumukire, and Mchini. Data for retailers and wholesalers was collected from Chigumukire and Mchini beaches, as well as other selected markets in Salima.

On the other hand, Lilongwe was purposively chosen, because it is one of the main fish markets in Malawi. Data for wholesalers were collected from Lilongwe central market for both semi-fried and fresh Ndunduma, while Salima turnoff and Lilongwe CCAP bus terminus for fresh Ndunduma. Data for retailers were collected from selected retail markets around Lilongwe. Stratified and simple random sampling techniques were used to sample fishers, processors, wholesalers, and retailers. A sample of 265 respondents, composing of 57 fishers, 51 processors, 32 wholesalers, and 125 retailers, participated in the study. Following primary data collection and preliminary analysis, two experts from the fisheries department and two members of the fishing community were involved as key informants to triangulate the findings.

3. Results and Discussion

3.1. Profitability among Ndunduma Fishers in Salima

Price spread as indicated in the methodology was used to determine the profitability of Ndunduma business at all marketing nodes. At the production level, which was in Salima

only, Table 1 presents the monthly average revenue, cost, and profit. The study shows that labour (35%), boat (25%), and gear (25%) hiring constituted the largest components of production costs.

Table 1. Monthly average revenue, costs, and profit of Ndunduma fishers in Salima.

	Value (MWK)	Percentage of Sales
Total monthly revenue	10,945,585.16	100
Cost		
Boat and fishing gear hiring	2,736,396.29	25
Fuel	795,581.37	7.27
Battery charging	17,842.11	0.16
Labour	3,830,954.81	35
Fees and license	3333.33	0.03
Profit margin	3,561,477.26	
Net profit margin	0.36	

Note: Exchange rate USD 1 = 760 MWK.

However, it was found that cost incurred for labour, boat, and fishing gear were fixed and not variable, with respect to the value of Ndunduma caught. The study revealed that, of all actors in Ndunduma value chain, fishers had a highest nominal average monthly profit, because large quantities of Ndunduma were sold, resulting in a higher sales turnover than any actor in the value chain. On average, a fisher harvested 55,166 dozen of Ndunduma per month (25 days of fishing), which was sold at an average price of 213.77 MWK per dozen, thereby realizing a sales revenue of 10,945,585.16 MWK. Deducting the costs incurred, the average monthly profit margin of a fisher was 3,561,477.26 MWK (4686.15 USD), with a net profit margin of 36%. This net profit margin implies that, for every 100 MWK of sales made, the fisher realized a profit of 36 MWK. This implies that high profits might encourage investors to enter into the fishery. However, the increased fishing effort might result in fishing beyond sustainable limits.

3.2. Profitability among Ndunduma Processors in Salima

In comparison to fishers, the study revealed that in a month, processors (found only in Salima) sold an average of 8627 dozen of Ndunduma, at 446.94 MWK per dozen. This translated into a monthly sales revenue of 3,735,600 MWK; subtracting the costs incurred in processing and marketing, processors realized a monthly profit of 971,300 MWK and net profit margin of 26%. However, the net profit margin for Ndunduma processors who also act as wholesalers, especially in Salima, was less than 58.5%, as found by [24] among wholesalers of Groundnuts in Malawi. Purchasing, processing (cost of cooking oil, labour, and firewood), and transport costs were by far the largest components of the selling price, constituting 50%, 13%, and 8%, respectively. Transport cost was found to be the largest market cost, and similar results were also obtained by [30] among fish producers in Nigeria. Therefore, this study underscores the need to improve and reduce the costs of transporting fish from production to consumption points within study areas, as a way of improving profits to processors and accessibility to consumers.

