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Value Stream Analysis and Middlemen Impact of Skipjack Tuna and Smoothbelly Sardinella Dried Fish Value Chains in Sri Lanka

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Abstract

Value-added activities, chain structures and middlemen impact are incomprehensible in dried fish economy. Processors have the significant impact at the initial stage of the value chain, but little control over value chain management; however vastly monopolized by intermediaries. Yet, the processors receive poor returns compared to other actors in the value chain. Value stream analysis visualizes the value additions incorporated by all the actors and agents in the value chain. Despite the literature states of different returns along the value chain, a comprehensive mapping is needed to assess the contribution by actors and agents over Value Added (VA), Necessary Value Added (NVA) and Non-Necessary Value Added activities (NNVA). This will enable fair and efficient functions in the value chain. The same scenario is common in dried fish value chains in Sri Lanka which is inadequately researched. This study aims to conduct a value stream analysis, middlemen impact assessment and their relationship for skipjack tuna and smoothbelly sardinella dried fish value chains representing the highest per-capita consumption dried fish varieties in Sri Lanka. Hambantota, Matara, Puttalam and Gampaha were selected to conduct the study representing the highest dried fish production districts. Quantitative data collection method was adopted employing a pre-tested structured questionnaire. Simple random and snowball sampling technique were used to draw the sample from processors, wholesalers and retailers where the sample sizes were 100, 80 and 80 respectively. Secondary data were collected from reputed published materials. Data were analyzed mainly using descriptive techniques. The number of VA, NVA and NNVA activities are approximately decreased through skipjack tuna value chain as processor (VA-10, NVA-01, NNVA-02), wholesaler (VA-2, NVA-1, NNVA-4) and retailer (VA-02, NVA-01, NNVA-01) and for smoothbelly sardinella processor (VA-08, NVA-01, NNVA-02), wholesaler (VA-02, NVA-01, NNVA-02) and retailer (VA-01, NVA-01, NNVA-02) levels. Time spent for each activity is decreased through value chain for both dried fish varieties. The market margins for skipjack tuna and smoothbelly sardinella are 46.64% and 38.19% respectively. Profit margins are increased along the value chain at the processor, wholesaler and retailer levels for skipjack tuna (9.63%, 15.25%, 27.22%) and smoothbelly sardinella (12.53%, 14.23%, 20.98%) respectively. In contrast, profit gain was not fairly distributed along the value chain proportionately contribution to activities and times spent by actors. This recommended an effective mechanism for fair profit sharing for dried fish actors based on their contribution to value addition and time spent on each activity.

Keywords: Dried fish, middlemen impact, value chain, value stream analysis

Introduction

Value Chain and Value Stream Mapping

Value chain analysis and mapping are visualizing the movement of resources, products, and information from one channel to another or from the manufacturer to the consumer [16]. Value stream mapping is used to assess the cycle timings, uptimes, change-over times, in-process inventories, information flow pathways, total lead time and number of personnel and material movements [30]. Value stream mapping

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is profusely used in a vast arena such as food losses, waste management [5], fish and dried fish production [16], dairy industry [38], agro-food supply chain [21] and industries including pump assembly process [6], and natural dye batik production [11].

The value chain analysis and value stream mapping are important in upgrading opportunities, discovering and planning process possibilities including improvements in quality and product design, the flow of resources and information required to deliver a product to a consumer [3, 39]. It allow manufacturers to earn extra value or to incorporate the diversity into the product lines they serve [30]. Further, it is discovered opportunities for raising value by enhancing the product, producing it more effectively, or adding improved value services [19]. The distribution of information and knowledge throughout the value chain is critical to its efficiency and productivity, and it is thus a key aspect of actor interactions and collaboration [37]. Product-related data from upstream actors must travel down to the market and from the market to downstream actors [23]. Knowledge must also travel in the opposite direction, from the market to the suppliers, to provide quick specifications and information on how to please the consumer with unique products [8].

Furthermore, there are similar research related to fish and dried fish value chain analysis and value stream mapping at local and international level. Value stream analysis of dried fish's supply chain in Bangladesh [16], a simulation-based performance investigation of downstream operations in the Indian Surimi supply chain using environmental value stream mapping [34], analysis of risk in the value stream of supply chain management of the marine fresh fish product, case of the coastal zone, Java Island, Indonesia [35], value stream mapping: literature review and implications for Indian industry [32], an evaluation of the value stream mapping tool [22], and value stream mapping to add value and eliminate Muda [29] are identified as value stream mapping related researches.

Value Addition and Agent in the Value Chain

The dried fish value chain is a collection of actions that add value to produce valuable dried fish products at every step of the process, from sourcing to manufacture, distribution, and final consumption [20]. The value of the operations and margins are made throughout the Sri Lankan fisheries' whole value chain [8].

Fish is prepared in a variety of ways, the most common of which is smoking and drying. The majority of the processing takes done at the individual or family level [10]. There are several phases to the processing of fish: first, it is washed in a channel, at that point it is dumped on a tangle and the fish are orchestrated with all the heads pointing a similar way, at that point it is washed in a can, what's more, held tight a low bamboo fence/platform [1]. After it has dried a little the tails are tied together and it is hung up to dry once more (for the most part on a taller platform) [17]. Fish are pre-dried on a rack until the tails are sufficiently dry to bunch, and afterwards the tails are integrated [31].

The value chain is condensed into three primary operations with so-called 'vertical connections' in its simplest form from processors to consumption through marketing [20, 30]. A variety of commodities and services are required to convert and move the product at each level along the value chain toward the end customers [30]. This is all part of the value chain for fisheries [10]. The research assessed six major value-chain actors within the Ethiopian fish market: fishers, collectors, wholesalers, manufacturers, retailers, and customers, who are involved in value-adding, supplying, accumulating, marketing and consuming [19].

Similar researches are identified as fish drying, processing methods and value addition technique [20], a study on the quality and safety aspect of three sun-dried fish [24], sanitation, fish handling and artisanal fish processing within fishing communities: socio-cultural influences [26], a review on dried fish processing and marketing in the coastal region of Bangladesh [27], adoption of hygienic fish handling practices by fishermen [32] and salt based dry fish processing and marketing by fishers of the Minneriya reservoir in Sri Lanka [33].

Middlemen Impact

Middlemen are key linkages in supply chains for communicating and supporting management actions for fisheries sustainability in specific conditions. However, they have nefarious motives; they can hasten the loss of local resources [36] between the assembly and the retail market. Small-scale fishermen's receive comparatively low returns for some processed species compared to downstream players might be related to a lack of information about the market value of these goods [2]. Increasing information openness in the value chain, for example, by making market pricing publicly accessible, might help to alleviate the lack of evidence on which fishers can demand higher prices from intermediaries or exporters [28]. However, more openness may not result in higher prices for fishermen unless they can also unite to obtain greater market power as a group. Transparency in value chains also function only if the information is trustworthy [12].

