

Full Length Research Paper

Value chain analysis of small-scale fisheries in the High Dam Lake in Egypt

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Although, High Dam Lake small-scale fisheries is an important source of fish for residents of Aswan in Upper Egypt, there is limited information available about the performance of small-scale fisheries value chain. Structured questionnaires with fishers, traders, and processors were used to collect input and output data at each node of the chain. Focus group discussions meeting with stakeholder collected qualitative information about and critical factors influencing performance across the chain. Catch distribution composed mainly from tilapias 75%. While pebbly fish (*Alestes* spp.) and tigerfish (*Hydrocynus* spp.) accounts for 13% of catch. Fish processing is an important subsector in lake fisheries. Fishers obtained a relatively low percentage (49%) of the final consumer price. The recorded average catch per fisher 20 kg/day and the average total fishing cost in the three landing sites was EGP 5210 / t. Every 100 metric tons of fish catch and sell provides around 30 full-time equivalent jobs. This study revealed that fish stock is under pressure of overfishing. Critical factors facing the small-scale fisheries and influencing profitability are numerous. This value chain study improves our understanding of the performance of small-scale fisheries and identified limiting factors and action needed to support fisheries development in the lake.

Key words: Small-scale fisheries, value chain, tilapia, tigerfish, pebbly fish.

INTRODUCTION

High Dam Lake (known as Nasser Lake) established after the construction of the High Dam in Aswan in the 1960s. The lake in the south of Egypt and extends for more than 300 km, with a shoreline of around 7000 km (Habib and Béné, 2008). It is the most important fishery source in Upper Egypt. The Lake providing an important source of generating income and provide a livelihood for fishermen, fish traders and fish processors in Aswan and attracting large numbers of fishers from other governorates in Upper Egypt. The lake has become an

important source of fish for the Egyptian markets. The fish caught from the lake represented 55% of the total catch from the inland lakes in Egypt in year 2013 (GAFRD, 2015).

Species diversity has declined in recent decades due to change of the lake ecosystem (Béné et al., 2008; van Zwieten et al., 2011; Halls et al., 2015). Four species of tilapias, *Oreochromis niloticus*, *Sarotherodon galilaeus*, *Tilapia zillii* (*Coptodon zillii*) and *Oreochromis aureus* comprise around 75% of the total catch by weight and

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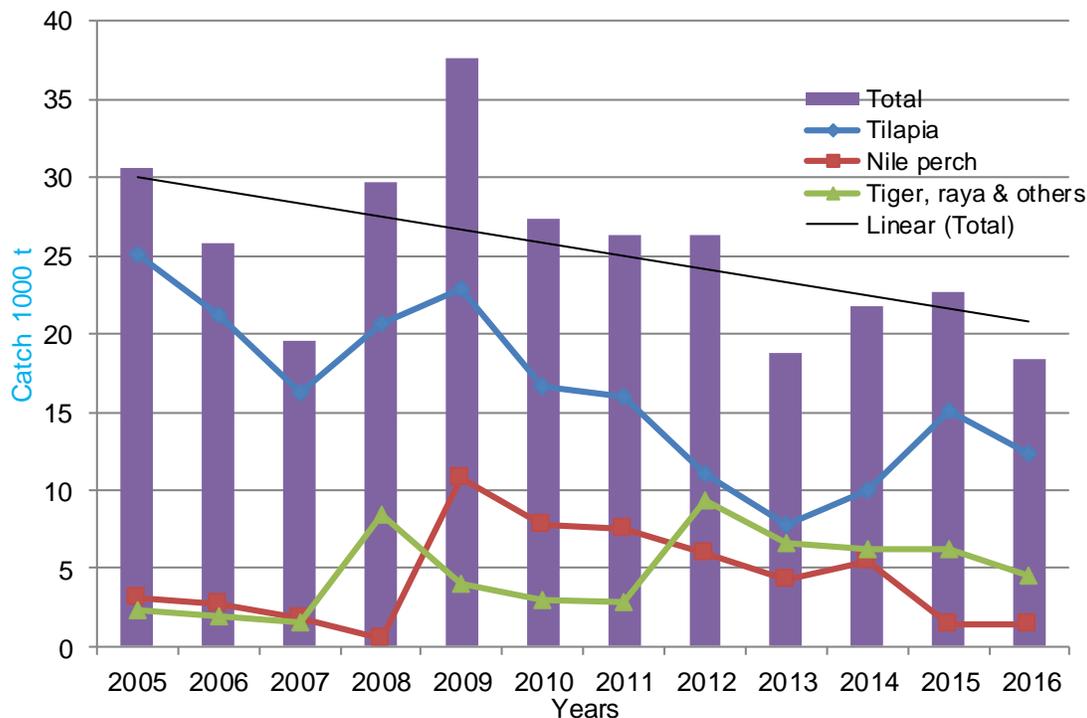


Figure 1. High Dam Lake annual catch by fish group from 2005 to 2016. Source: GAFRD (2018).

are sold as fresh fish, while pebbly fish (*Alestes* spp.) and tigerfish (*Hydrocynus* spp.). They are important and are used as raw material to produce a traditional salted fish product (Nasr-Allah and Zakkar, 2018). Other species are recorded in the catch such as Nile perch (*Lates niloticus*), squeaker catfish (*Synodontis* spp.), sharptooth catfish (*Clarias gariepinus*), bagrus catfish (*Bagrus* spp.), and Nile carp (*Labeo* spp.). Lake yearly catch by species group from the year 2005 to 2016 are presented in Figure 1 (GAFRD, 2018). The official statistics indicate declining catches trend gradually. Tilapia catch declined from 25 to 12.3 thousand ton during the same time. As the relative percentage of tilapia in catch declined from 82 to 67% over the time (Figure 1).