3.3. Profitability among Ndunduma Retailers in Salima

Monthly sales revenue, costs, and profits for processors and retailers of fresh and semi-fried Ndunduma in Salima are presented in Table 2. The study revealed that, on average, Salima retailers of fried Ndunduma sold 580 dozen monthly, at 647.06 MWK per dozen. This translates into a monthly sales revenue of 362,800 MWK (Table 2). Deducting the purchase and marketing costs, a monthly net profit margin of 110,700 MWK and net profit margin of 31% were realized, respectively. The net profit found in this study was higher than the 18.74% and 12.73% found by [30] among retailers of farmed catfish in Nigeria. Unlike processors, it was observed that retailers were marking profits outside the range of 20–30%. Purchase cost for Ndunduma accounted for 62.31% of consumer price,

while transport was the largest component of the marketing cost, constituting 1.74% of consumer price.

	Processor	% of Sales	Retailer (Fresh)	% of Sales	Retailer (Semi-Fried)	% of Sales
Revenue	(MWK'000) 373.56		(MWK'000) 63.14		(MWK'000) 36.28	
Costs						
Fish						
purchase	186.28	50	30.92	48.97	22.61	62.32
cost	100.20	00	0007	10007		02.02
Personal						
expenses	2.32	1	1.55	0.5	0.57	1.57
Cooking						
oil	33.92	9	-	-	-	-
Labour	8 98	2	1 16	2	-	-
Firewood	7 25	2	-	-	-	-
Market fee	0.13	0.03	0.13	0.2	0.10	0.28
Transport	30.67	8	1.38	4	0.63	1.74
Rent	4.57	1	0.11	0.17	0.23	0.63
Fish	107	-	0.11	0.17	0.20	0.00
damage or	_	-	0.27	0.43	0.027	0.1
spoilage						•
Storage						
cost	-	-	0.18	0.29	-	-
Processing					0.44	1 01
cost	-	-	-	-	0.44	1.21
Ice cost	-	-	1.18	1.87	-	-
Handling					0.20	1.07
cost	-	-	-	-	0.39	1.07
Packaging			0.62	0.08	0.25	0.06
cost	-	-	0.02	0.98	0.33	0.90
Net	07 12		24.1		11.07	
income	97.13	-	24.1	-	11.07	-
Net profit margin	26	-	38	-	31	-

Table 2. Monthly sales revenue, costs, and profits for processors and retailers of fresh and semi-fried Ndunduma in Salima.

The study also found that retailers of fresh Ndunduma in Salima sold, on average, 1346 dozen of Ndunduma per month, at 464.58 MWK per dozen, which resulted in a monthly sales revenue of 631,400.64 MWK. Deducting purchase and marketing costs from the sales revenue, a net profit margin of 240,970.25 MWK, with a net profit margin of 38%, is realized. The retailers had a net profit margin that was more than 18.74%, as reported by [30], among retailers of farmed catfish in Nigeria and less than 69% realized by Banana retailers in Nigeria [31]. Unlike in retailing semi-fried Ndunduma, purchase and marketing costs for retailing fresh Ndunduma accounted for 48.97% and 13.03% of selling price, respectively. Transport costs constituted the largest share of marketing cost, which accounted for 4% of the selling price.

However, the net profit margin achieved by retailers of fresh Ndunduma was twice as high as the profit margin achieved by retailers of semi-fried Ndunduma. There are two possible reasons for higher net profit margin for retailers of fresh Ndunduma than those selling fried Ndunduma. Firstly, the purchase cost of fresh Ndunduma constitutes 48.97% of the selling price, which is lower than the 62.31% incurred by the retailers of semi-fried Ndunduma. Secondly, retailers of fresh Ndunduma sell 1346 dozen per month, which is higher than 560 dozen sold by retailers of semi-fried Ndunduma.

3.4. Profitability of Ndunduma Markets among Wholesalers in Lilongwe

Unlike in Salima, where fishers, processors, and retailers are the main actors involved in Ndunduma trading, in Lilongwe, retailers and wholesalers dominate the trading of both fresh and fried Ndunduma.