Poor processing and handling practices cause deterioration of product quality, nutritional value and food safety in most countries including Sri Lanka. Therefore, stringent hygiene measures with value addition should be implemented at the national, regional, and international levels to satisfy these food safety and quality requirements and assure consumer protection [18]. Processors have a significant impact at the initial stage of the value chain, but little control over value chain management; however vastly monopolized by intermediaries [19]. Yet, the processors receive poor returns compared to other actors in the value chain [19] [16]. Value stream analysis visualizes the value additions incorporated by all the actors and agents in the value chain [16]. Despite the literature states of different returns along the value chain [40], a comprehensive mapping is needed to assess the contribution by actors and agents over Value Added (VA), Necessary Value Added (NVA) and Non-Necessary Value Added activities (NNVA) [16]. This will enable fair and efficient functions in the value chain. The same scenario is common in dried fish value chains in Sri Lanka but is inadequately researched. In terms of species, processing, and product forms destined for food or non-food applications, fisheries and aquaculture production is quite diverse [13] and dried fish production is identified as a diversified industry. However, in recent decades, growth in worldwide marketing, trading, and consumption of fish and dried fish products has been accompanied by considerable improvements in food quality and safety standards, as well as enhanced nutritional characteristics and loss reduction [7].

Therefore, this study mainly aims to conduct a value stream analysis, middleman impact assessment and to identify the relationship between those components of skipjack tuna and smoothbelly sardinella dried fish value chain in the south and west coast of Sri Lanka. Especially, to the identification of Value-Added

Activities (VA), Non-Value Added Activities (NVA), and Necessary-Non-Value Added Activities (NNVA), time spent for each activity and market margin variation through the Sri Lankan dried fish value chains.

Methodology

Dried fish varieties representing large pelagic and small pelagic were considered for comparative analysis. Accordingly, skipjack tuna (*Katsuwonus pelamis*) and smoothbelly sardinella (*Amblygaster cluepeoides*) were selected respectively. These two varieties were highest per capita and households' consumption dried fish varieties from each type [4]. Also, these selected two varieties were mainly produce in Sri Lanka [25].

Table 01. Household consumption of dried fish varieties (grams/month)

Dried fish varieties	**2009**	**2012**	**2016**	**2019**
Small pelagic group				
Sprattus sprattus (Sprats)**	556.44	500.22	487.00	479.30
Amblygaster clupeoides (Smoothbelly sardinella)	69.46	93.18	76.41	92.84
Sardinella gibbosa (Gold-striped sardinella)	48.52	47.99	43.69	40.07
Amblygaster sirm (Trenched sardinella)	34.36	41.40	22.85	22.76
Large pelagic				
Scomberoides lysan (Double-spotted queen fish)	78.43	74.80	74.82	80.02
Katsuwonus pelamis (Skipjack tuna)	140.24	111.42	113.15	126.92
Carcharhinus sp. (Shark)	93.93	79.74	84.19	90.26
Carangoides fulvoguttatusf (Yellow-spotted trevally)	6.58	6.31	5.75	6.52
Arlus thalassinus (Giant catfish)	69.48	54.07	41.23	28.87

Source: Department of Census and Statistics [4]/ **More than 70% are imported [25]

Four main fisheries districts were selected as key study sites concerning the major dried fish variety produced. Hambantota and Matara districts in Southern Province are the main production area of large pelagic dried fish due to the prevalence of the number of harbors with 1598 multiday boats [25]. In contrast, Negombo and Puttalam were selected for small pelagic as these areas host small-scale fisheries occupying more than 75% of small-scale fishers. Sample distribution and composition are given in Table 02.

Table 02. Selected sample size in each area

Dried fish variety	District	Study site	Sample size (n)
Skipjack tuna	Hambantota, Matara	Kudawella and Devinuwara	Processors- 50 Traders- 40

Smoothbelly sardinella	Gampaha, Puttalama	Negambo and Kalpitiya	Processors- 50 Traders- 40

Primary data were gathered by administering a structured questionnaire via a simple random sampling technique and snowball sampling technique. Data were mainly collected on different value-added activities at processors, wholesalers and retailers levels, time spent for each activity, the cost associated with value addition and price variation of two dried fish value chains. The sampling frame was the name list of dried fish producers and traders available in each fisheries association and government office. Secondary data were collected from Hector Kobbekaduwa Agrarian Research and Training Institute's weekly food commodities bulletin and other relevant organizations such as the Department of Census and Statistics and the Ministry of Fisheries and Aquatic Resources Development. Data analysis was done mainly through descriptive statistics methods and following the Value Stream Mapping (VSM) technique.

Value Stream Mapping

Value stream mapping was conducted to discover and plan process possibilities, and concentrate on the flow of resources and information required to deliver a product to a consumer. Three categories of activities namely Value-Added Activities (VA), Non-Value Added Activities (NVA), and Necessary-Non-Value Added Activities (NNVA) (NNVA) [16] were identified. Different activities listed under each category are given below.

Value-Added Activities (VA) are identified as activities which directly involve with the dried fish production activities like cutting, mixing, drying etc. Without these value-added functions there can't be produced dried fish. Non-Value Added Activities (NVA) is the stocking of the dried fish in various middlemen warehouses like processors, wholesalers and retailers hold it as their inventory which ultimately adds no value to the dried fish. Again some of the activities involve to the movement of dried fish. These are the transportation, receiving and storing of fish by various intermediaries. These are called necessary-Non-Value Added Activities (NNVA) [16]. Individual interviews and field observations were conducted to identify each VA, NVA and NNVA activity as well as the time spent on each activity. The number of three types of activities and mean time spent on each activity were calculated by using total interviews conducted at processors, wholesalers and retailers levels by using the methods like Hossain and Masud [16].

Calculation of Middleman Impact

Average price variations of skipjack tuna (*Katsuwonus pelamis*) and smoothbelly sardinella (*Amblygaster cluepeoides*) varieties at each value chain level and cost associated with value addition were calculated to identify middlemen impact through market margin, profit margin and share of value chain actors. These methods were widely used to calculate middlemen impact in most of the local and international research. Following the methods of Sandika [41], market margin, profit margin and actors' share were calculated by using following equations.

$$\text{Market margin for dried fish} = (\text{Ps}/\text{Sp}) \times 100\% \qquad \text{Equation (1)}$$

$$\text{Ps} = \text{price spread (paid price} - \text{sale price in rupees)} \qquad \text{Equation (2)}$$

Sp = Sale price in rupees

$$\text{Profit} = \text{Total Revenue} - \text{Total Cost} \qquad \text{Equation (3)}$$

$$\text{Cost share} = \frac{\text{Total cost}}{\text{Total revenue}} * 100\% \qquad \text{Equation (4)}$$

$$\text{Profit share} = \text{Value chain actors share} - \text{Cost share equation} \qquad \text{Equation (5)}$$

Assuming,

Processor price = a, Wholesaler price = b, Retailer price = c

The equation depicted below was adapted to calculate the share in consumer's rupee for each segment of dried fish value chain.

