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Original article

Supply chain analysis of prawn *(Penaeus monodon Fabricius)* in Northern Mindanao, Philippines

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ABSTRACT

The study investigated the prawn growers and traders in the Northern Mindanao Region 10, Philippines for better government support and to enable sustainability in the supply chain of the prawn industry. Focus group discussion was conducted and survey instrument was used to document and interview players in the supply chain. Major players were in Tangub City and Municipality of Bonifacio, Ozamis City, and Lanao del Norte. The latter was identified as the most profitable supply chain in Northern Mindanao. Prawn traders were rated high in flexibility, responsiveness and concern on product and process quality compared to prawn growers. Traders reap greater profitability. However, both growers and traders shared similar critical logistic issues on environmental concerns. Certain inefficiencies are also identified in the study, such as asymmetric market information, poor farm to market road, lack or absence of market weight standards, high transaction cost, and determination of the selling price is generally based on average body weight which may not be accurate and may prove disadvantageous to prawn growers. In the significance of the findings of the study, the following recommendations are formulated. Producers shall be empowered to push for standardized price determination. Strengthened government programs through agri-fishery infrastructures and technical assistance on water pollution management.

KEYWORDS: *Prawn (Penaeus monodon Fabricius), Supply Chain, Northern Mindanao*

1 INTRODUCTION

Penaeus monodon, a giant tiger prawn locally called Lukon or pansat, is the biggest of the penaeid group (500-600 gms offshore catch) or 30-60gm/ piece at intensive farming. It is characterized by high survival rates of up to 90'/o in grow-out ponds, survives a wide range of temperature and salinity levels, and can tolerate over-crowding for a short time (SEAFDEC, 2008). Prawns have universal appeal both in the Philippines and abroad. With new technologies on prawn farming, the prawn industry continues to grow, regaining investors' confidence in prawn farming (Dela Cruz, 2012). Tiger prawn (*Penaeus monodon Fabricius*) or *sugpo* culture is one of the most profitable industries in region 10. It has significant economic contributions to the region as it encourages employment and generates foreign currency (BAR, 2012).

However, certain inefficiencies along the supply chain hinder the industry to reach its full production and market potential. In order for the industry to achieve its optimum potential there is a need to examine and analyze the dynamics of the supply chains and assess the gaps along these chains.

A supply chain is a network of organizations involved through upstream and downstream linkages, in the different processes and activities, which produce superior value for the consumer (Cadilhon et al., 2006). As the output of one firm becomes the input for another, in food chains, each participant must understand how the quality of the product will deteriorate irrevocably at each stage of the supply chain with inappropriate handling (Van der Vorst et al., 2007). The efficiency of a supply chain ultimately depends upon the efficiency of each individual actor and the linkages that have been established between them (Humphrey, 2005; Herlambang, *et al*., 2006). However, if the benefits of successful coordination are to be achieved, four variables are considered crucial: trust, decision making, information sharing, and goal congruence (Lejeune and Yakova, 2005). Moreover, awareness in the whole system gives rise to equality of supply and demand. Supply chain management implies managing the relationships between the businesses responsible for the efficient production and supply of agricultural products from the farm gate to consumers with the broad objective of meeting consumers' requirements in terms of quantity, quality, and price (ITC Ltd., 2007). Meeting customer requirements involve integrated management of the transactions and relationships between firms, as well as processes within firms (Woods, 2004; Hanf and Pall, 2009). Supply Chain Management provides an integrated approach to plan the improvements required in the management of their agricultural production and

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marketing systems to meet future challenges (UNCTAD, 2004; Woods, 2004).

In recent years, there has been a rapid increase in demand for prawns, particularly in Japan. Knowledge on prawn production and marketing would serve as a guide to producers to adjust their production to meet consumers' demand and get maximum return on investment. Thus, based on the foregoing statements stated above- this research was undertaken to analyze the supply chain and business relationships existing within the prawn industry in Northern Mindanao from the perspective of a supply chain management framework.

Conceptual Framework

Supply chains are defined as a set of sequential, vertically organized transactions representing successive stages of value creation. Supply Chain Analysis (SCA) suggests vertical interdependencies that require a systemic understanding of resource allocation and information flow between firms engaged in sequential stages of production. It focuses on elements related to vertical transactions, such as logistics management or the design of contractual arrangements between buyers and suppliers. There are three core sources of value in SCA. These are optimization of production and operations, reduction of transaction costs, and appropriation of property rights (Lazzarini, Chaddad, and Cook 2007). Two of the core sources are emphasized in this SCA of the prawn industry.