On the other hand, monthly sales revenue, cost, and profits for semi-fried and fresh wholesalers and retailers in Lilongwe (Table 3) showed that, on average, wholesalers of fresh Ndunduma sold 5796 dozen per month, at 421.09 MWK per dozen; however, on average, a wholesaler of semi-fried Ndunduma sells 6118 dozen per month at 493.75 MWK per dozen. On average, a wholesaler of fresh Ndunduma would realize a monthly sales revenue of 2,493,800 MWK, while wholesalers of fried Ndunduma realize a sales revenue of 2,999,400 MWK. Subtracting the purchase and marketing costs from the monthly sales revenue, on average, a wholesaler of fresh Ndunduma in Lilongwe realizes a monthly net profit of 632,200 MWK, with a net profit margin of 25%, while a wholesaler of semi-fried Ndunduma realizes a monthly net profit of 778,500 MWK, with a profit margin of 26%. The net margins of wholesalers of both fresh (25%) and semi-fried Ndunduma (26%) obtained in this study are less than those realized by retailers and wholesalers. This implies that the price of Ndunduma keeps increasing from its captured price by over 100%.

Table 3. Monthly sales revenue, costs, and profits for semi-fried and fresh wholesalers and retailers in Lilongwe.

	Wholesaler (Fresh)		Wholesaler (Semi-Fried)		Retailer (Fresh)		Retailer (Semi-Fried)	
Revenue	(MWK'000) 249.38	% of Sales	(MWK'000) 299.94	% of Sales	(MWK'000) 64.67	% of Sales	(MWK'000) 47.22	% of Sales
Costs								
Fish								
purchase cost	123.73	49.62	174.66	58.23	42.75	66.11	34.96	74.04
Personal expenses	4.64	2	1.63	0.5	1.02	1.58	0.70	1.48
Labour	6.32	3	1.76	0.5	0.25	0.39	-	-
Market fee	0.12	0.05	0.1	0.03	0.16	0.25	0.13	0.28
Transport	45.56	18	22	7	1.38	2	1.01	2.14
Rent	-	-	5.9	2	0.30	0.46	0.33	0.7
Fish								
damage or	0.24	0.1	1.84	0.6	0.54	0.84	0.19	0.4
spoilage								
Storage cost	-	-	0.69	0.23	0.30	0.46	0.035	0.07
Processing cost	-	-	14.81	5	-	-	-	-
Ice cost	8.23	3	-	-	1.04	1.61	-	-
Handling cost	-	-	-	-	0.69	1.07	0.02	0.04
Packaging cost	-	-	-	-	0.67	1.04	0.35	0.74
Net income	63.22	-	77.85	-	15.94	-	12.19	-
Net profit margin	25	-	26	-	24.65	-	24.77	-

Similar to processors and retailers in Salima, transport cost was, by far, the largest component of the marketing cost in the wholesaling of both fresh (18%) and fried (7%) Ndunduma in Lilongwe. The results show that wholesalers of fresh Ndunduma incur higher transport costs than wholesalers of fried Ndunduma. The low transport cost among wholesalers of semi-fried Ndunduma is due to the fact that fried Ndunduma can be tightly packed, thereby allowing wholesalers to carry huge volumes of Ndunduma at a relatively

low price per dozen. In general, high transport costs could be attributed to the absence of specialized vehicles for carrying fresh fish and unreliable public transport system.

3.5. Profitability of Ndunduma Markets among Retailers in Lilongwe

The study findings in Table 3 revealed that it is also profitable to retail both fresh and fried Ndunduma in Lilongwe. On average, a retailer of fresh and fried Ndunduma realized monthly sales revenues of 646,700 and 472,200 MWK, respectively, when deducting marketing and purchase costs, which are 66.11% of the sales revenue for fresh Ndunduma and 74.04% for semi- fried Ndunduma. Retailers of fresh Ndunduma realized a net profit of 159,400 MWK, with a net profit margin of 24.65%, while retailers of fried Ndunduma realized a net profit of 121,900 MWK, with a net profit margin of 24.77%. The monthly net profit margin for retailers of fresh Ndunduma was higher than that of fried Ndunduma, due to differences in the quantity sold, as retailers of fresh Ndunduma sold more than retailers of semi-fried Ndunduma. The study found that, on average, a retailer of fresh Ndunduma would sell 886 dozen per month, while retailers of fried Ndunduma would sell 634 dozen per month. Although retailers of fresh Ndunduma make higher net profit than retailers of semi-fried Ndunduma, the net profit margin suggested that retailers of fried Ndunduma are better off than retailers of fresh Ndunduma in making net profit per sales. These results suggest that value addition, in the form of semi-fried, was a mere fish preservation technique that did not result in significant financial returns.