Market margin% = {(c-a)/c} ×100% Equation (6)

$$\text{Processor's share \%} = \{a/c\} \times 100\% \qquad \text{Equation (7)}$$

Wholesaler's share% = {(b-a)/c} ×100% Equation (8)

Retailer's share% = {(c-b)/c} ×100% Equation (9)

Results and Discussion

Main Processing Sequences

Skipjack tuna (*Kastuwamas pelamis*) and smoothbelly sardinella (*Amblygaster cluepeoides)* dried fish processors in the southwest area using special processing techniques when producing dried fish. The following figure 01 illustrates the small and large pelagic fish processing sequences for selected fish varieties.

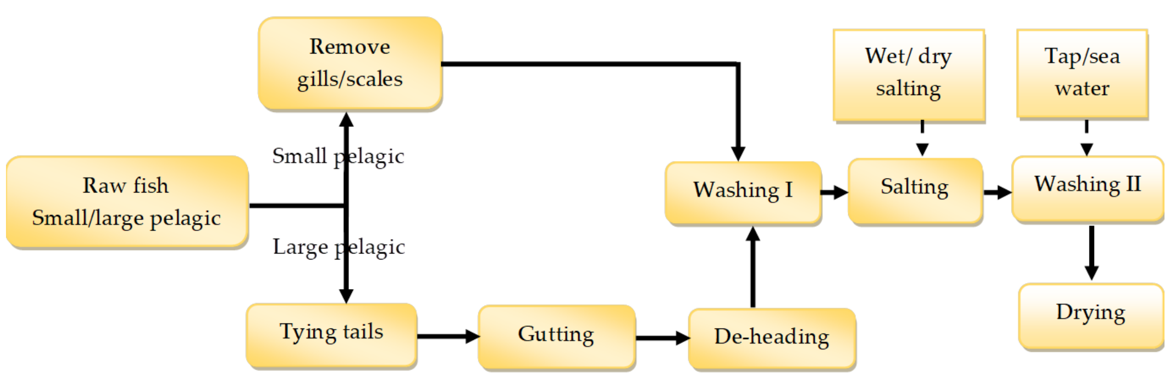

Figure 01. Major steps of small and large pelagic dried fish production

They got approximately 1 kilogram of dried fish yield by processing 2.5-3.5 kg of big-size skipjack tuna raw fish and 1.75-3.25 kg of smoothbelly sardinella raw fish. However, the processing activities cater to the value addition while processing fish. There are a lot of value-added activities, non-value-added activities, and necessary value-added activities throughout the value chain from dried fish production to consumption. Other than the time spent on each activity is different. Therefore, value stream mapping and analysis are very important to the identification of whole activities from processing to consumption by calculating the time spent on each activity.

Value Stream Mapping and Analysis of Skipjack Tuna Dried Fish

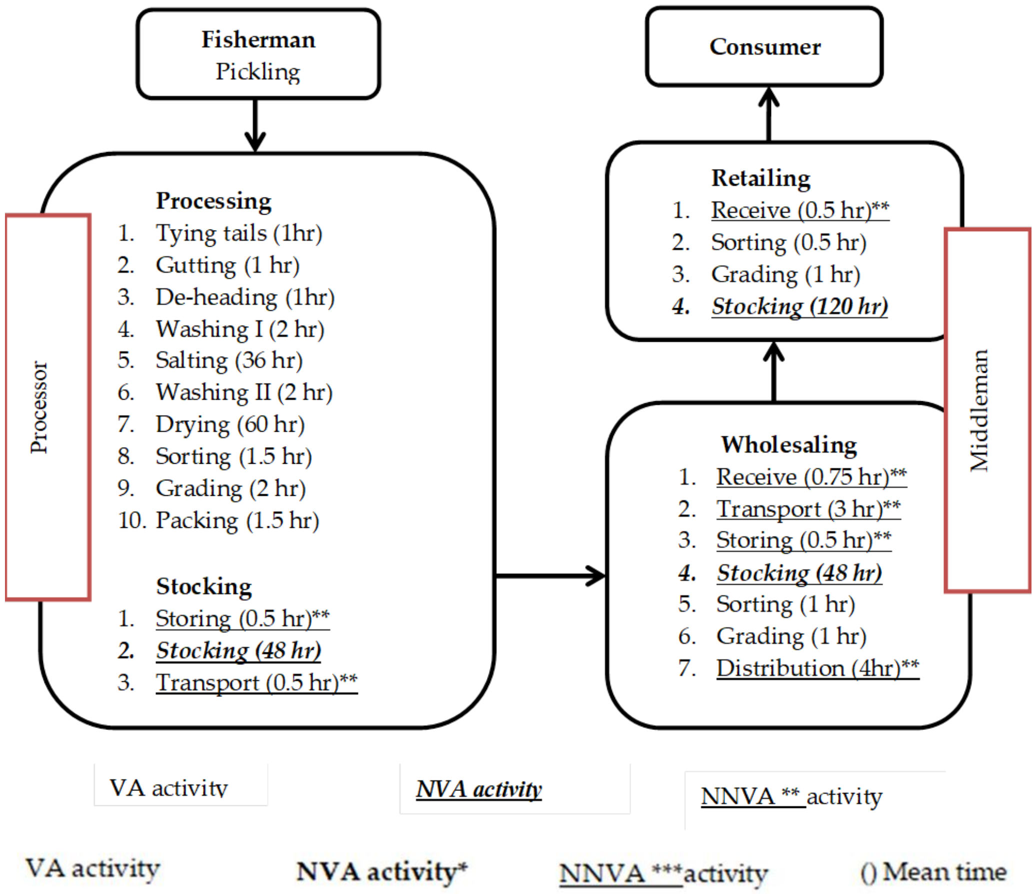

Figure 02. Value stream analysis of skipjack tuna dried fish (for 500kg raw fish)

Figure 02 illustrates the value stream analysis of skipjack tuna dried fish variety in the southern area. Different types of VA, NVA, and NNVA activities and the mean time spent to complete each activity are mentioned here for the major three levels of the value chain at the processor, wholesaler, and retailer levels. (See annex I for standard deviation and standard error values of time for each activity).

