

Supply Chain Analysis of Clown Knife Fish (*Chitala Ornata*) in Laguna, Philippines

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Abstract: Clown knife fish (*Chitala ornata*) locally known as arwana is one of the invasive freshwater fish in the Laguna Lake that affects the production of tilapia and other fishes cultured in the lake. Due to the massive number of clown knife fish, it was found out by the local fisherfolks that there is a potential for clown knife fish for processing purposes. The study was conducted to obtain primary data that will serve as first hand data since there were no studies conducted in particular to this commodity within the locality. With this the study was conducted to determine the supply chain of clown knife fish in the Province of Laguna, Philippines. Descriptive research design was used in the study following the purposive sampling technique which complete enumeration of registered fisherfolks in the locale was served as respondents. Data was analyzed using frequency counts and percentage. Data obtained in the study shows that there is a potential for economic aspect of the fisherfolks since there are processors bought there catch. Also, data revealed that the clown knife fish were brought to international level for food and processing purposes. With the identified potential of clown knife fish, the production of other freshwater fishes is increasing due to the population of clown fish are lessen. Also, the government may develop production practices to sustain the supply of clown knife fish.

Keywords: supply chain, *Chitala ornata*, intermediaries, profitability, marketing practices, fisherfolks

I. INTRODUCTION

Clown Knifefish (*Chitala ornata*) is one of the commodities that are commonly found around the aquatic structure such as rocks, wood, and aquatic vegetation in lakes or more in-depth pools of rivers. An underwater structure is used as a daytime shelter as well as a spawning substrate. In the wild, the clown knife fish can grow to be around 100cm long and weigh around 5 kilograms. Clown knifefish are carnivorous, devouring crustaceans, insects, and fishes. This is a species that is active at night (Poulsen et al. 2004).

According to the Department of Agriculture, Bureau of Fisheries and Aquatic Resources, Clown Knifefish was introduced in the Philippines through the ornamental fish trade. It occurs naturally in swamps, lakes, and rivers of Southeast Asia and South America. The abundant supply and poor demand for knife fish result in massive investment losses in the livelihoods of individuals who rely on the fishing business. Even though it has low market demand and is unknown to some people, that was the reason also to make more research about clown knife fish. Having this kind of disadvantages in this commodity, there is a potential for this resources to be marketable since it can be processed into fish

balls and nuggets in other provinces. Currently, clown knife fish is a regular catch among fisherfolks instead of cultured and indigenous species (Mayuga, 2013).

According to Lucy Powers, (2013), one of the techniques of BFAR or Bureau of Fisheries and Aquatic Resources in the containment of knife fish is to study its economic utilization. Under this is the use of knife fish as a raw material in postharvest. Training is now being conducted specifically to people from the coastal municipalities of Laguna Lake on the value-adding of clown knife fish. A supply chain map was created using the data gathered. Up until the product is purchased by the consumer, it examines the product's farm gate price, price spread, and price control mechanism. Different activities, people, information, and resources are included in this network. A value chain is a collection of businesses, activities, products, and the interactions that go into making a finished product or service. It is based on the notion (UNIDO, 2009).

Fisherfolks in the Laguna Lake encountered the loss of production of tilapia, milk fish and other freshwater fish due to the massive destruction of fish cages caused by this species. As part of the intervention of the local fisherfolks, they catch the clown knife fish and sold to the intermediaries who are buying tilapia. In this regard, the exchange of services between the fisherfolks and intermediaries comes to the attention that there is a need to conduct a study pertaining to supply chain analysis. The purpose of this study is to analyze the supply chain, primary and marketing activities, corresponding costs, constraints, and opportunities discovered along the chain in Brgy. Banilan, Pakil, Laguna, Philippines. This study was conducted in April 2022 to June 2022 in Brgy. Banilan, Pakil, Laguna where the said commodity is located. This study will affect the key players of clown knife fish along the chain. The possible outcome of this study will provide essential knowledge that can be used by future students and researchers who want to engage in learning about this study.