Similar to earlier studies on the profitability of the fisheries industry in Malawi on different fish species, this study also revealed that Ndunduma trading was profitable to fishers, processors, wholesalers, and retailers. On the other hand, our results are contrary to the earlier studies by [1,20], who reported that the volume (concentration) of fish was a key determinant of profitability, whereas this study established that purchase and selling price were key determinants of net profit margin. For example, the fishers in this study sold many Ndunduma units, but their marketing margin was smaller; this was contrary to [20], where fishers had the lowest quantity. However, the selling price in our study increased at each node, thereby offsetting the quantity differences.

These results also suggest that players within Malawi's fish value chain have adopted several marketing strategies, in order to realize profits. For example, it could be argued that the other marketing players (processors, wholesalers, and retailers) might have been buying other Ndunduma stocks from other fish landing sites, as compared to fishers who only depended on their catch [32].

3.6. Return on Capital Employed for Fishers, Processors, Wholesalers, and Retailers in Salima and Lilongwe

Since the profit level fails to provide a cut-off point for optimal business performance, the study employed return on capital employed (ROCE) to measure and determine the operational efficiency of the Ndunduma business at all market levels. The ROCE results on Ndunduma fishers, processors, wholesalers, and retailers in Lilongwe and Salima (presented in Table 4) show that fishers had the largest capital invested, with an average value of 3,795,263.16 MWK, while retailers of semi-fried Ndunduma in Salima had invested the lowest capital, with a mean of 24,117.65 MWK. More details on the type of investments of the study respondents (fishers) are shown in Table 1. Despite investing the largest amount of capital, fishers had a ROCE of 93.4%, which is the lowest among all Ndunduma market actors. This implies that, for every 100 MWK invested, 93.4 MWK is returned as profit. Processors reported ROCE of 427.48%, implying that, for every 100 MWK of capital invested, 427.48 MWK was realized as profit. Wholesalers of fresh and semi-fried Ndunduma in Lilongwe reported ROCE of 302.86% and 458.82%, implying that, for every MWK 100 capital invested, 302.86 and 458.82 MWK was realized as profit, respectively.

Furthermore, retailers for fresh and semi-fried Ndunduma in Salima recorded a ROCE of 562.26% and 458.82%, respectively, while, in Lilongwe, it was 440.76% for retailers of fresh and 357.33% for semi-fried Ndunduma. The ROCE results found in this study

differ from those of other studies; for example, a ROCE of 93.4% found among fishers is lower than the 1127% found by [33] among tomato farmers in Ghana, while the ROCE found among Ndunduma wholesalers was higher than the 237.59% found among tomato wholesalers in Ghana; the ROCE found among fresh and semi-fried Ndunduma was higher than the 40% and 66% found among tomato retailers in Ghana [34]. These results are also contrary to [34], who noted a weak relation between return on investment of assets in the short-term (similar to fisheries), resulting in no guarantor for high profits. This could, therefore, help to explain the observation within our findings. Despite high capital invested, but low ROCE, among Ndunduma fishers, compared to other Ndunduma market actors, this may act as a disincentive for fishers to capture the Ndunduma species.