Value chain analysis is in use to understand and describe the enterprises involved in the value-chain and the financial performance across the chain (Porter, 1985; Kaplinsky and Morris, 2001; Gereffi et al., 2005; Macfadyen et al., 2012; Nasr-Allah et al., 2012; Anane-Taabeah et al., 2016). Value chain analysis (VCA) approach has become a form of analysis in the fisheries and aquaculture sectors (Velu et al., 2009; Christensen et al., 2011; Macfadyen et al., 2011, 2012; Phiri et al., 2013; Nasr-Allah et al., 2014; Adeleke et al., 2015; Anane-Taabeah et al., 2016). Private sectors and government operators in the value chain can improve value chain performance (Riisgard et al., 2010). The private business can improve the chain performance

through reducing costs, increasing output, and/or increasing the prices of their products (Macfadyen et al., 2011; Nasr-Allah et al., 2014; El-Sayed et al., 2015).

Adopting value chain analysis approach helps us to study the distribution of income for actors involved in the value-chain at each linkage and evaluate the relative importance of issues affecting competitiveness and the costs and earnings for actors involved in the value chain. It helps as well to identify the weakness in value chain performance and suggest development strategies to improve the performance of value chain actors (Macfadyen et al., 2012).

In spite of the existence of a small-scale fishery in High Dam Lake for more than 50 years, the economic and financial performance of the fishermen and different actors across the value chain, have not been performed in value chain approach. Limited information was available about the level of inputs and outputs for every node in High Dam Lake fishery value chain. As well as, limited information documented about the sector limiting factors and suggested strategy to improve value chain performance of the lake small-scale fisheries. The current paper aims to map the small-scale fisheries value chain and the flow of fish products through the chain. In addition, it helps to identify the various actors, their functions, and existing linkages across the chain. This study aims as well to conduct a preliminary analysis of the input-output structure and the distribution of margins,

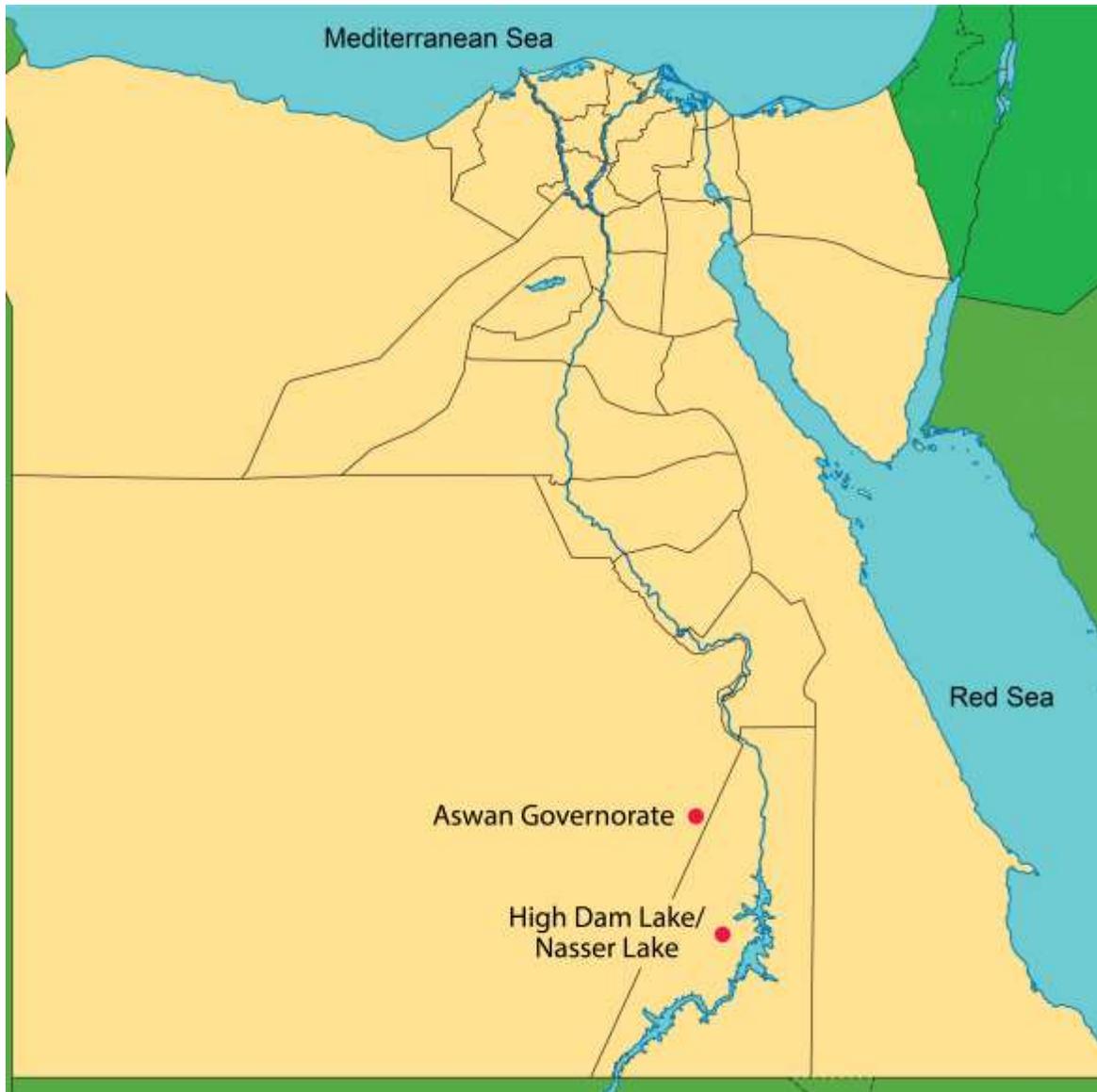


Figure 2. Map of Egypt showing study area (High Dam Lake).

and job creation along the chain. Finally, this study aiming to identify the problems and opportunities facing different actors in the fisheries value chain.