There are major 24 steps for skipjack tuna dried fish value stream analysis from production to retailing, 13 at the processor level, 07 at the wholesale level and 04 at the retailer level. Further total of 347.5 hrs is spent to complete the whole dried fish activities from processing to retailing by all value chain actors. Total of 121.5 hrs for VA activities, 216 hrs for NVA activities and 10 hrs for NNVA activities are spent to handle 200-250 kg of dried fish during the whole process. Moreover, there are 10 Value Added (VA) activities, 1 Necessary Value Added (NVA) activity and 2 Non-Necessary Value Added (NNVA) activities at the producer level. Also, 2 VA, 1 NVA and 4 NNVA activities are identified at the wholesaler' level while 2 VA, 1 NVA and 1 NNVA activities are observed at the retailer level. Processors spent a total of 157hrs to complete their activities, 118 hrs for VA activities, 48 hrs for NVA and 1 hrs for NNVA activities. Wholesaler spent a total of 58.25 hrs within the whole process as 2 hrs for VA activities, 48 hrs for NVA and 8.5 hrs for NNVA activities. The retailer spent total of 122 hrs as 1.5hrs for VA activities, 120hrs for NVA and 0.5 hrs for NNVA activities.

Percentage comparison of different value-added activities, non-value added activities and necessary non-value added activities with respective time spent are important to improve awareness of value-added production at different actor's levels. It helps to expand quality, safety production and management of different activities effectively. Table 03 reveal the results of percentage distribution of VA, NVA and NNVA activities and time for each activity at skipjack tuna producer, wholesaler and retailer level for handling 500kg of raw skipjack tuna fish.

Table 03. Activities and time percentage of skipjack tuna at each actor's level (for 500 kg raw fish)

		Activities			**Times**		
		No. of activities	%	%	**Hours**	%	%
Value-added activities (VA)	Processor	10	71.42	41.66	118	97.11	33.96
	Wholesaler	2	14.28	8.33	2	1.64	0.58
	Retailer	2	14.28	8.33	1.5	1.23	0.43
	Total	**14**	100	**58.33**	**121.5**	100	34.96
Non-Value-added Activities (NVA)	Processor	1	33.33	4.16	48	22.22	13.81
	Wholesaler	1	33.33	4.16	48	22.22	13.81
	Retailer	1	33.33	4.16	120	55.55	34.53
	Total	**3**	100	**12.5**	**216**	100	62.16
Necessary Non-Value-added Activities (NNVA)	Processor	2	28.57	8.33	1	10	0.29
	Wholesaler	4	57.14	16.66	8.5	85	2.46
	Retailer	1	14.28	4.16	0.5	5	0.14
	Total	**7**	100	29.16	**10**	100	2.87
Total		**24**		**100**	**347.5**		100

Value chain actors highly engage with the types of VA activities than NVA and NNVA activities by representing 58.33% of skipjack tuna. NNVA activity types are identified as the second highest involving activity representing 29.16% for skipjack tuna. The NVA activities are the least involving activities for value chain actors indicating 12.50%. However, skipjack tuna value chain actors spent the highest time doing NVA (62.16%) activities than the other two types of activities. There is the least time for NNVA activities as 2.87% within the whole process from processing to retailing.

Skipjack tuna processors engage with the highest percentage of VA activity types than NVA and NNVA. Wholesalers engage with the highest percentage of NNVA activities 16.66% than other two types of activity. Retailers mainly involve with VA activities (8.33%). Based on the time spent on each activity type, Skipjack tuna processors spent the highest time on VA activities (33.96%). Both wholesalers and retailers spent the highest time on NVA activities than the other two types of activities.

Value Stream Mapping and Analysis of Smoothbelly Sardinella Dried Fish

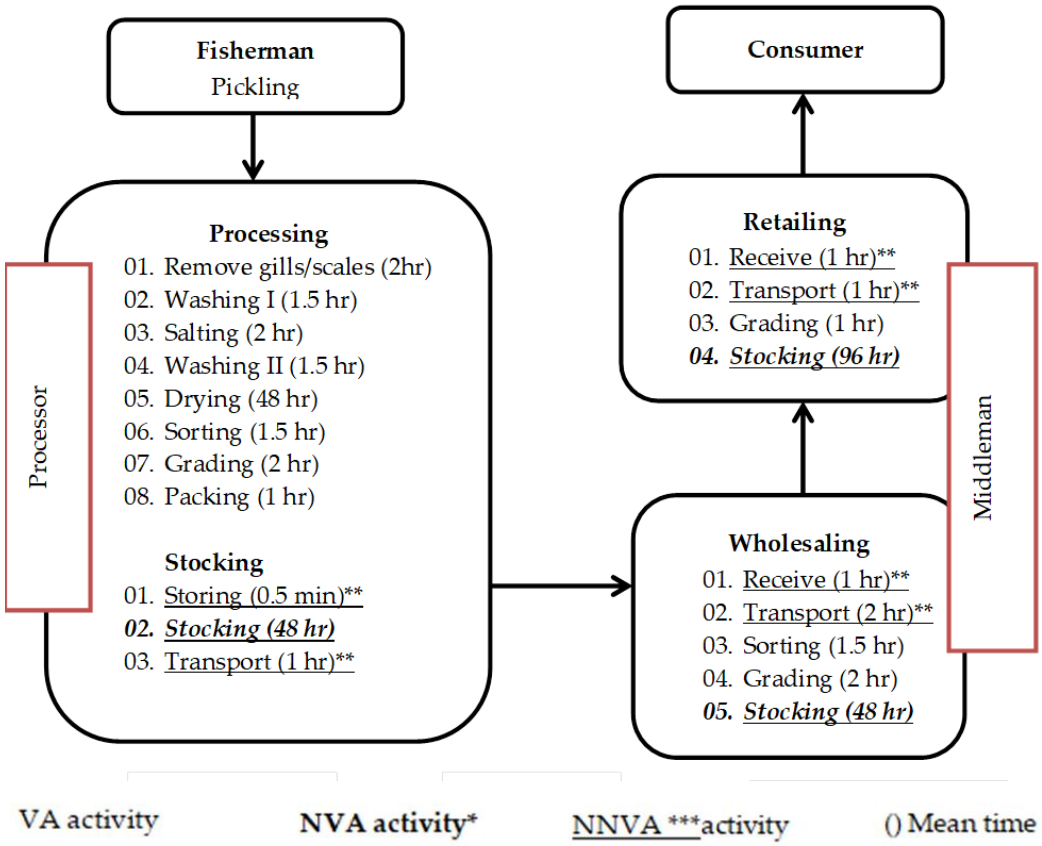

Figure 03. Value stream analysis of smoothbelly sardinella dried fish (for 500 kg raw fish)

Figure 03 illustrates the value stream analysis of gold-stripped sardinella dried fish in the southern area. Different types of VA, NVA and NNVA activities and the time spent on each activity are mentioned here for major three levels of the value chain processor, wholesaler, and retailer. (See annex II for Standard deviation and Standard error values for each activity).