MARKET ACTOR	STATISTIC					
MARKET ACTOR -	Mean (MWK)	Minimum (MWK)	Maximum (MWK)			
FISHER (SA)						
Capital invested	3,785,263.16	100,000	7,000,000			
Net profit margin	3,561,477.26					
ROCE	93.4%					
PROCESSOR (SA)						
Capital invested	227,063.49	25,000	400,000			
Net profit margin	971, 328.45					
ROCE	427.78%					
RETAILER, FRESH (SA)						
Capital invested	42,857.14	20,000	60,000			
Net profit margin	240,970.26	,	,			
ROCE	562.26%					
RETAILER.						
SEMI-FRIED (SA)						
Capital invested	24,117.65	10,000	50,000			
Net profit margin	110.657.17	,	,			
ROCE	458.82%					
WHOLESALER,						
FRESH (LL)						
Capital invested	208.750	50.000	500.000			
Net profit margin	632.228.4		,			
ROCE	302.86%					
WHOLESALER.						
SEMI-FRIED (LL)						
Capital invested	290.625	100.000	500.000			
Net profit margin	778,499.6	,	,			
ROCE	267.87%					
RETAILER, FRESH (LL)						
Capital invested	36,166.67	15.000	80.000			
Net profit margin	159,407.92	,,	,			
ROCE	440.76%					
RETAILER.						
SEMI-FRIED (LL)						
Capital invested	34,117.65	10,000	30,000			
Net profit margin	121,914.07	,	,			
ROCE	357.33%					

Table 4. ROCE of Ndunduma fishers, processors, wholesalers, and retailers in Lilongwe and Salima.

KEY: SA = Salima; LL = Lilongwe; MWK = Malawi kwacha. Exchange rate: 1 USD = 720 MWK.

3.7. Ndunduma Marketing Channels in Salima and Lilongwe

To determine marketing efficiency, there was a need to identify Ndunduma marketing channels. Four Ndunduma marketing channels in Salima and Lilongwe (presented in Figure 1) were identified.



Figure 1. Ndunduma marketing channels in Salima and Lilongwe. **Key**: channel prevalent in Salima; channel prevalent in Lilongwe; **Ch** is channel.

Channel 1 was prevalent in both Salima and Lilongwe, and about 1.83% of fresh Ndunduma was sold by the fishers to retailers, who, in turn, sold it to consumers (individuals and restaurants). This is contrary to [1], who found evidence that fishers of Lake Chilwa were selling fish directly to consumers. In channel 2, approximately 23.3% of fresh Ndunduma was sold to wholesalers, who, in turn, transported them to Lilongwe, where they were sold to retailers, who, in turn, sold them to either to individual consumers or restaurants. In channels 3 and 4, approximately 74.87% of Ndunduma catch passed these channels. In channel 3, which presents both Salima and Lilongwe, fishers sold fresh Ndunduma to processors, who, in turn, sold the processed (semi-fried) Ndunduma to retailers, who, in turn, sold it to consumers. In channel 4, fishers sold fresh Ndunduma to processors, who, in turn, processed and sold them to wholesalers, who then sell to consumers. These results are contrary to [35], who noted that retailers accessed the majority (72%) of the captured fish, in comparison to 28% of the wholesalers. Furthermore, their study noted that all retailers and wholesalers were involved in the processing of the fish. This entails non-separation of roles within the value chain.

Furthermore, market-level financial efficiency was assessed using the price spread method and [29] marketing efficiency index. Fishers' share was used to determine how Ndunduma markets perform, on the basis of prices, and it was calculated as the percentage of final consumer price. The results on Ndunduma market channels efficiency indices for Salima and Lilongwe (presented in Table 5) indicates that the average fisher's share in channel 1 was 46% for Salima and 47.5% for Lilongwe; in channel 2, it was 28.6% for Lilongwe; in channel 3, it was 33% for Lilongwe; in channel 4, it was 27.3% and 27.3% for Salima and Lilongwe, respectively.