First, the concept of optimization of production and operations is rooted from the concept of logistics management. In supply chain management, the planning tool to develop a system-wide, integrated view of the firm is extended to include external integration of the firm. All activities associated with the flow and transportation of goods are included. Supply chain management refers to the coordination and alignment of materials, financial, and information flows for all activities and processes involved in a supply chain. Second, transaction costs refer to the costs of using market systems. These are search costs, bargaining and contracting costs, monitoring and enforcement costs that have to be decreased by farmers to increase production and profit.

Figure 1 shows the business environment of a prawn industry player. Factors in the external environment present are technical, economic, cultural, and political. The considerable extent that each factor affects an industry player was mapped.

Figure 2 shows the diagram of the prawn industry players' performance measured in production volume, peso amount cost and satisfaction of customers. A set of indicators to evaluate the performance of the existing supply chain was used. These are efficiency, flexibility, responsiveness, and perceived prawn quality by customers. These indicators drove the needed policy improvement in the industry. Efficiency refers to the ability of chain players to perform their respective task at a minimum cost. It is also the ability of the supply chain

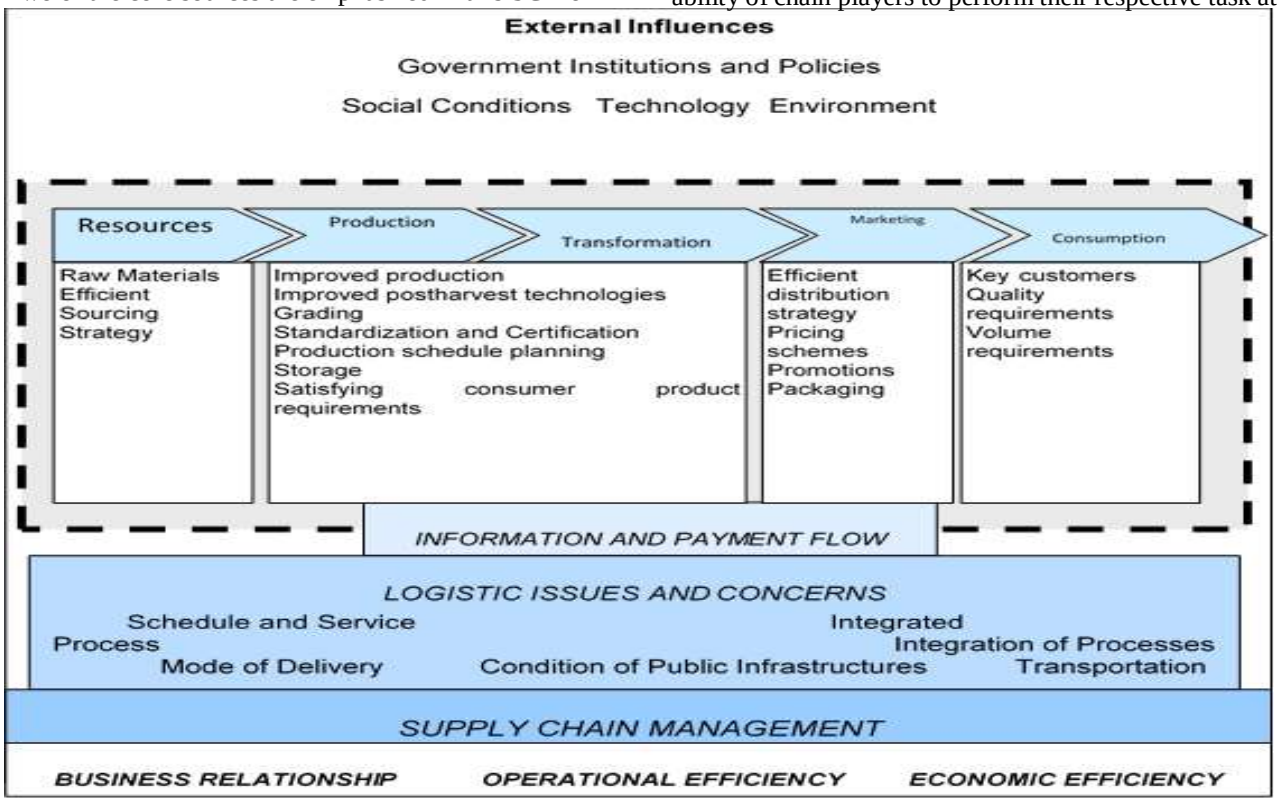

Figure. 1. Agri-food Supply Chain Mapping Model (Source: Brown *et al*., 2011.