II. MATERIALS AND METHOD

The research design used in this study was descriptive method. A total number of 145 respondents, consisting of 143 fisherfolks and 2 intermediaries. The 143 fisherfolks are the total number registered in the Local Government Unit of Pakil, Laguna. On the other hand, the 2 intermediaries are also identified since they are registered in

the locale as buyers of fresh water fish. The sampling technique used in the study was purposive sampling a form of non-probability sampling in which researcher rely on their own judgment when choosing members of the population to participate in their surveys. The researcher used the survey method to gather relatively limited data from a fairly large number of cases. It involves determining information about the variables rather than about individuals. It is used to measure the current phenomena inquiring into why it exists. A total enumeration was used in the study.

Both primary and secondary data was used in the investigation. Using a guide questionnaire, primary data was acquired through a series of personal interviews with key participants. Data was obtained using separate sets of questionnaires for the fisherfolks and intermediaries. Moreover, secondary data was gathered through the list from the Office of the Municipal Agriculturist in Pakil, Laguna.

The questions were divided into five categories: the distribution of the respondents, demographic profile, primary activities, problems encountered, and opportunities they discovered with clown knife fish fishing activities. Profitability Analysis was also done in this study. This analysis measured the efficiency of a firm in producing goods. The net profit margin can be computed as:

$$\text{Net Profit Margin} = \frac{\text{Net Profit}}{\text{Revenue}} \times 100$$

Where:

Net Profit = Revenue – Total cost of funds and operating expenses.

Revenue = Total amount of money received by a firm for goods and services provided.

The research was based on the Supply Chain model for Clown Knife Fish, which was taken from Gay Lord Madrio's study (2018). Key figures, marketing roles, and various chain components were among them. Labor was an input supplier, and the Department of Agriculture (DA), the Bureau of Fisheries and Aquatic Resources (BFAR), and the Local Government Units were the governing bodies (LGU). Clown Knife Fish Fisherpeople were those who engaged in wild fishing. Materials inputs and other operating expenses were included in the production costs. distributors of the commodity's supplies through intermediaries. Purchasing, selling, wholesaling, and transportation were all part of the marketing activities. The chain also included the other important actors, such as the consumers or final end users. Data collected was analyzed using simple statistical treatment such as mean, frequency counts and percentage. It was presented in tabular and graphical representation.

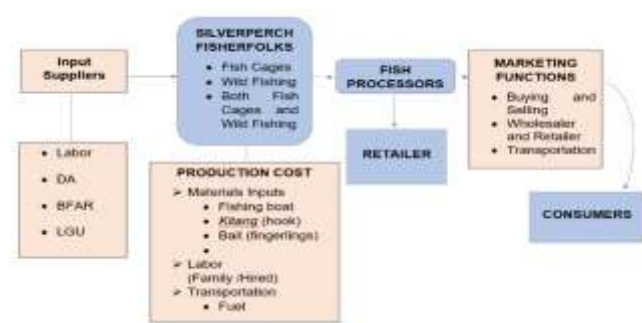


Figure 1. The Clown Knife fish Supply Chain (Madrio, 2018)

Objectives of the Study

The study aimed to determine the value chain analysis of clown knife fish in Banilan, Pakil, Laguna. Specifically, it sought to:

1. Determine the key players involved in clown knife fish supply chain;
2. Determine the demographic profile of the res in the chain;
3. Determine the primary activities taking place in the supply chain with its corresponding costs;
4. Determine marketing practices and activities taking place along the chain; and
5. Determine the constraints and opportunities by the key players along the chain;

III. RESULTS AND DISCUSSION

The Supply Chain Key Players

Table 1 shows the distribution of the respondents. There were 145 respondents considered, 143 fisherfolks, 1 trader, and 1 wholesaler respectively. Data shows that majority of the key players are the fisherfolks engaged in clown knife fish fishing in wild fishing (98.62%). According to the Municipal Fisherfolk Registration System, 1.03 million fisherfolk, or nearly half (49.50 %) of the total 2.08 million registered fisherfolk, engage in capture fishing, (Philippines Fisheries Profile, 2020). While the least number consists of intermediaries (trader-wholesaler) that bought the catch knife fish in Banilan, Pakil Laguna. Along the value chain of knife fish in Banilan, there is only one trader where all the fisherfolk sell their catch clown knife fish immediately after each fishing trip to only one trader.

Table 1: Distribution of respondents as the key players in the study.