MATERIALS AND METHODS

Study area and data collection

This study is limited to the fishers working at the High Dam Lake (Nasser Lake), in Aswan, at the southern border of Egypt (Figure 2). There are three official landing sites surrounding the Lake (Aswan, Garf Hussein and Abu Simbel) (Halls et al., 2015). The secondary data indicated that there are three different enterprises in the chain. The three main actors groups identified cross the chain are fishers, traders (intermediaries, wholesalers and retailers) and fish processors. Three structured questionnaires prepared for use

in the study, one per each actors group (fishers, processors and traders)¹. Before starting fieldwork, the questionnaire was tested, and revised. The survey conducted in 2015.

In order to ensure representation of the different fishing location, fishers sample collected on a stratified random basis in the three fish ports (Aswan, Garf Hussein and Abu Simbel). Fishers interviewed at their fishing camps in the lake and/or at the three landing sites during landing their catch or sailing to their fishing areas. As fish processors are located in Aswan city, the sample selected focused only on fish processors working in the city. The sample selected for the interview from a list of processors operators. Fish traders sample selected to represent different trading activities (intermediaries, wholesalers, and retailers).

¹ Copy of the three survey forms are available in this link: https://cgia-my.sharepoint.com/:f/g/personal/a_allah_cgjar_org/EobPKWchTMhNs53vHKIUBWkBmyysqE3IHUanFfhRSuDkdA?e=3eeWX5

Interview of fish traders conducted in Aswan and Abu Simbel, where most of their activities were concentrated. The sample for each category considered in this study are as follows; fishers 162; processors 22 (fresh and salted processors); and traders 23 (intermediaries, wholesalers and retailers). Data from the questionnaires entered into an Excel sheet and validated for accuracy with the interviewers. Descriptive analyses of data means and standard errors conducted using Microsoft Excel to demonstrate the difference between groups.

Calculations

The questionnaires generated data on fish capture quantities, sales price and on operational and fixed costs, which allowed for the construction of costs and earnings models for each respondent group across the chain. Operating costs for fishers calculated the costs that are vary depending on the production/capture volume. Fishers operating costs include boat fuel, labor, transport, ice, food for fishers in the lake, and sales commission paid to intermediaries or wholesalers. For fish traders and processors, operating costs include fish purchase, transportation, ice/salt, fuel, electricity, and wages.

Fixed costs for fishers include fishing boat or equipment repair, fishing tools or gear and license fees. Depreciation costs for fixed cost items were calculated as described by Jolly and Clonts (1993). Annual depreciation = (Cost – Salvage Value) / Useful life. Where, salvage value calculated equal to zero assuming no value of scrape (Nasr-Allah et al., 2014). The questionnaires included questions on the number of employees at each node and classify job by nature into full-time, part-time or seasonal. The obtained data were converted into Full-Time Equivalent (FTE) jobs. FTEs estimated based on one FTE being the equivalent of 300 days per year in the fishing and processing, and 330 days FTE in the trading sub-sector as described by Macfadyen et al. (2012). Costs and earnings were calculated based on 2015 data collected in Egyptian Pounds (EGP) (\$1=EGP 7.73). The financial indicators calculated included: gross output values; operational profits (gross return-operational cost) per ton and as a percentage of sales; and net profits (gross return - (operational + fixed cost)). Total value-added calculated as (net profit + wages) per metric ton sold (Macfadyen et al., 2012). The obtained data enabled the calculation of a percentage of total operational profits, net profits, and value-added throughout the chain.

RESULTS AND DISCUSSION

High Dam Lake fisheries value chain mapping

The available information about the small-scale fisheries value chain revealed that most of catch is sold as fresh on ice. Tilapia and Nile perch represent 76% of catch and are sold to middle traders and wholesalers. Pebbly fish and tigerfish represent 13.6% of catch are sold after salting. Mapping of flow of product of the small-scale fisheries in the lake is illustrated in Figure 3. Small-scale fisheries value chain in the High Dam Lake is longer than the Egyptian aquaculture value chain (Macfadyen et al., 2012). Fish processing is an important subsector of the fisheries value chain in Aswan. The following sections summarise performance fish processing section of the chain. Fresh fish processors hold fish on average for 4–5 days and produce on average 98.4 t/year. The average sales prices of finale product is EGP 21/kg to generate

annual gross revenue EGP 1.77 million/year.

By volume, degutted fish represent 84% of final product and fish fillet is only 16%. The products are sold frozen. Fresh fish processing generate value-added at average (EGP 3652/ t). Processing of fresh fish generated 5.7 FTE per 100 t of processed fish. Salted fish processors produce 71 t/year at an average sales price EGP 13.7/kg and average gross revenue EGP 0.975 million/year/processors. By volume, pebbly fish and tigerfish represent 93% of product and the final product sold in salt in tins or jars. Processing of salted fish processing generated 5.5 FTE/100 t processed. Salted fish processing generates value-added at an average EGP 2507/t produced.

Operational and financial performance of small-scale fishing

Findings of operational data for small-scale fishers at the different fishing harbors are displayed in Table 1. The obtained data indicate that the highest catch per fishing boat per year was in Abu Simbel and lowest in Aswan. While, the highest fish sale price was in Garf Hussein and the lowest was in Aswan. The overall employment generation was 18.1 FTE/100 t of fish catch ranging from 20.8 FTE/100 t in Aswan to 15.4 FTE/100 t in Abu Simbel. The current study showed that fishing generates higher FTE compared to fish farming in Egypt. Macfadyen et al. (2011) reported that in the Egyptian aquaculture, fish farming generates 8.3 FTE/100 t of fish production.