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as a whole to provide the ultimate consumers of time, place, and form and quality satisfaction at the lowest cost.

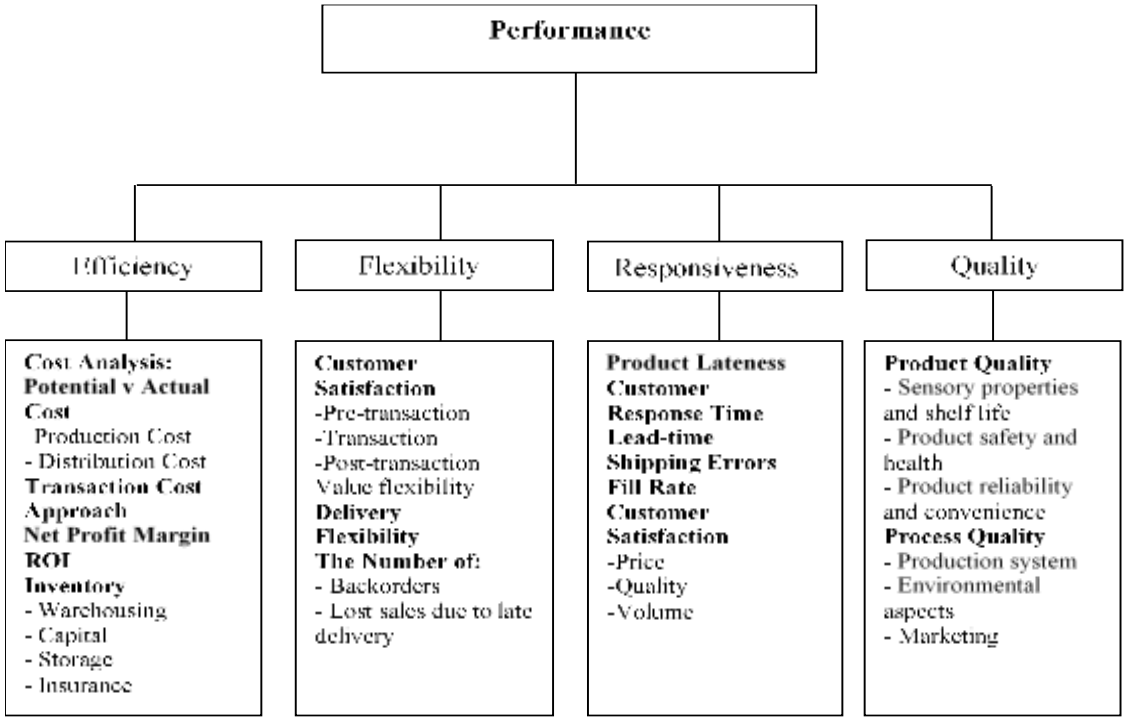

Figure 2. Performance measurement system for agri-food supply chains (Aramyan, *et al*., 2006)

Sources of inefficiency must be identified. Examples of these are transaction cost (*palangis*, *kutong*, payment to fixers), losses, and duplication of functions among others (Bayacag, 2012).

Flexibility can be defined as the ability to react and adapt quickly to changes in the market due to an increase or decrease of customer requirements, accelerating or decelerating the manufacturing process when it is requested. Cooper *et al*., as cited by Magolama (2012) mentioned that a logistical competent firm is measured by how well it is able to accommodate unpredicted situations.

Quality is not a bonus for the customer; it is expected. Quality is also important for the acceptance of the product. High costs, low productivity and loss of market share are directly related to poor quality (Dramm, as cited by Magolama, 2012). Quality is meeting or exceeding the expectations of your customer (Bishop, as cited by Magolama, 2012).

2 MATERIALS AND METHODS

The study covered the major areas in Northern Mindanao where prawn farms are most abundant. The areas included were located along the Panguil Bay in Misamis Occidental and some part of Lanao del Norte. In Misamis Occidental, the study areas covered are the Municipality of Bonifacio and the cities of Tangub and Ozamis. Bonifacio study areas include six barangays namely; Migpange, Bagumbang, Buracan, Pisaan, Digson and Baybay Bonifacio. Moreover, Tangub City study areas covered the following twelve barangays, Minsubong, Sialanga, Maloro, Migcanaway, Garang, Maquilao, Aquino, Pangabauan, Panalsalan, Bocator, Balatacan and Sumirap. Ozamis City covered only two barangays namely; Tabid and Malaubang, Ozamis City. In Lanao del Norte, the study areas covered are Lala, Baroy, Kapatagan and Kolambugan.