Key Players	Frequency	Percentage
Fisherfolks		
Fish cages	0	0
Wild fishing	143	98.62
Both	0	0
Intermediaries		
Trader	1	0.68
Wholesaler	1	0.68
Total	145	

Clown Knife Fish Supply Chain

Figure 2 show the supply chain of the study, it implies that all supplies were coming from the fisherfolks who goes for fishing regularly and immediately direct sold to the trader known as transporter of clown knife fish and then loaded to the transport vehicle bound to Navotas City where wholesaler is located, the wholesaler put it to the facility for storing and preparing for the export.

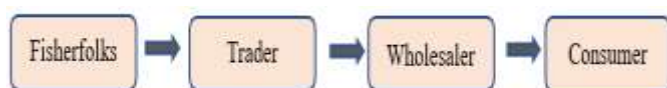


Figure 2. Flow of Production Supply Chain Analysis of Clown Knife Fish

Geographical Flow

The geographic flow shows the different sites where exchange the clown knife fish occurred. This exchange involved transactions from the source of inputs to the destination of the commodity. The clown knife fish were commonly catch among fisherfolks in the study area and immediately buys the trader from fisherfolks after fishing trip, then transport to Navotas City (wholesaler).

Table 2: Geographical flow of Clown Knife Fish

Source	Destination
Clown Knife Fish Banilan Pakil, Laguna	Navotas City

Demographic Profile of the Fisherfolks

Table 3 shows the profile of the fisherfolks in terms of age, sex, and civil status. The results revealed that majority of the respondents belong to ages between 43 and 47 with the highest frequency of 35 and they are all male, fact that fishing is only performed by men in the study area. In terms of educational attainment and monthly income. Results show that with a frequency of 137, many of the fisherfolks are high school graduates, and 2.10% of them are elementary and college graduates.

Table 3: Demographic profile of the Fisherfolks.

Fisherfolks	Frequency	Percentage
Age in years		
61-66	3	2.10
55-60	16	11.19
49-54	23	16.08
43-48	35	24.48
37-42	31	21.68
31-36	14	9.79
25-30	10	6.99
19-24	11	7.69
Total	143	100
Sex		
Male	143	100
Female	0	
Total	143	100
Civil status		

Single	50	34.97
Married	93	65.03
Separated	0	0
Widowed	0	0
Total	143	100
Educational attainment		
Elementary	3	2.10
High school	137	95.80
College graduate	3	2.10
Monthly income		
1000-5000	24	16.78
5000-10,000	118	82.52
10,000-20,000	1	0.70
Above 20,000	0	0
Total	143	100

Primary Activities

Fisherfolks' costs in catching materials (kitang)

Table 4 shows that out of 143 fisherfolks, 97 of them usually used four boxes of kitang. They claim that they only purchase a new kitang (hook) when the previous one becomes unusable. In terms of cost, most of them paid Php5,501.00 to Php6,000.00 on purchases of catching materials with a frequency of 75.

Table 4. Fisherfolks' costs in catching materials.

Kitang per box (hook)	Frequency	Percentage
6	2	1.40
5	41	28.67
4	97	67.83
3	3	2.10
Total	143	100
Price		
4,000-4,500	9	6.29
4,501-5,000	26	18.18
5001-5,500	12	8.39
5,501-6,000	75	52.45
6,001-6,500	17	11.89
6,501-7,000	3	2.10
7001-7,500	1	0.70
TOTAL	143	100

Fisherfolk's costs in Catching Material (pamain/bait)

As shown in Table 5, 134 out of 143 fisherfolks used 2000-3000 pieces of various types of fish fingerlings for the bait, and there are 2 used 500-999 fish fingerlings. In terms of cost, most of the fisherfolks with a frequency of 134 spent between 1,000 and 1,500 pesos for the fingerlings or bait and there are these 3 fisherfolks stated that they do not buy their bait, because their relative were also a fisherfolk of other fishes, they said that sometimes they also catch their own bait. All of them are not using fishing nets for catching.