In the three landing sites, tilapia represents most of the catch (76%). Catches of fish species for salting (pebbly fish and tigerfish) represented 13.5%. Nile perch and other species represented the remaining 10.6% of total catch. Size distribution of the catch indicates that a small-sized tilapia (< 250g) in Aswan represent (57.6%) of the total catch. While, a lower percentage small-size tilapia catches reported in Garf Hussein and Abu Simbel (43.2 and 42.7% respectively). This suggests that higher pressure in Aswan may be responsible for lower catches and higher employment levels. This study result supports the findings of Halls (2015). The authors reported that fish stock in the lake is under pressure of over fishing.

Revenue of fish sale per boat was higher in Garf Hussein and Abu Simbel landing sites compared to Aswan landing site (Table 2). This can be attributed to the higher catches quantity and sales prices in both Garf Hussein and Abu Simbel compared to Aswan. The result indicates that, average income above operating costs per boat was lower in Aswan compared to fishers` groups working in Garf Hussein and Abu Simbel. A similar trend was reported in sales revenue per boat.

Operational profit (return above operational cost) is higher for fishers working in Abu Simbel, 44% and the lowest is in Aswan, 26%. The result indicates that fixed costs were higher in Garf Hussein than Abu Simbel, while

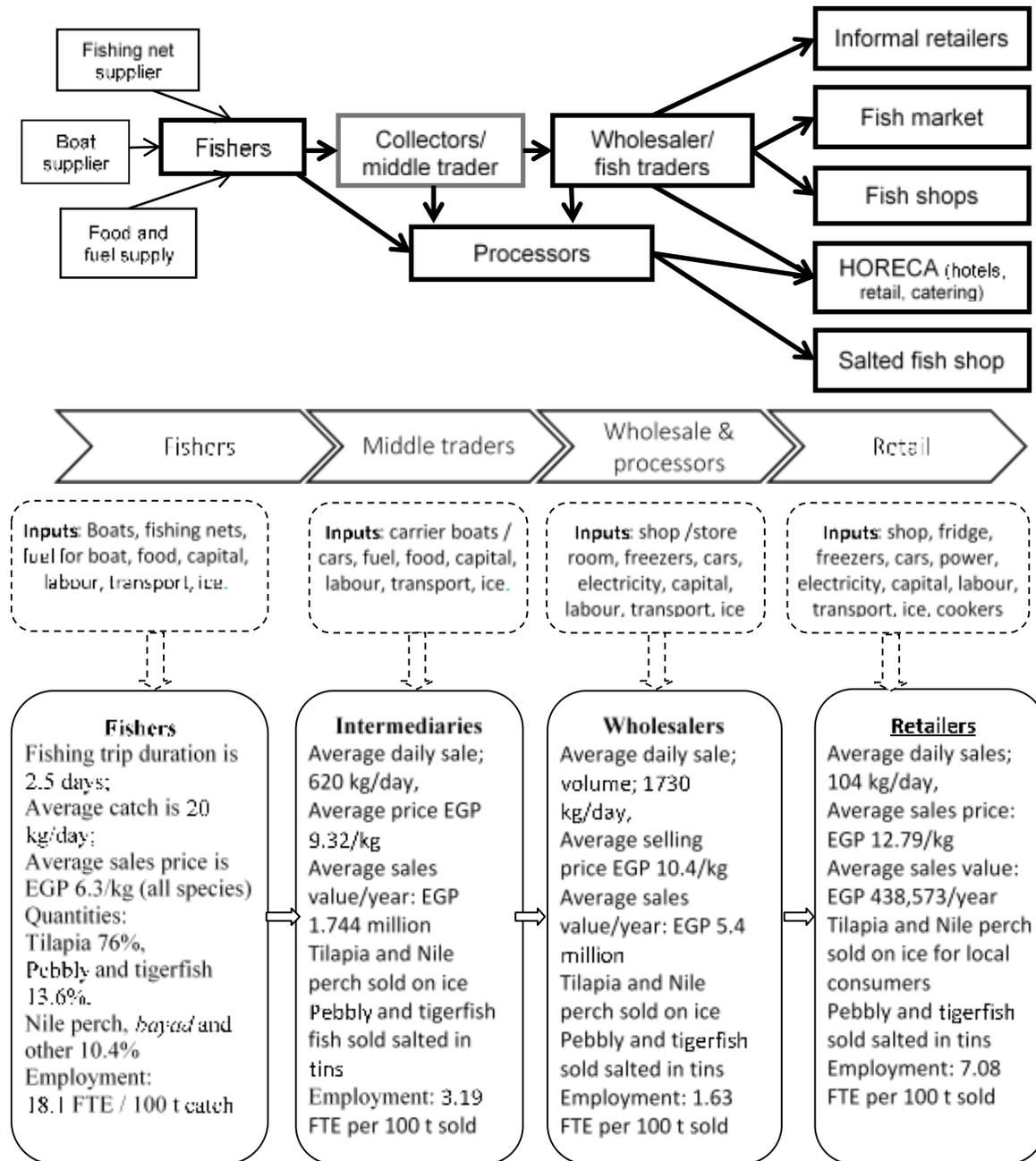


Figure 3. Value chain mapping of small-scale fisheries in the High Dam Lake.

the lowest is in Aswan. Income above total costs was similar in Garf Hussein and Abu Simbel, while Aswan recorded the lowest. Fishers in Aswan landing site generates the lowest net profit as a percentage of sales 5%, while the other two fishing locations 20-21%, giving an overall average of 15% in the lake. Value added calculated as described by Macfadyen et al. (2012) as follows = revenue – (operational and fixed costs), excluding labor costs from operational costs. Estimation of value-added per ton showed that the lowest is in

Aswan and the highest is in Garf Hussein, with an average of EGP 3172/t. A lower value-added reported in Egyptian aquaculture sector by Macfadyen et al. (2012) with an average of (EGP 2989/t of fish sold).