The primary instrument utilized was a survey-questionnaire adopted from a study on Development of the Mud Crab Sector in Three Provinces of the Philippines -Constraints and Prospects (Gaillard, 2010). Two sets of survey questionnaires were administered. One was for the prawn producers and the other for the traders.

Data were taken from the key players inside the supply chain for prawn and these included the prawn producers and traders. Prawn producers are the individuals or group of individuals who produce and sell prawn on a regular basis while prawn traders are responsible individuals or groups of individuals who will do the buying and selling of prawns from the point of production and deliver it to the point of consumption.

The data were gathered through focus group discussions. In addition, the number of traders interviewed was also determined based on the responses of the prawn growers. However, the sampling frame consisted of the two provinces identified as top prawn producers in the region using Sloven's Formula.

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Mapping was done, considering relevant information needed in supply chain analysis. In this study, the key downstream customers were identified then the whole supply chain was traced downstream (prawn producers) to upstream (prawn traders).

The data collected were analyzed using the established methods, indicators and tools for supply chain studies. Descriptive statistics such as means, frequency counts and percentages were also used to present the gathered data. Weighted means were computed to describe qualitative aspects of prawn industry players' performance. The performance indicators were classified broadly under flexibility, responsiveness and quality of key players inside the chain.

3 RESULTS AND DISCUSSION

Supply Chain Map

Figure 3 illustrates the exchange of product and payment, how information was disseminated and how product was brought from a point of production (farm site) to a point of consumption (end-user) by each of the supply chain nodes of the prawn industry in Northern Mindanao. Along with the flow of goods and services, flow of information is an important attribute and requirement in the supply chain (Russel and Taylor, 2004; Simchi-Levi, et al., 2005; Krajjewski, et al., 2007).

market including the role of brokers. Products flow from the point of production to the point of consumption. Frozen products were picked-up by the local traders or by the wholesalers at the farm site. Local traders then delivered the prawns to the wholesalers' buying stations. Viajeros picked-up the products at the local traders' buying station and delivered them to wet-market vendors. The latter brought prawn products to the consumers. In the same manner, fresh prawn commodities were either sold directly to wholesalers or to local traders and a minimal participation of the walk-in customers at the farm sites. The price was based on the wholesalers but the actual retail price is lower than that of the market prevailing price. On the other hand, wholesalers had more market access in-place. These were the exporters, local buyers and other institutional markets. There were three supply chains identified in Northern Mindanao. These were Tangub City and Municipality of Bonifacio, Ozamis City, and Lanao del Norte Supply Chains. As a result, Ozamis City supply chain is found to be the most efficient while Lanao del Norte is considered to be the most profitable supply chain in Northern Mindanao.

Table 1 below shows the summary of the Total Production volume of prawns in kilograms traded in each supply chain node and each industry player. The types of industry players identified in each supply chain node were prawn growers, local traders, wholesalers, *viajeros* and wet-market vendors. Major supply chain nodes identified in the region were Tangub-Bonifacio, Ozamis

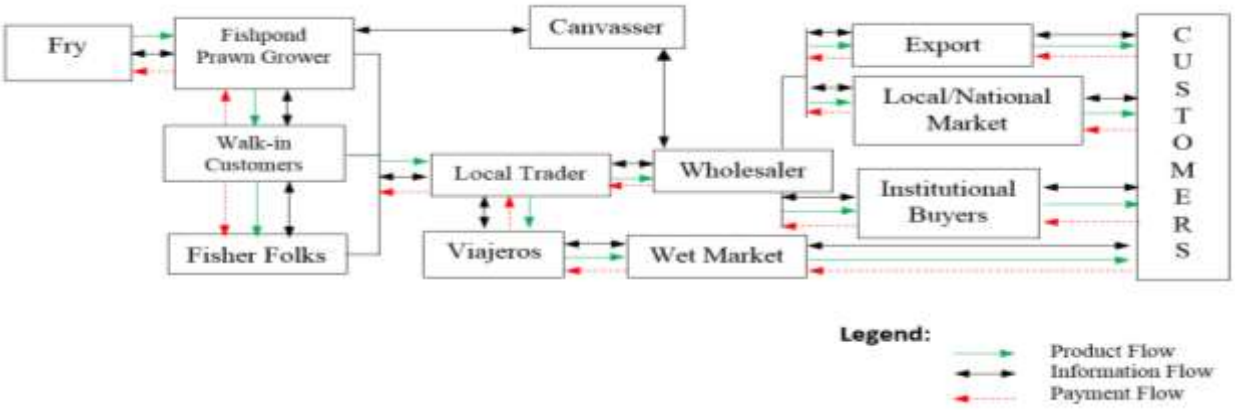

Figure 3. General Framework of supply chain of prawn industry in Northern Mindanao, Philippines, 2014 (Guigue,2014).