Table 5. Fisherfolks' costs in Catching Material

Bait (Fingerlings) Per Pcs.	Volume	Frequency	Percentage
	500-999	2	1.40
	1000-1999	7	4.90
	2000-3000	134	93.71
Total		143	100
	Price (in peso)	Frequency	Percentage
	500-999	6	4.20
	1000-1500	134	93.71
	NONE	3	2.10
Total		143	100
Fishing net	Price	Frequency	Percentage
	0	0	0

Store where equipment purchased

The data gathered implicates that all the fisherfolks in Banilan purchase their fishing equipment which is the kitang that they are using for catching knife fish in the agricultural supply store in Siniloan, Laguna.

The volume of the harvest of Knife Fish

According to table 4, the volume of fisherfolks' harvest in peak months is 100 to 199 kilograms, with a frequency of 83 out of 143. In terms of lean month, the table shows that the majority of fisherfolks (54.55%) catch 15 to 20 kilograms of fish, but there is also the least harvest with 4.90% between 0 and 15, which was 7 responses.

Knife fish ranked first in a survey conducted by the BFAR IV-A in the areas where fishermen live, followed by *bangus* and tilapia. It became alarming since the clown knife fish is a carnivore, it can wipe off all the other fishes in the lake, including milkfish (*bangus*), tilapia, catfish (*kanduli*), silver perch (*ayungin*), shrimp, seashells, and so on (Encelan, 2017).

Table 6. The volume of the harvest of Clown Knife Fish.

Period of harvest	Volume (kg)	Frequency	%
Peak month			
	50-99	10	6.99
	100-199	83	58.04
	200-250	50	34.97
Total		143	100
Lean month			
	0-15	7	4.90
	16-20	78	54.55
	21-30	47	50.92
	31-40	6	4.20
	41-50	5	3.50
Total		143	100

Distribution of the respondents based on the frequency of time spent in catching

Table 7 shows that out of 143 fisherfolks 131 spent almost of their everyday life catching knife fish. In terms of the hours, there are 131 respondents spent 6 to 10 hours for catching, and others spent 1 to 5 hours and 10 hours above.

Table 7. Distribution of the respondents based on the frequency of time spent in catching

Number of days catching knife fish	Frequency	Percentage
Period		
Everyday	131	91.61
Twice a week	4	2.80
4x a week	8	5.59
Total	143	100
Number of hours spent in catching		
1-5 hours	6	4.20
6-10 hours	131	91.61
10 hours and above	6	4.20
Total	143	100

The number of a kilogram of knife fish generally catch during the fishing trip by the fisherfolks

The table below shows that the majority of the fisherfolks usually catch clown knife fish between 50 to 100 kilograms every fishing trip with a frequency of 134 out of 143, and the rest were 9 fisherfolks generally catch between 101 to 250 kilograms of the said commodity.

Table 8. The number of a kilogram of knife fish generally catch during a fishing trip by the fisherfolks.

Quantity (kg)	Frequency	Percentage
50-100	134	93.71
101-250	9	6.29
251-300	0	0.00
301 above	0	0.00
Total	143	100

Marketing Practices

Fisherfolks' buyer of clown knife fish

Findings revealed that all the fisherfolks in Banilan Laguna sell their catch directly to the trader. It demonstrates that they are not selling the fish to any other intermediaries and residents around the area because some of the fisherfolks stated that there is no any buyer than the trader.

Fisherfolks' Selling Price

The data gathered shows that all fishermen sell their catch to the trader for Php50.00 per kilogram; regardless, of the quantity, the price remains the same at fifty pesos. It demonstrates that the trader set the price of the knife fish in

Banilan. Because the price is fixed at Php50.00 per kilogram, there are no pricing differences.

Volume sold per cycle of kg of Knife Fish

The table below shows that all the fisherfolks sell their harvests on every fishing trip directly to traders in Banilan, Pakil, Laguna with a volume of between 51 to 100 kilograms. According to the fisherfolks, there is no other outlet where they can sell their catch because clown knife fish needs to be processed first before you can eat it.

Respondents answer if their income covers their expenses

Data shows that there is only one fisherfolk who answered that his income sometimes does not cover up the amount of money he spent on the initial capital. And there are 142 answered that all their capital expenses covered their income since most of the equipment was fixed cost and changed only after years.