Operational and financial performance of fish traders

Three actor groups are working in fish trade subsector. These actors' groups are intermediaries, wholesalers and

Table 1. Detail of operational data for the small-scale fishing activity in the High Dam Lake.

Operational data	Aswan	Garf Hussein	Abu Simbel	Pooled
Number	55	51	56	162
% have license	82%	98%	70%	83%
Fishing experience (yr)	19 ±1.4	29 ±1.8	24 ±1.7	24
Catch (kg/boat/yr)	10,651±342	12,995±410	13,907±345	12,506
Daily catch (kg/boat/day)	36 ±1.1	43 ±1.4	46 ±1.1	42
Average FTE/100 t	20.8 ±0.8	18.4 ±0.6	15.1 ±0.5	18.1
Sales price (EGP/kg)	5.4 ±0.2	7.2 ±0.3	6.2 ±0.2	6.3
Catch distribution (%)				
Tilapia	80.8	64	82.6	76
Nile perch	7.8	9.6	2.7	6.4
Pebbly fish	5.8	7.0	9.7	7.7
Tigerfish	2.5	11.4	3.2	5.8
Catfish *	2.8	6.4	1.5	3.5
Bayad and Others	0.3	1.9	0.2	0.7

Source: Survey data

* Catfish include (Squeaker and Sharptooth).

Table 2. Summary of financial performance of small-scale fishing in the High Dam Lake.

Financial performance data	Aswan	Garf Hussein	Abu Simbel	Pooled
Fish sales (EGP/boat/yr)	57,767±2.506	92,720±3.366	86,383±3.054	78,621
Operational cost (EGP/boat/yr)	40,293±1.512	51,517±1.699	47,895±2.025	46,447
Income above operational cost (EGP/boat/yr)	17,474±2.028	41,444±3.048	38,55±2.541	32,273
Operational cost (EGP/t catch)	3,912±154	4,059±137	3,466±131	3,807
Operational profit (EGP/t)	1,560±176	3,253±259	2,772±175	2,511
Operational profit/sales (%)	26 ±2.9	42 ±2.2	44±2	37
Labor cost (EGP/t)	2,187±87	2,206±73	1,812±59	2,065
Fixed cost per boat (EGP/yr)	12,264±970	20,977±1.581	18,831±929	17,269
Total cost per boat (EGP/yr)	52,557±2.116	72,493±2.678	66,726±2.506	63,717
Income above total cost (EGP/boat/yr)	5,209±1.872	20,468±2.859	19,724±2.766	15,004
Fixed cost per metric ton (EGP/t)	1,158±86	1,73±146	1,398±87	1,403
Total cost (EGP/t catch)	5,071±154	5,732±137	4,865±131	5,210
Net profit (EGP/t)	401±168	1,580±240	1,374±202	1,107
Net profit/sales (%)	5±3	20±2.7	21±2.7	15
Value added per ton (EGP/t)	2,588±144	3,786±242	3,186±184	3,172

Source: Computed survey data.

retailers. Intermediaries are the trader group own or manage fish carrier boats and collect fish from fishing camp to deliver to wholesalers in the landing sites. However, the liberation of fish trade in year 2001, pickup trucks replaced in some cases carrier boats and intermediate traders started to use a truck instead of carrier boats (Béné et al., 2009; Halls et al., 2015). Transportation by car is faster than using carrier boats and can collect fish from fishers all around the lakeshore rather than the three landing sites. The introduction of cell phones technology allows the intermediaries trader to

arrange with fishers for lakeside meetings to collect their catch. This enables transporting fish to wholesalers in a shorter time. Landing at non-official sites where there is no catch recording system. Wholesaler trader group have land-based fish storage facilities and are able to sell fish in bulk to markets outside Aswan (to other Upper Egypt governorates and El-Obour market in Cairo). Wholesalers sell a small proportion of fish catch to retailers in Aswan markets.

Fish trader operational characteristics and financial performance are displayed in Table 3. The study result

Table 3. Fish trader operational and financial performance.

Parameter	Intermediaries	Wholesalers	Retailers	Pooled
Sample size	8	5	10	23
Operational data				
Annual sales volume (t/yr)	187 ±22	519 ±121	34 ±7	-
Daily sales volume (t/day)	0.62 ±0.07	1.73 ±0.4	0.104 ±0.02	-
Average FTE/100 t of sales	3.19 ±0.5	1.63 ±0.4	7.08 ±0.9	4.5
Sales price (EGP/kg; all species)	9.32 ±0.4	10.40 ±0.6	12.79 ±0.7	-
Daily sales value (EGP/day)	5,815 ±812	18,003 ±3,838	1,462 ±398	-
Financial performance				
Annual sales value (EGP/yr)	1,744,425±243,647	5,400,780±1,151,466	438,573±119,393	1,971,523
Operating costs (EGP/yr)	1,481,428±189,029	4,319,974±1,055,661	341,312±97,380	1,602,800
Operating profit (EGP/yr)	262,998±71,242	1,080,806±151,294	97,261±22,982	368,723
Labor costs (EGP/t)	494 ±71	299 ±64	622 ±178	507
Operating profit (EGP/t)	1,249 ±275	2,340 ±364	2,873±187	2,192
Operating profit/sales (%)	13 ±2.6	22 ±2.8	25 ±2.2	20
Fixed costs (EGP/yr)	39,256±5,966	64,450±17,292	10,059±1,951	32,038
Net profit (EGP/yr)	223,741±74,822	1,016,356±136,887	87,203±21,711	336,684
Net profit per ton (EGP/t)	1,009 ±314	2,214 ±363	2,565±191	1,948
Net profit/sales (%)	11 ±3.1	21 ±2.8	22 ±2	18
Total value added (EGP/t)	1,503 ±254	2,513 ±406	3,187 ±235	2,455