There are major 20 steps for smoothbelly sardinella dried fish value stream analysis as 11 at the processor level, 05 at the wholesale level and 04 at the retailer level. Further total of 262.5 hrs is spent on the whole dried fish process to handle 200-250 kg of dried fish from processing to retailing. A total of 64 hrs for VA activities, 192 for NVA activities and 6.5 for NNVA activities are spent by value chain actors within the whole process. There are 08 Value Added (VA) activities, 02 Necessary Value Added (NVA) activities and 01 Non-Necessary Value Added (NNVA) activities at the producer level. The 1 VA, 1 NVA and 1 NNVA activities are identified at the wholesale level while 2 VA, 2 NVA and 2 NNVA activities are observed at the retailer level. Processors spent a total of 1.9 hrs to complete activities as 59.5hrs for VA activities, 48hrs for NVA and 1.5hrs for NNVA activities. Wholesaler spent a total of 54.5hrs as 3.5hrs for VA activities, 48 hrs for NVA while 3hrs for NNVA activities. The retailer spent total of 99 hrs as 1 hrs for VA activities, 96 hrs. for NVA and 2hrs for NNVA activities from processing to retailing.

Table 04 illustrates the percentage distribution of VA, NVA and NNVA activities and time for each activity at smoothbelly sardinella producer, wholesaler and retailer level for handling 500 kg of raw smoothbelly sardinella.

Table 04. Activities and time percentage of smoothbelly sardinella at each actor's level (for 500kg raw fish)

		Activities			**Times**		
		No. of activities	%	%	**Hours**	%	%
Value-added activities (VA)	**Processor**	8	72.73	40.00	59.5	92.97	22.67
	Wholesaler	2	18.18	10.00	3.5	5.47	1.33
	Retailer	1	9.09	5.00	1	1.56	0.38
	Total	**11**	100.00	55.00	**64**	100.00	24.38
Non-Value -added Activities (NVA)	**Processor**	1	33.33	5.00	48	25.00	18.29
	Wholesaler	1	33.33	5.00	48	25.00	18.29
	Retailer	1	33.33	5.00	96	50.00	36.57
	Total	**3**	100.00	15.00	**192**	100.00	73.14
Necessary-Non-Value -added Activities (NNVA)	**Processor**	2	33.33	10.00	1.5	23.08	0.57
	Wholesaler	2	33.33	10.00	3	46.15	1.14
	Retailer	2	33.33	10.00	2	30.77	0.76
	Total	**6**	100.00	30.00	**6.5**	100.00	2.48
Total		**20**		100	262.5		100

Value chain actors highly engage with the types of VA activities than NVA and NNVA activities by representing 55.00% of smoothbelly sardinella activities out of total activities. NNVA activities are identified as the second highest engaging activity type representing 30.0% while NVA is the least engaging activity type for value chain actors indicating 15.00%. However, value chain actors spent the highest time to complete NVA activities than the other two activity types for smoothbelly sardinella (73.14%) dried fish varieties within the whole process. There is the least time for NNVA activities as 2.48%. Smoothbelly sardinella processors engage with the highest percentage of VA activities than NVA and NNVA activities. Wholesalers engage with NNVA (10%) and VA (10%) activities as the highest percentage out of total activities from processing to retailing. Smoothbelly sardinella (10%) retailers mainly engage with NNVA activities than the other two types. Processors spent the highest time completing VA activities (22.67%). Both wholesalers and retailers spent the highest time completing NVA activities than the other two activity type.

Furthermore, processors' attentions to VA activities are higher than the other two types of activity compare to wholesalers and retailers of both skipjack tuna and smoothbelly sardinella dried fish value chain. All the wholesalers in both dried fish varieties put equal attention on NVA activities while skipjack tuna wholesalers give the highest attention to NNVA activities than other value chain actors. Also, all smoothbelly sardinella value chain actors give equal attention to NNVA activities. According to the spent

time variation, both dried fish processors spent the highest time completing VA activities than wholesalers and retailers. Both dried fish retailers spent the highest time practising NVA activities while wholesalers spent the highest time completing NNVA activities than other value chain actors.
Research [16] results are tallied with this value stream analysis results. The value stream of Bangladesh dried fish that is found is presented and explored primarily from two separate perspectives [16]. One example is when a fisherman is also a dried fish processor. Another example is when a fisherman and a dried fish processor are not the same individuals. According to this study on the value stream, the total number of actions is 18. There are total of 06 VA activities with 10-25 days, NVA activities are once again equal to four. Generally, these actions just suggest stocking in various hands such as producers and other intermediaries with the huge numbers of days. The final group is NNVA, which has eight activities [16]. Further, [42] indicates that actors contribution to value addition in the dried fish value chain in Bangladesh. It reveals that contributions of actors are decreased through the value chain from processors to sellers. In another research in Bangladesh, the overall value add situation is identified as from fisher to processor 16%, processors to wholesaler 7%, wholesaler to commission agent 5%, commission agent to dry fish seller 2% [42]. Other than that, results of [43] indicate that nature of major dried fish processing activities [33] of de-heading and gutting, washing, salting, rewashing, drying, and packing [43]. It also explores actors' contribution to value addition through dried fish value chain in Sri Lanka [8, 43].
Calculation of middleman impact by using market margin and profit margin is very important to identify profit distribution proportionately to effort they put when producing dried fish. Therefore, the next section described the middlemen impact for observed dried fish varieties separately at the producer, wholesaler and retailer levels of dried fish value chain.

Middleman Impact

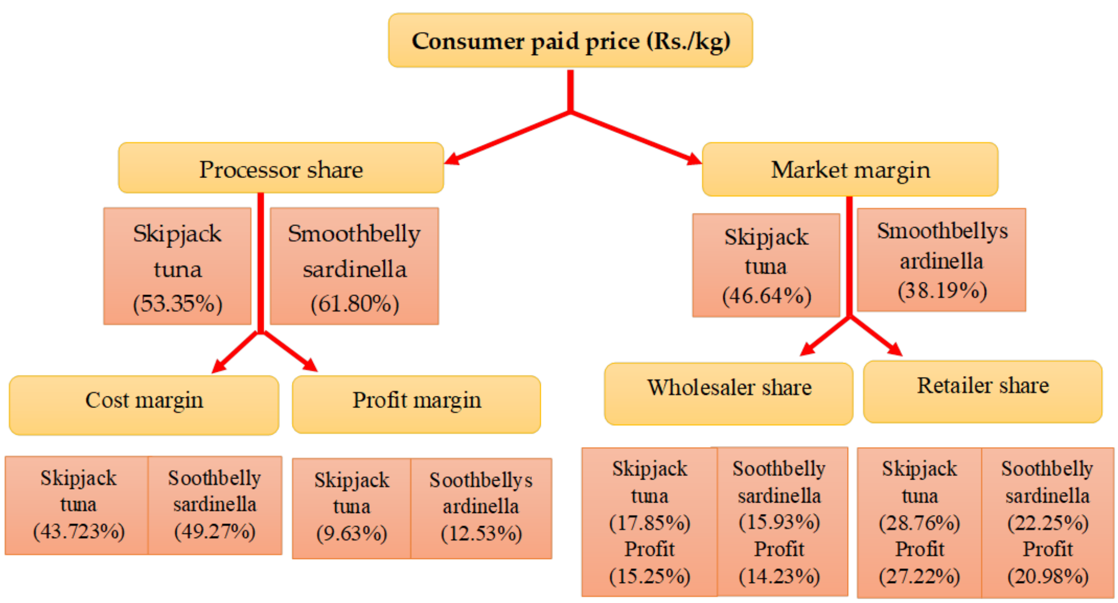

Figure 04. Market margin and shares of each dried fish value chain actors

Figure 04 illustrates the processor, wholesaler, and retailer's share and market margin variation through both dried fish value chains.