The frequency of Fisherfolks stopped and not catching and selling knife fish due to its low price

Based on the results in the table below, even if the commodity price is too low, 133 fisherfolks out of 143 stated that they did not and will not stop fishing. In terms of selling, 137 out of 143 will not stop, stating that they have no alternative but to work for their basic needs. According to Garces (2011), small-scale fishery is a major source of livelihood for coastal communities, employing an estimated 1.37 million people not considering auxiliary activities such as fish processing and marketing/trading, and is a significant contributor to the country's economy.

Table 9. Frequency of Fisherfolks stopped catching and selling knife fish due to its low price.

Particular	Frequency	Percentage
Number of fishermen stopped catching knife fish because price is too low		
Yes	10	6.99
No	133	93.01
Total	143	100
Number of fishermen about stopped selling knife fish because price is too low		
Yes	6	4.20
No	137	95.80
Total	143	100

Net Profit Margin Analysis

Table 10 illustrates the income statement of the fisherfolks. It shows that the total monthly revenues of fisherfolks were Php 67,500.00, the total expenses of Php51,295. And the net income amounts to a total of Php 16,205.00 pesos with a net profit margin of 24.01. According to Anbarasu, (2019), some of their difficulties include the unavailability and the high expense of an outboard engine, premix fuel, and a fishing net (equipment).

Table 10. Income statement of Fisherfolks' (Monthly)

Particular	Value in Peso
Revenues	
45 kilograms of knife fish (50.00/kg)	67,500.00
Total Revenues	67,500.00
Less Expenses	
Depreciation Cost of <i>Kitang</i>	167.00
Depreciation Cost of Fishing Boat	188.00
Operating Expenses	
Bait or <i>pamain</i> (.50 centavos/piece)	30,000.00
Labor	12,000.00
Repair and Maintenance	1,920.00
Fuel	7,020.00
Total Expenses	51,295.00
Net Income	16,205.00
NPM	24.01

Government Support received by the Fisherfolks

The table below demonstrates the frequency of the respondents who have not received and received support from the government. And the data shows that the majority of the fisherfolks in Banilan with a frequency of 117 out of 143 did not yet receive any kind of support, while there are 26 got received like fishing equipment such as *kitang* (hook) and bait (fingerlings), these were the important equipment used by the fisherfolks for catching clown knife fish. However, the fisherfolk said that they receive the support rarely. Some also stated that “*Minsan nga sa loob ng tatlong taon, isang beses lang*” (sometimes, we only receive it once in every three years), that is why they are really hoping that maybe they will receive it again.

Table 11. Government Support received by the Fisherfolks

The number of fishermen has received gov't support	Frequency	Percentage	Type of support they received	Times those respondents received gov't support
Yes	26	18.18	Fishing equipment (<i>kitang, pamain</i>)	Rarely
No	117	81.82		

Problems encountered by the Respondents and opportunities they discover

Findings revealed that most of the respondents encountered problems in terms of weather, many of them stated that when the wind strikes, they automatically do not go for a fishing trip on a day because it will be going to be hard for them to catch fish if the weather is bad. Some of the fisherfolks stated that “*Panahon, pag malakas ang hangin*

hindi na muna kami nalabas (nangingisda)” (weather, when the wind strikes, we won’t go for fishing”.

And in terms of factor that most affects their harvest, majority of them answered that weather is also the main factor that makes their harvest low as shown in the statement above, while there are some answered that seasonality is the cause and seems like it is rare to happen because if there were not enough fish to catch, they find another place for catching. Here’s the statement of one of the fisherfolks the researcher encountered, the researcher asked if they are available for an interview and when they will possibly come back, and here’s what they said: “*Baka bukas pa, dadayo kami eh*” (maybe tomorrow, we will go to another place for fishing).

In terms of opportunities, while resolving the constraints the data shows that there are none because, according to the data about the fisherfolk’s problems, they stated that they are resolving it in such a way that they are not going on a fishing trip because of the strong wind, which is why the majority of the answers is no, many of them answered the question of what opportunity they discovered with “*wala e, nakakapahinga lang*” (none, we are just resting).

Intermediaries

Demographic Profile of the Intermediaries

Table 12 shows that the type of market intermediaries were traders and wholesalers from different location. A trader is a female, aged 60 years old and married, while the wholesaler is a male from Navotas City, 43 years of age and single.