The Fishers' share of the final consumer price, found in all channels, ranged between 27% and 48%. These were less than 100% found by [20] among *Oreochromis* spp. (Chambo) intermediaries in Malawi. This study found longer marketing channels and high marketing costs to be factors leading to low Fishers' share. Marketing efficiency indices were thereafter calculated to determine the level of marketing efficiency for all identified marketing channels. All the marketing channels were inefficient, as their marketing efficient indices were less than 1. Channel 1 was better off, since it had a relatively higher market efficiency index of 0.73. The study found two factors that contributed to markets inefficiencies. Firstly, there is limited availability of wholesale market stalls, which are expensive and difficult to secure. This acted as a deterrent to most fishers; as such, they are forced to sell to middlemen, even if the fish prices are very low. Secondly, Ndunduma have long marketing channels,

meaning high consumer price. Therefore, the high marketing margin has to be shared among all actors in the market chain (fishers, processors, wholesalers, and retailers).

	Channel 1		Channel 2	Char	Channel 4	
	SA	LL	LL	SA	LL	LL
Fisher						
Beach price	213.77	213.77	213.77	213.77	213.77	213.77
Selling price	-	427.08	-	-	-	-
Marketing cost	-	72.23	-	-	-	-
Net margin	-	141.08	-	-	-	-
Marketing margin	-	213.31	-	-	-	-
Processor	-					
Buying price	-	-	-	213.77	213.7	213.77
Selling price	-	-	-	417.65	493.75	350
Marketing costs	-	-	-	61.58	109.36	61.58
Net margin	-	-	-	142.3	170.45	83.13
Marketing margin	-	-	-	203.88	279.98	136.23
Wholesaler						
Buying price	-	-	213.77	-	-	350
Selling price	-	-	427.08	-	-	493.75
Marketing costs	-	-	72.23	-	-	81.79
Net margin	-	-	141.08	-	-	62.84
Marketing margin	-	-	213.31	-	-	143.63
Retailer						
Buying price	213.77	427.08	494.42	417.65	550.2	550.2
Selling price	464.58	746.67	746.67	647.06	774.26	774.26
Marketing costs	41.62	69.66	60.93	45.64	47.35	47.35
Net margin	209.19	182.43	178.72	181.61	176.71	176.71
Marketing margin	250.81	532.9	252.25	229.41	224.06	224.06
Total marketing cost	41.62	141.89	133.16	107.22	109.36	108.93
Total gross	250.81	532.0	532.0	133 29	560.49	560 49
marketing margin	200.01	002.7	002.7	100.27	500.47	500.17
Fisher's share (%)	46	47.5	28.6	33	27.6	27.6
Marketing	0.73	0.32	0 32	0.40	0.32	0 32
efficient index	0.75	0.52	0.32	0.10	0.52	0.52

Table 5. Ndunduma market channels efficiency indices for Salima and Lilongwe.

KEY: SA = Salima; LL = Lilongwe; MWK = Malawi kwacha.

4. Conclusions

In the presence of the under-exploitation of Ndunduma in Lake Malawi and undersupply of fish in Malawi, this paper has determined the performance of Ndunduma market system. The performance of the Ndunduma market system was determined by examining channel actor profitability, return on capital employed, and channel efficiency. The study has shown that the Ndunduma market is profitable to all chain actors (fishers, processors, wholesalers, and retailers). The study has also shown that all chain actors are efficient in using their capital, with fishers registering relatively low ROCE and retailers high ROCE. However, all identified channels were inefficient. The low fishers' share of the consumer price and high marketing cost accounted for the Ndunduma market-level inefficiencies. Although profitable to all chain actors, fishers, who are important in the harvesting of Ndunduma, obtain a lower unit profit than processors, wholesalers, and retailers, among others, due to the lowest fisher's share of the consumer price. The study recommends that, unless the unit profit of fishers is raised, by reducing marketing margins, increasing fisher's share of Ndunduma consumer price, and increasing fishers' access to better consumer markets (by expanding the existing wholesale markets or constructing new wholesale fish markets in major cities), fishers will continue under-exploiting the Ndunduma species in Lake Malawi, thereby widening the fish supply gap in Malawi. From these findings, there

is a need to further determine the optimal harvesting rates of Ndunduma that should not disbalance the already existing equilibrium.

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