Source: Computed survey data.

indicates that the highest volume of fish sales is in wholesaler actors' group (519 t/year) compared to intermediaries (187 t/year), and only 34 t/year in retailers. A similar trend is shown in daily sales value. The daily sales value is in the following descending order wholesalers, intermediaries and retailer (18,003, 5815 and 1462 EGP, respectively). Average sales price per kg of tilapia indicated that wholesalers made around one EGP per kg, while retailers added more than 2 EGP for every kilogram sold to cover their expenses and generate income.

Analyses of input and output costs indicate that the three traders group is all making good profits from fish sales. Fish retailer generated the highest return on operating costs 25%. A lower return recorded in wholesaler trades 22%. While the lowest return on operating costs was in intermediaries 13%. The average net profits as a percentage of sales revenue were similar for wholesalers and retailers, but lower in intermediaries. Similar result reported during studying value chain of Lake Malawi by Phiri et al. (2013), who reported that fish retailer generates a slightly higher net profit. The highest employment generation rate was in fish retailers 7.08 FTE per every 100t sold, intermediaries generate 3.19 FTE per 100t sold and the lowest FTE generation was in wholesales (FTE 1.63 FTE/ 100 t sold). Labor costs per every metric ton sold were highest for retailers. While the lowest labor cost per ton sold was in wholesalers. The result indicates that fixed costs were highest for

wholesalers and lowest for retailers. On the other hand, the highest value added generated per 100 t fish sold was in the retailing, followed by wholesaling, and intermediaries (Table 4).

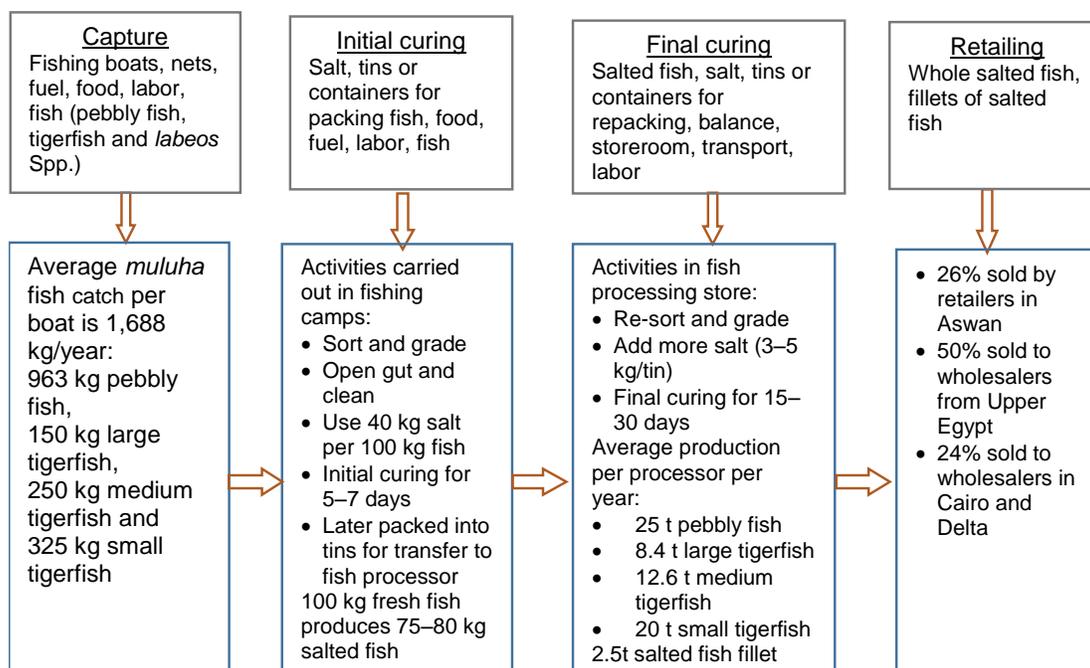
Operational characteristics and financial performance of fish processing

Table 4 presents data of operational characteristic of fish processing establishment in High Dam Lake. The obtained result indicates that average years of experience were noticeably higher in fish salting processing (21.7) than fresh fish processing (9.9). One-third of the fish processing operators had other income sources; for instance, owning fishing boats and collect fish from their boats or fishers for processing. The average quantity of sales per processing facility was higher for fresh fish (98.4 t/yr) compared to salted fish (70.9 t/yr). The average sales prices of all fish species were also higher for fresh fish processors group (EGP 20.9 kg) compared to salted fish (EGP 13.6 kg). Fresh fish processing focused mainly on tilapia (97% of quantity processed) compared to Nile perch (1.5%). Tilapia degutted represent (82%) while sales of Nile tilapia fillets represented 15% of fresh fish processed. Salted fish processing focused mainly on different size grades of tigerfish (58%) and pebbly fish (35%). Salted fish processing steps are illustrated in Figure 4.

Table 4. Summary of operational data of fish processing in the High Dam Lake.