Table 12. Demographic Profile of the Intermediaries.

Market Intermediaries	Address	Age	Sex	Civil status
Trader	Banilan, Laguna	60	F	Married
Wholesaler	213 A Tuazon San Jose Navotas City	43	M	Single

As viewed in the table below, it shows that the trader was a high school graduate and earning Php20,000.00 above monthly, while the wholesaler was a college graduate and earning Php20,000.00 above monthly.

Table 13. Economic Profile of the Intermediaries.

Respondents	Educational attainment	Monthly income
Trader	High school	Above 20,000
Wholesaler	College	Above 20,000

Expenses of Intermediaries

According to the data in Table 14, intermediaries paid Php400.00 per head on labor costs for sorting, and none uses salt for storage. When it came to ice, the trader spent Php2,000.00, whereas the wholesaler just spent Php1,500.00. The trader paid Php2,500.00 on truck maintenance/transportation, while the wholesaler spent only

Php1,500.00 for transferring the commodity from the fish port to the storage facility.

Table 14. Expenses of Intermediaries.

Labor	Salt	Ice	Truck maintenance	Sorting	Transportation
400/head	No	2,000	2,500	400	2500
400/head	No	1,500	1,500	400	1500

Marketing Practices

Table 15 demonstrates that the trader’s knife fish supply came straight from fisherfolks with an estimated average weight of 1000 kilos, and the wholesaler’s supplies came from Banilan which is classified as a trader. That means, all the supply is coming from Banilan, Laguna.

Table 15. Intermediaries’ source of supply.

Respondents	Who supplies the knife fish?
Trader	Direct from Fisherfolks
Wholesaler	Trader

Price of the Commodity (Intermediaries)

As viewed in Figure 3, in terms of commodity pricing, the trader purchases the clown knife fish from the direct supplier, which is fisherfolks, for Php50.00 per kilogram and sells it to the wholesaler for Php70.00 per kilogram. The results also show that the trader sells the commodity directly to the wholesaler in Navotas City. When it comes to wholesaler, the data collected show that they typically buy the knife fish from the source for Php70.00 per kilogram. the price they add from the source of their supplies to traders, wholesalers, retailers, and consumers. The trader stated that the additional cost she established for all buyers is 10 pesos per kilogram. Respondent 2 identified as wholesaler located in Navotas City responded to all the questions with a "No," stating that they are unable to provide the particular amount they added while selling the item to another buyer due to its confidentiality.



Figure 3. Price of the Commodity

Mode of selling, transportation, and product destination of the Intermediaries.

The result of the study shows that intermediaries have the same answers in terms of mode of selling, which is wholesaling. In terms of mode of transportation, the results

demonstrate that the two respondents had the same replies, namely, they both use their own truck or jeep to transport the commodity. When it comes to the product destination of the intermediaries, the trader delivered the commodity in the local market in Navotas City, while the wholesaler exports the clown knife fish in the international market in Bangkok, Thailand.

Table 16 illustrates the trader's income statement. Data shows that the trader's total monthly revenues were Php2,100,000.00 for the estimated volume of 1 ton from the fisherfolks in Banilan, which was sold for Php70.00 pesos per kilogram, with total expenses of Php1,687,691.00 including the pay for clown knife fish, laborers for sorting, ice, and transportation maintenance, tables also revealed that the trader net income and a net profit margin of 19.63%, results imply that in every Php1.00, the trader got that net profit.

Both intermediaries answered that their income in the clown knife fish business was enough to cover up all their initial and current operating expenses.

Table 16. Income statement of the Trader.

Particular	Value in Peso
Revenue	
1000 kg of knife fish per delivery/day at 70 pesos	2,100,000.00
Total Sales	2,100,000.00
Less Expenses	
Raw Material	1,500,000
Operating Expenses	
Depreciation Cost of Transport Vehicle	4,691.00
Labor (400/head)	48,000.00
Truck Maintenance	75,000.00
Ice	60,000.00
Total Expenses	1,687,691.00
Net Income	412,309.00
NPM	19.63

Problems encountered by the Intermediaries and opportunities they discovered

Based on the collected data of the intermediaries, the trader stated that low price is the usual problem they encountered in their business but even when the price is low, they continue to sell different commodities because they need to earn money for their daily needs. While the wholesaler indicated that lack of transportation was the issue they faced, he also stated that when a pandemic occurred, they had some difficulties exporting the items to their next destination, which is Bangkok, Thailand.