Results indicate that comparatively the highest percentage of processors' share for both dried fish varieties is 53.5% for skipjack tuna and 61.80% for smoothbelly sardinella than market margin (Skipjack tuna- 46.64%, 38.19%). Further, market margin is divided as 17.85% and 22.25% for skipjack tuna wholesaler and retailer share while 15.93% and 22.25% for smoothbelly sardinella wholesaler and retailer share respectively. However, the profit margin for dried fish processors of both dried fish varieties is very low comparatively wholesaler and retailer profit

The same results are found in most of the studies related to middlemen impact calculation. The data indicated that certain middlemen and exporters in most of the countries indicate very low rates to fishermen and fish processors for specific species compared to the price they sold for them [27]. Others appeared to utilize ethical methods and demand exorbitant fees for dried fish processors (e.g., more than 50% of their selling price) [9]. However, competition among intermediaries tends to minimize fisher exploitation at times [14].

Figure 05 indicates the scatter plot for percentage variation of profit, VA, NVA and NNVA activities, and total time along the dried fish value chain for skipjack tuna and smoothbelly sardinella dried fish varieties.

The figure shows as number 01 is the processor level, number 02 is the wholesaler and number 03 is the retailer level. In both skipjack tuna and smoothbelly sardinella dried fish value chain, the percentage of the profit of each value chain actor is increased; Percentage of VA activities are decreased. Value chain actors 'attentions toward NVA activities are constant throughout the value chain. Further, the percentages of total time for all activities are decreased in-between processor and wholesaler while increased in-between wholesaler and retailer. Percentage of NNVA activities are increased in-between processor and wholesaler while decreased in-between wholesaler and retailer in skipjack tuna dried fish value chain. The percentage of NNVA activities is constant through the value chain of smoothbelly sardinella dried fish.

In results of [16] cost is added to the product at every stage of the supply chain. As a result, prices are gradually rising. First, dried fish is transferred from the fisherman to the processor. Fisherman activities come with a huge cost. The fisherman sells it to the processor at a greater price than that paid. This price increase may change depending on the kind and time of year. When dried fish move from the processor to the retailer there is a huge cost associated along the value chain due to transportation [16]. There are other researches identifying the relationship between actors' contribution and their gains through the value chain [6],[35]. In most the countries like India [21], Bangladesh [16] and Indonesia [35] processors indicate the highest contribution to the dried fish value addition by contributing to VA, NVA and NNVA activities. But they gain less retain than other chain actors [16].

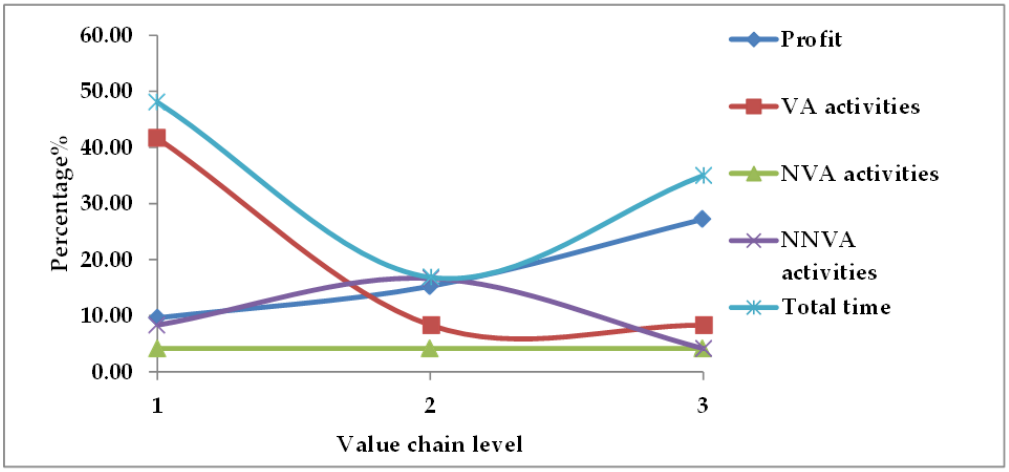

Figure 5a. Skipjacktuna

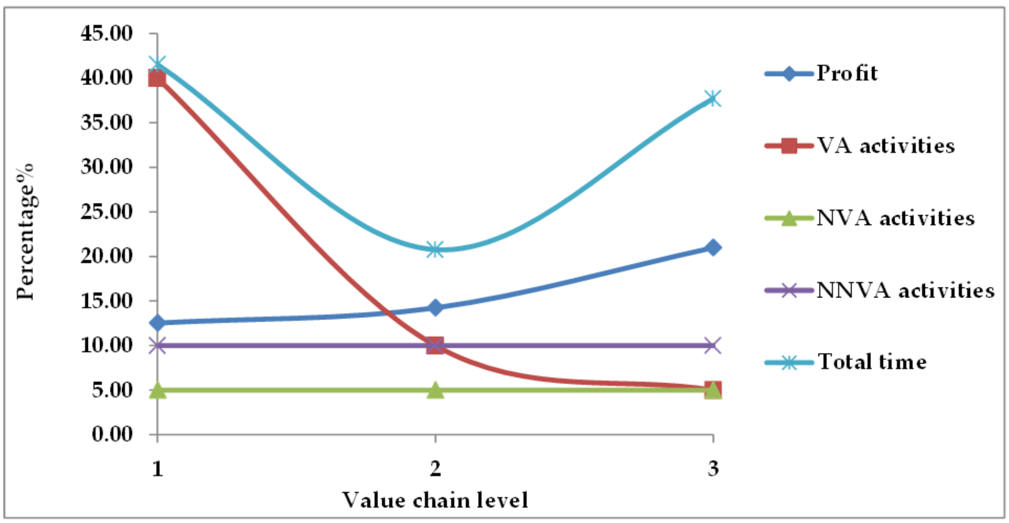

Figure 5b: Smoothbelly sardinella

Figure 05. Scatter plot for percentage variation of profit, activities and time along the value chain (for 500kg raw fish)