General information	Salted fish	Fresh fish
Number interviewed (sample size)	14	8
Experience in fish processing (yr)	21.7	9.9
Other income source (%)	35.7	25.0
Annual sales volume (t)	70.94±11	98.25±27
Average FTE/100 t	5.5±0.6	5.7±1.6
Sales price (EGP/kg; all species)	13.6±0.7	20.9±3.6
Sales volume distribution by species (%)		
Tilapia fillet (kg)	-	95,316 (97)
Other fish (kg)	-	2938 (2.9)
Tigerfish (kg)	41,197 (58.1)	-
Pebbly fish (kg)	25,071 (35.3)	-
Other species (kg)	4,671 (6.6)	-

Note: Numbers in parentheses refer to % of total fish processed.
Source: Computed survey data.

**Figure 4.** Salting fish processing steps in the High Dam Lake.

Salted fish (*muluha*) is a product that is unique to High Dam Lake and produced from tigerfish (*Hydrocynus* spp.), pebbly fish (*Alestes* spp.), Nile carp (*Labeo* spp.) and other species that are not marketed fresh. The process of fish salting start with gutting and salting the fish in plastic containers, during which salt absorb the liquid from the fish. After around three weeks, the moisture content has dropped, and it is a stable product for transporting from fishing camp to inland processors

store. The processors repack the product into tins or jars for distribution and sale across Egypt (Nasr-Allah and Zakar, 2018). Adeleke et al. (2015) reported that fishers in Ondo State in Nigeria are practicing other form of processing such as precooking, drying and smoking. They also reported that 33% of fishers preserve fish through drying. The current study revealed that none of the fishers interviewed practice fish drying.

Obtained data of the financial performance for fish

Table 5. Fish processors financial performance in the High Dam Lake.

Financial performance	Salted fish	Fresh fish
Annual sales revenue (EGP)	975,046±164,388	1,766,025±305,132
Operating costs (EGP)	788,288±105,105	1,526,789±264,343
Operating costs (EGP/t)	11,112±634	15,539±2,686
Operating profit (EGP/t)	2,091±558	3,028±1,054
Operating profit/sales (%)	15±3	12.9±2.6
Fixed costs per metric ton	151±24	324±110
Net profit (EGP/t)	1,939±567	2,703±1,058
Net profit / sales (%)	13.8±3.1	11.3±2.9
Labor costs (EGP/t)	567±71	948±214
Total value added (EGP/t)	2,507±538	3,652±1,036

Source: Computed survey data 2016.

Table 6. Change in sales prices in the small-scale fisheries value chain.

Subsector	Average price EGP/kg	% of consumer prices
Fishers	6.29	49
Intermediaries	9.32	73
Wholesalers	10.40	81
Retailers	12.79	100

Source: Computed survey data.

processors in High Dam Lake are listed in Table 5. The result indicates that gross revenue was higher in fresh fish processing compared to salted fish processing. This can be due to higher sales volume and sales prices per kilogram product in fresh fish processing establishments. The cost of input cost in fresh fish processing contributed to higher overall operating costs compared to salt processing. Average operating profits for fresh fish processors were also higher, but when labor costs per metric ton were included, the average operating profit as a percentage of sales revenue was lower than for salted fish producers. The obtained result revealed that net profit per metric ton was higher in fresh fish processing, but average net profit as (percentage of sales) was lower for fresh fish producers. This can be justified due to the higher level of fixed cost in fresh fish processing businesses (Table 5). Akinola et al. (2006) reported that fish preservation using smoking and drying is common in the Niger Delta. The authors attributed that to the less access to electricity by fisheries communities.

Value chain performance

Changes in product price across the value chain are displayed in Table 6. The obtained result indicates that prices increase at each node across the chain. The result revealed that fishers` sales price just below 50% of the

final retail price. Similar result reported by Phiri et al. (2016) in Lake Malawi. The authors reported that fishers in Lake Malawi receive only around 44.8% of consumer sales price. This is contrary to aquaculture value chain in Egypt, as fish producers receive 71% of the consumer price (Macfadyen et al., 2012).

Operational profits, net profits and value added (per ton) at each node in the chain are presented in Table 7. The study results revealed that the fish retailing generate the highest operational and net profits (EGP/ t of fish sold). While, fishers generate the highest return on operation costs, followed by fish retailers. Calculation of net profit revealed that retailers and wholesalers are achieving the highest return on investment. The highest value-added generation was in fish retailers. Both generate 62% of the value added per ton caught and sold. While, wholesalers generated only 24% (EGP 2513/t) of value added per metric ton. The obtained result shows noticeably high value-added generation across the value chain compared to value added generated in the Egyptian aquaculture value-chain reported by Macfadyen et al. (2012).

Studying High Dam Lake small-scale fisheries value chain revealed that, fish processing is an important activity. A summary of fish processing performance data is presented in Table 8. The obtained result revealed that higher FTE is generated in fresh fish processing compared with salted fish processing. Costs of labor and

Table 7. Summary of financial performance of the small-scale fishers and fish traders.

		Fishers	Intermediaries	Wholesalers	Retailers	Total
Operation profit	EGP/t	2511	1249	2340	2873	8972
	%	37.3	13.4	21.7	24.9	
	% of total	28	14	26	32	100
Net profit	EGP/t	1107	1009	2214	2565	6896
	%	15.2	10.8	20.5	22.2	
	% of total	16	15	32	37	100
Total value added	EGP/t	3172	1503	2513	3187	10375
	%	31	14	24	31	
	% of total	30.6	14.5	24.2	30.7	100

Source: Computed survey data.

Table 8. Summary of fish processors performance.