In terms of opportunities, the trader stated that there is no opportunity they discovered because the problem is about low price, and she has no alternative except to market all the supplies she has. While the wholesaler indicated that he did not discover an opportunity due to a shortage of

transportation he has no alternative but to ship the product to its next destination.

IV. CONCLUSION

The study concludes that the key players in the value chain of silver perch are fisherfolks, fish processors. The Fisherfolks were the one who catch fresh clown knife fish and sold it to the merchants who are also buying other fish available in the locality. With the determined potential of this commodity, the local fisherfolks decided to catch knife fish in the lake since it is destructive to fish cages established in the lake. In terms of profitability the result of all key players achieved the desired net profit margin. With the massive sources of clown knife fish that is free from the Laguna Lake, it provides income to the key players at present since it has a potential in food processing.

V. RECOMMENDATION

Based from the data obtained, the study recommends to create organization that all fisherfolks are properly organized in such to avail the services from the government to improve the sustainability of the resources. It also recommended that the fisherfolks may attend trainings on fish processing and other related seminars to expand their knowledge about the commodity. This may lead them to create other livelihood for the residents in the study area. The study recommends to develop good production practices for the clown knife fish in order to avoid invasion and destruction to other facilities and other fresh water fishes. Further, it is also recommended to conduct studies in food technology using the commodity, development of fresh water engineered facilities intended only for knife fish and develop management practices on hatchery of clown knife fish.

REFERENCES

- [1] Addisu, Ha 2016. Value Chain Analysis of Vegetables: The Case of Ejere District West Shoa Zone, Oromia National Regional State of Ethiopia
- [2] Ande M, Luna, 2019. A Decade After the Ondoy: A Timeline of The Knife Fish Outbreak in Laguna Lake
- [3] C. (2006). Integrating design and retail in the clothing value chain: an empirical study of the organization of design, International Journal of Operations and Production Management, 26(3/4), 412-428. <https://doi.org/10.1108/014435706106505>
- [4] De Silva D. A. M., 2011. "Value Chain Analysis of Fish and fishery products: origin, functions, and application in developed and developing country markets. Retrieved from https://www.researchgate.net/publication/342329030_Value_chain_of_fish_and_fishery_products_origin_functions_and_application_in_developed_and_developing_country_markets
- [5] Elin Torell; Joan Castro; Alfredo Lazarte; Danielle Bilecki. Analysis of Gender Roles in Philippine Fishing Communities. Retrieved from <https://onlinelibrary.wiley.com/doi/full/10.1002/jid.3520>
- [6] Farrah T. Chan; Stephen J. Beatty; Allan S. Gilles, Jr.; Jeffrey E. Hill; Sebastian
- [7] Kozić; Du Luo; David L. Morgan; Richard T. B. Pavia, Jr.; Thomas W.
- [8] Therriault; Hugo Verreycken. Aquatic Ecosystem Health & Management (2019) 22 (4): 417439. <https://doi.org/10.1080/14634988.2019.1685849>
- [9] F. Laboratory, 2013. "Clown Knife Fish Overview". Retrieved from <https://www.fishlaboratory.com/fish/clown-knife-fish/FL>,