Conclusion

Having identified the economic importance of the dried fish industry in Sri Lanka, this study attempted to explore value stream analysis and middlemen impact of skipjack tuna and smoothbelly sardinella dried fish value chains in Sri Lanka representing large pelagic and small pelagic dried fish varieties respectively. Value chain actors' contribution to the sequence of processor, wholesaler and retailer were decreased over VA, NVA and NNVA activities. The number of activities performed by each actor in skipjack tuna value chain was as follows: processor (VA-10, NVA-01, NNVA-02), wholesaler (VA-2, NVA-1, NNVA-4) and retailer (VA-02, NVA-01, NNVA-01). The activities on smoothbelly sardinella value chains was processors (VA-08, NVA-01, NNVA-02), wholesalers (VA-02, NVA-01, NNVA-02) and retailers (VA-01, NVA-01, NNVA-02) respectively. Thus, a similar declining pattern was noted for both dried fish varieties. The market margin was comparatively higher around 46.64% for skipjack tuna and

38.19% for smoothbelly sardinella indicating a profit margin of 12.53%> for processors, 14.23 %< for wholesalers and 20.98 %< for retailers. It confirms lower profit margin received by the initial actors, hence the processors. This analysis unraveled unequal profit sharing and price distribution along the dried fish value chains compared to the level of value addition done at each node. Unfair, profit distribution from the processor to the retailer was noted where the middlemen absorb the lion's share dwindling the share for the processors who were the key actors in value addition in the dried fish value chains. Fair pricing and profit margins were advised through an effective pricing system based on the level of value addition at each node to improve the industry to motivate the actors and agents involved.

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Conflict of interest

The authors declare no conflict of interest.

References

[1] O.A. Akinola, A.A. Akinyemi, B.O. Bolaji, Evaluation of traditional and solar fish drying systems towards enhancing fish storage and preservation in Nigeria: Abeokuta local governments as case study, Journal of Fisheries International, **2006**, 1(2), 2-4.

[2] P. Barua, S.H. Rahman, M. Barua , Sustainable management of agriculture products value chain in responses to climate change for South-Eastern coast of Bangladesh. Modern Supply Chain Research and Applications. Modern Supply Chain Research and Applications, **2021**, 3(2), 98-126.

[3] T. Calzolari, A. Genovese, A. Brint, Circular Economy indicators for supply chains: A systematic literature review. Environmental and Sustainability Indicators, **2022**, 13 (1), 100-160.

[4] Department of Census and Statistics, Household Income and Expenditure Survey. Ministry of National Policies and Economic Affairs. Colombo 01, Sri Lanka. **2019**.

[5] H. De Steur, J. Wesana, M.K. Dora, D. Pearce, X. Gellynck, Applying Value Stream Mapping to reduce food losses and wastes in supply chains: A systematic review. Waste management, **2016**, 58, 359-368.

[6] K.R. Dushyanth, G.S. Shivashankar, S.K. Rajeshwar, Application of value stream mapping in pump assembly process: a case study. Industrial Engineering & Management, **2015**, 4(3), pp 2-11.

[7] Food and Agriculture Organisation, The consumption of fish and fish products in the Asia-Pacific region based on household surveys, United Nations, **2020**.

[8] H. Gestsson,O. Knútsson, G. Thordarson, The Value Chain of Yellow Fin Tuna in Sri Lanka, International Institute of Fisheries Economics & Trade, Montpellier, France, July 13-16, **2010**.

[9] H.A. Grema , J.K.P. Kwaga , M. Bello, O.H. Umaru, Understanding fish production and marketing systems in North-western Nigeria and identification of potential food safety risks using value chain framework, Preventive Veterinary Medicine, **2020**, 181, pp.105-380.

[10] A.Gordon, A. Pulis, E. Owusu-Adjei, Smoked marine fish from Western Region, Ghana: a value chain assessment, The world fish center, June **2011**.

[11] S. Hartini, J. Manurung and R. Rumita, Sustainable-value stream mapping to improve manufacturing sustainability performance: Case study in a natural dye batik SME's. In IOP Conference Series, Materials Science and Engineering, **2021**, 1072 (1), 12-66.

[12] N. Hamilton-Hart, C. Stringer, Upgrading and exploitation in the fishing industry: Contributions of value chain analysis, Marine Policy, **2016**, 63, 166-171.

[13] A. Henriques, J.A. Vázquez , J. Valcarcel, R. Mendes, N.M. Bandarra, C. Pires, Characterization of Protein Hydrolysates from Fish Discards and By-Products from the North-West Spain Fishing Fleet as Potential Sources of Bioactive Peptides. Marine Drugs, **2021**, 19(6), 338.

[14] R. Hilborn, C. Costello, The potential for blue growth in marine fish yield, profit and abundance of fish in the ocean, Marine Policy, **2018**, 87, 350-355.

[15] M.A. Hossain, B. Belton, S.H. Thilsted, Preliminary rapid appraisal of dried fish value chains in Bangladesh, World Fish Bangladesh, Dhaka. 01 August **2018**.

[16] M.S. Hossain, A.A. Masud, Value stream analysis of dried fish's supply chain in Bangladesh, Journal of Economics and Sustainable Development, **2012**, 3(9), 11-15.

[17] M.N. Jaman, M.S. Hoque, F. Yeasmin, M.M. Hasan , M.A.S. Ripon, A. Akter, M.A. Jhumur, Comparative assessment of dried fish quality collected from market and drying centre at Kuakata in Patuakhali, Bangladesh. Bangladesh Journal of Fisheries, **2021** 33(1), 137-146.

[18] S.B. Jeffer, Analysis of the postharvest food safety management systems in the meat supply chain: a case of Uganda, Ph.D thesis, American University of Beirut, Uganda, **2021**.

[19] K. Kamaylo, D. Galtsa , T. Tsala, K. Tarekegn , E. Oyka, M. Dukamo, Value chain analysis of fish in Gamo zone, Southern Ethiopia. Cogent Food & Agriculture, **2021**, 7(1), 116-183.

[20] R. Kaplinsky, M. Morris, A Handbook for Value Chain Research: Republic of Ghana Fisheries and Aquaculture Sector Development Plan, Institute of Development Studies, UK, **2001**.

[21] A. Kumar, G. Kushwaha , Value stream mapping: a tool for Indian agri-food supply chain, International Journal of Multidiciplinary Research in Social and Management Sciences, **2015**, 3(1), 45-54.

[22] I.S. Lasa, C.O. Laburu, R. De Castro Vila, An evaluation of the value stream mapping tool. Business process managemnt journal, **2008**, 14(1), 39-52.

[23] C. Lechner,G. Lorenzoni,S. Guercini, G. Gueguen, Supplier evolution in global value chains and the new brand game from an attention-based view, Global Strategy Journal, **2020**, 10(3), 520-555.