Parameter	Salted fish	Fresh fish	Overall
FTE/100 t	5.5	5.7	5.6
Output value or basket price (EGP/t)	13,597	20,898	16,252
Labor cost (EGP/t)	567	948	706
Operational profit (EGP/t)	2,091	3,027	2,431
Net profit (EGP/t)	1,939	2,703	2,217
Value added (EGP/t)	2,507	3,652	2,923

Source: Computed survey data.

sales value per ton were higher in fresh fish processing compared to salted fish processing. Similar trend exists in operational and net profits. The obtained result revealed that fresh fish processing generates noticeably higher value added per ton (EGP 3652) compared to fish salting processing (EGP 2507). This can be attributed to the high cost of labor in fresh fish processing compared to salted processors. Similar conclusion reported by, Anihouvi et al. (2012) and Nasr-Allah and Zakar (2018), who stated that salted fish is low cost methods of fish preservation.

Job creation in High Dam Lake fishery value chain

The current study revealed that fishing subsector generates in total 30 employment opportunity (FTE) per every 100 t of fish caught and sold in the High Dam. The highest employment level was in fishing (18.1 FTE/ 100 t of catch, or 60% of total FTE created) followed by retailing (24% of FTE), and intermediaries (11% of FTE) and wholesaling at (5% of FTE) (Table 9). Small-scale fisheries in High Dam Lake represent an attractive job opportunity for fishers from Upper Egypt governorates (Table 9). The current study found that most works were full time (>79%) indicating that fish businesses generate a good level of income across all subsectors.

Furthermore, in fish trade (retail and wholesale), almost all employment was full time more than 95%. Youth (≤ 30 -year age) represented 49–59% of total FTE. This can be considered indicator for accepting youth working in the fisheries value chain. Due to the remoteness of fishing grounds from harbors and residential areas and poor living conditions in fishing camps, all fishers interviewed were men. The current result revealed that around 15% of the catches are used in fish processing. Average job generation in fish processing is 5.5 FTE/100 t of fish processed. Lower contribution to FTE generation in the aquaculture value chain and fish seed value-chain in Egypt was reported by Macfadyen et al. (2012) and Nasr-Allah et al. (2014).

Analysis of critical factors limiting fisheries development

The output of focus group discussions (FGD), which held with board members of fishers' associations and resulted in the identification of a series of challenges and potential solutions as follows:

- (i) Livelihood challenges (affording fuel and bread required during a fishing trip, poor living condition in the lake, no compensation scheme for boat loss, lack of

Table 9. Employment creation in the High Dam Lake small-scale fisheries value chain.

Employment	Jobs (FTE)/100 t sold	Percentage across the value chain	Full-time jobs (% of FTE)	Youth (% less than 30 years old)	Source of labor	
					Aswan (%)	Other governorates (%)
Fishers	18.1	60	79	57	9	91
Intermediaries	3.19	11	78	53	47	53
Wholesalers	1.63	5	95	59	50	50
Fish retailers	7.08	24	97	49	35	65
TOTAL	29.99	100				

Source: Computed survey data.

health service and no maintenance of navigation lighting system in the Lake).

(ii) Inputs availability challenges (access to credit; lack of skilled labor, high cost and poor ice quality).

(iii) Operation challenges (lax of enforcement of security in and around the Lake and overfishing problem due to illegal fishing methods).

(iv) Post-harvest and marketing challenges (poor post handling and absences of a fish auction in Aswan).

Recommended action for improving value chain performance

Suggested recommendations for improving value chain performance in this study mainly based on the critical issues identified during the FGD and issues raised by fishers during interviewing.

(i) Establish new service organizations to provide inputs (such as nets, handling boxes and fish-salting equipment) and help with fish marketing. Also, facilitate getting operations inputs such as food, fuel and ice.

(ii) Develop community-based fisheries management plan to create an awareness among stakeholders about the current situation in the Lake. The plan should emphasize on the importance of adopting best fisheries management practice to avoid overfishing in the lake.

(iii) Improve living condition within the fishing camps in the lake. Renovate health care service boats providing basic services for fishers in the Lake.

(iv) Train fishers on deliver first aid to victims until they can reach medical centers to get the appropriate treatment and medical care.

(v) Establish social and health insurance scheme for fishers as they work in a vulnerable situation.

(vi) Train fishers on the importance of good fish handling practices in maintaining quality, reduce spoilage, extend shelf life in markets and obtain higher selling prices.

(vii) Local authority should support establishing fish auctions in both Aswan and Abu Simbel to regulate fish prices.

(viii) Provide training on processing of both fresh and

salted fish and the conversion of fish processing waste into fishmeal should be promoted to increase processors income.

Conclusion

High Dam Lake small-scale fishery is an important source of income and food security in Aswan and Upper Egypt. The current study has revealed that the small-fisheries value chain in the lake is important for economic activity, profits and employment. The long-term experience in the sector indicating that working in the value chain represents a good source of income for living for a long time. Small-scale fisheries value chain in the lake contributes significantly to direct job creation, including for youth.

However, there are no identified women employed in fish processing. The study identified a number of challenges such as overfishing due to lack of security and enforcement of regulations including legal mesh size and closed fishing periods. Official catch record indicates a declining trend in the last years mainly due to reduced tilapia catches. The opportunities for improving the small-scale fisheries value chain performance, provides a strong argument for intervention required by private-sector to maintain employment benefits generated in the sector, and to increase such benefits in the future.

This study revealed that value chain analysis could be used for understanding the financial benefits that are generated in the sector. The study identified the critical factors that are affecting the financial and social performance of the value chain. Identifying sector limiting factors can be used for recommending actions for better financial and social benefits generated across the chain. The study recommends some of the necessary actions to ameliorate this sector will be the responsibility of the sector itself, government, donors and local organizations.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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