- <https://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=793>, Revision Date: 12/13/2013, Peer Review Date: 12/13/2013, Access Date: 2/3/202
- [10] Jhon Michael C. Castro¹, Ma. Vivian C. Camacho¹, and Jon Carlo B. Gonzales², 2018. Reproductive Biology of Invasive Knife Fish (*Chitala ornata*) in Laguna de Bay, Philippines and its Implication for Control and Management. Retrieved from https://www.researchgate.net/publication/334224509_Reproductive_Biology_of_Invasive_Knifefish_Chitala_ornata_in_Laguna_de_Bay_Philippines_and_its_Implication_for_Control_and_Management
- [11] Jillard O. Mercado and Rozette E. Mercado, 2016. Analysis of Socioeconomic Profile of Rural Fishers in Northern Part of Surigao Del Sur, Philippines. Retrieved from [https://www.idosi.org/wjfm/wjfm8\(1\)16/10.pdf](https://www.idosi.org/wjfm/wjfm8(1)16/10.pdf)
- [12] Jon Hellin and Madelon Meijer, 2006. Guidelines for Value Chain Analysis. AbecassisMoedas https://www.fao.org/fileadmin/templates/esa/LIS_FAME/Documents/Ecuador/value_chain_methodology_EN.pdf
- [13] Lauron J. F., 2011. "Vulnerability of Small-Scale Fishing Community in Brgy. San Isidro, Cabangan, Zambales, Philippines". Retrieved from https://www.academia.edu/7848002/Vulnerability_of_Small_Scale_Fishing_Community_in_Brgy_San_Isidro_Cabangan_Zambales_Philippines
- [14] Leo Nico, Pam Fuller, Matt Neilson, and Bill Loftus, 2022. *Chitala ornata* (Gray, 1831): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville,
- [15] L. Towers, 2013. Finding a Sustainable use for Knife Fish. Retrieved from <https://thefishsite.com/articles/finding-a-sustainable-use-for-knife-fish-in-the-philippines#:~:text=This%20is%20because%20knife%20fish,in%20ponds%20and%20open%20waters.>
- [16] M. A. Encelan, 2017. "Eliminating "pest" Knife Fish in Laguna Lake. Retrieved from <https://lbtimes.ph/2017/04/29/eliminating-pest-knife-fish-from-laguna-lake/>
- [17] Madrio, G.L., (2018) Supply Chain Analysis of Tilapia (*Oreochromis niloticus*) in Similoan, Laguna
- [18] Marine Stewardship Council. (2004, June). Sustainable fishing and communities. MSC International - English. <https://www.msc.org/what-we-are-doing/oceans-at-risk/the-impact-on-communities>
- [19] Mentzer, J. T., Stank, T. P., & Esper, T. L. (2008). Supply chain management and its relationship to logistics, marketing, production, and operations management. *Journal of business logistics*, 29(1), 31-46
- [20] Nagurney, A. (2015). Design of sustainable supply chains for sustainable cities. *Environment and Planning B: Planning and Design*, 42(1), 40-57.
- [21] Nel Andrade, 2021. "Knifefish seen as source of livelihood for fisherfolks in Tanay, Rizal" Retrieved from <https://mb.com.ph/2021/02/03/knifefish-seen-as-source-of-livelihood-for-fisherfolks-in-tanay-rizal/?amp>
- [22] Obura et, al, 2017. Analysis of Rice Supply Chain. Retrieved from <https://www.arcjournals.org/pdfs/ijmsr/v5-i8/2.pdf>
- [23] Punongbayan, Michael, 2012. "LLDA vows to address knife fish problem in lake". Retrieved from <https://www.philstar.com/nation/2012/05/24/809655/llda-vows-address-knife-fish-problem-lake>
- [24] Philippines Fisheries Profile, 2020. <https://www.bfar.da.gov.ph/wp-content/uploads/2022/02/2020-Fisheries-Profile-Final.pdf>
- [25] Sevellia et, al. (2004). *Research methods and thesis writing'* 2007 ed. Rex Bookstore
- [26] Sharma, et al, 2013. Supply Chain Management of Rice in India: A Rice Processing Company's Perspective. Retrieved from <http://www.airccse.org/journal/mvsc/papers/4113ijmvsc03.pdf>
- [27] Talavera, V., & Gloria, M. (2014). Supply chain collaboration and trust in the
- [28] Philippines. Operations and Supply Chain Management: An International Journal, 7(1), 1-12.
- [29] Towers, Lucy. (2013, August 06) www.thefishsite.com. retrieved March 2019 click here <https://thefishsite.com/articles/finding-a-sustainable-use-for-knife-fish-in-the-philippines>.
- [30] Zamora, Elvira A. 2016. (Department of Business Administration, Vice President for Development, University of the Philippines) Retrieved: 2015.09.24 Accepted: 2016.07.19 Published: 2016.08.31