[24] M.A. Mansur,S. Rahman, M.N.A. Khan, M.S. Reza , S. Uga, Study on the quality and safety aspect of three sun-dried fish. African Journal of Agricultural Research, **2013**, 8(41), 5149-5155.

[25] Ministry of Fisheries and Aquatic Resource Development, Fisheries statistics. Colombo 10, Sri Lanka, **2021**.

[26] K.O. Odongkara, I. Kyangwa, Sanitation, fish handling and artisanal fish processing within fishing communities: socio-cultural influences, National Fisheries Resources Research Institute, Jinja, Uganda, 24 May **2021**.

[27] J. Pal, B.N. Shukla , A.K. Maurya , H.O. Verma, G. Pandey, A. Amitha, A review on role of fish in human nutrition with special emphasis to essential fatty acid. International Journal of Fisheries and Aquatic Studies, **2018**, 6(2), 427-430.

[28] N. Roberts, From catch to consumption: food security dynamics in an Indonesian fishing community:A dissertation submitted in partial fulfillment of the requirements for the degree of master of science in biological and environmental sciences, M.Sc. Thesis, University of Rhode Island, **2021**.

[29] M. Rother, J. Shook, Learning to see: value stream mapping to add value and eliminate muda. Lean Enterprise Institute, Cambrige, MA, USA, **2003**.

[30] R.M. Rosales, R. Pomeroy, I.J. Calabio, M. Batong, K. Cedo, N. Escara, V. Facunla, A. Gulayan, M. Narvadez, M. Sarahadil, M.A. Sobrevega, Value chain analysis and small-scale fisheries management.Marine Policy, **2017**, 83, 11-21.

[31] M.A. Samad, S.M. Galib, F.A. Flowra, Fish drying in Chalan Beel areas. Bangladesh journal of scientific and industrial research,**2009**, 44(4), 461-466.

[32] B. Singh,S.K. Garg, S.K. Sharma, Value stream mapping: literature review and implications for Indian industry. The International Journal of Advanced Manufacturing Technology, **2011**, 53(5), 799-809.

[33] R.M.N.S. Sugathapala, T.V. Suntharabarathy, U. Edirisinghe, Salt based dry fish processing and marketing by fishers of minneriya reservoir in Sri Lanka. Tropical Agricultural Research, **2012**, 23(4), 357 -362.

[34] F.A. Sultan, S. Routroy, M. Thakur, A simulation-based performance investigation of downstream operations in the Indian Surimi Supply Chain using environmental value stream mapping, Journal of Cleaner Production, **2021**, 286 (1), pp.125-389.

[35] E. Suwondo , H. Yuliando , F.J. Saputro, Analysis of risk in the value stream of supply chain management of marine fresh fish product, case of coastal zone, Java Island, Indonesia. In AIP Conference Proceedings,**2016**, 1755, 1, p. 130011.

[36] A.G. Tacon, M. Metian, Food matters: fish, income, and food supply—a comparative analysis. *Reviews in Fisheries Science & Aquaculture*, **2018**, *26*(1), 15-28.

[37] G. Thordarson, Value chain of yellow-fin tuna in Sri Lanka. Unpublished M. Sc. dissertation, University of Bifrost, Iceland, **2008**.

[38] J. Wesana, X. Gellynck , M.K. Dora, D. Pearce, H. De Steur H, Measuring food and nutritional losses through value stream mapping along the dairy value chain in Uganda. Resources, Conservation and Recycling, Elsevier, 20**19**, 150, 104-416.

[39] P.S.S.L. Wickrama, D,N, Koralagama, Value stream analysis and middlemen impact on smooth bellysardinella dried fish value chain on the Northwest coast of Sri Lanka, IMBER West Pacific symposium, Online event.11/22-25, **2021**.

[40] P.S.S.L. Wickrama, D.N. Koralagama, A.L. SandikA, Assesing seasonal price behaviour of selected dried fish varieties in Sri Lanka. Tropical Agricultural Research & Extension, **2021**, 24 (1), 21-34.

[41] A.L. Sandika, Impact of middlemen on vegetable marketing channels in Sri Lanka. Tropical Agricultural Research and Extension. **2012**, 14(3): 59-62.
[42] M. Ahmed, M.N. Islam, M. Shamsuddoha, Value chain analysis in the dry fish production and marketing of postharvest fishery products (PHFP) in the coastal belt of Bangladesh. The Bangladesh Fisheries Research Forum (BFRF), Mymensingh, Bangladesh **2007**.
[43] T.P. Neranjala, W.G. Eranga, D.C. Dissanayake, Dried fish production and trade in Negombo, Sri Lanka. Sri Lanka Journal of Aquatic Sciences. **2022**, 27(1): 31-43.

Annex I

Table 05. Standard deviation and error mean for time of skipjack tuna value stream activities

Skipjack tuna				
	Activity	Mean time (Hour)	Standard deviation	Standard error mean
Processing	Tying tails	1	0.26	0.037
	Gutting	1	0.29	0.041
	De-heading	1	0.22	0.031
	Washing I	2	0.25	0.034
	Salting	36	2.18	0.307
	Washing II	2	0.28	0.038
	Drying	60	2.63	0.371
	Sorting	1.5	0.39	0.056
	Grading	2	0.29	0.032
	Packing	1.5	0.35	0.043
	Storing	0.5	0.18	0.015
	Stocking	48	3.68	0.521
	Transport	0.5	0.14	0.019
Wholesaling	Receive	0.75	0.21	0.045
	Transport	3	0.31	0.045
	Storing	0.5	0.20	0.015
	Stocking	48	3.51	0.531
	Sorting	1	0.21	0.031
	Grading	1	0.24	0.038
	Distribution	4	0.63	0.903
Retailing	Receive	0.5	0.15	0.010
	Sorting	0.5	0.19	0.013
	Grading	1	0.20	0.030
	Stocking	120	10.35	1.46

Annex II

Table 06. Standard deviation and error mean for time of sprats value stream activities

Smoothbelly sardinella				
	Activity	Mean time (Hour)	Standard deviation	Standard error
Processing	Remove gills/scales	2	0.29	0.038
	Washing I	1.5	0.35	0.042
	Salting	2	0.26	0.035
	Washing II	1.5	0.38	0.045
	Drying	48	3.62	0.051
	Sorting	1.5	0.35	0.042
	Grading	2	0.32	0.041
	Packing	1	0.26	0.036
	Storing	0.5	0.19	0.014
	Stocking	48	3.78	0.059
	Transport	1	0.20	0.030

Wholesaling	Receive	1	0.25	0.035
	Transport	2	0.25	0.034
	Sorting	1.5	0.37	0.044
	Grading	2	0.28	0.036
	Stocking	48	3.85	0.051
Retailing	Receive	1	0.21	0.031
	Transport	1	0.27	0.040
	Grading	1	0.22	0.031
	Stocking	96	8.45	1.35