Furthermore, Figure 3 shows the general framework of the supply chain of prawn in Northern Mindanao where four nodes were identified. These are local traders, wholesalers, viewers and wet-market vendors interacting with each other in the chain. Payment flowed down from the final consumers to input providers or the hatcheries in the form of cash, and partial payment.

Information however was disseminated by the important key players, by each node in terms of price, product requirement, among others, based on the export

City, Lanao Del Norte chains.

Lanao del Norte supply chain had the highest Total Production volume traded with 389.53 kgs at an average retail price of P310 per kg. Ozamis City supply chain registered the lowest Total Production volume traded with 335 kgs at an average retail price of P300 per kg. It should be noted that Ozamis City depends on various alternative sources of income generating activities other than agriculture and aquaculture compared to Lanao de Norte thus the indicated production differential.

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Table 1. Summary of the average volume traded and average retail price in each node of Northern Mindanao, Philippines, 2014 (Dec-2013-March-2014).

INDUSTRY PLAYERS or DISTRIBUTION CHANNELS	TOTAL PRODUCTION VOLUME BY SUPPLY CHAIN NODE			TOTAL (Kg)	AVERAGE (Kg)
	TANGUB-BONIFACIO CHAIN (Kg)	OZAMIS CITY CHAIN (Kg)	LANAO DEL NORTE CHAIN (Kg)		
Prawn growers to local traders	100	50	72	222	74
Prawn growers to wholesalers	82.4	130	142.53	354.93	118.31
Local traders to wholesalers	75	65	75	215	71.67
Local traders to viajeros	50	40	50	140	46.67
Viajeros to wet-market vendors	70	50	50	170	56.67
TOTAL (Kg)	377.4	335	389.53	-	-
AVERAGE PRICE/KILOGRAM	300	300	310	-	-

** Average retail price per kilogram regardless of the classification*

Performance Analysis of Key Players

Average Cost and Return Analysis on Prawn Growers and Traders

Table 2. Summary on the average cost and returns analysis of prawn growers in Northern Mindanao, 2014 (Dec. 2013-March-2014)

ITEM	TANGUB-BONIFACIO	OZAMIS CITY	LANAO DEL NORTE	TOTAL	AVERAGE
Volume Traded	182.4	180	212.53	574.93	191.64
Price/Kg	300	300	310	910	303.33
Gross Income	54,720	54,000	65,884	174,604	58,201.33
Cost/Expenses					
Cash Costs	36,800	36,300	45,900	119,000	39,666.04
Imputed Costs	15,472	15,400	16,588.4	47,460.4	15,820.13
Total Costs	52,272	51,700	62,488.4	166,460.4	55,486.8
Returns above cash cost	17,920	17,700	19,984	55,604	18,534.67
Net returns	2,448	2,300	3,395.6	8,143.6	2,714.53
Gross income	300	300	310	910	303.33
Cost/Kg	286.58	287.22	294.02	867.82	289.27
Net income/Kg	13.42	12.78	15.98	42.18	14.06
ROE	4.68	4.49	5.43	14.6	4.87
ROI	90.67%	85.19%	125.76%	301.62%	100.54%

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Table 3. Summary on the average cost and returns analysis of prawn traders in Northern Mindanao, 2014 (Dec. 2013-March-2014)

Item	Local Trader (Good & Local sizes)	Wholesaler (Good Size)	*Viajeros* (Local Size)	Wet-market-vendor (Local Size)
Gross Income	80,890	196,618.5	42,000	59,500
Less:				
Marketing Cost	66,600	159,894.15	33,600	51,000
Transaction Cost	5,780.14	15,508.10	3,024	1,785
Total	72,380.14	175,402.25	36,624	52,785
Net Returns	8,509.86	21,216.25	5,376	6,715
Income per kg	364.37	450	300	350
Cost per kg	326.04	401.44	261.6	310.5
Net Income per kg	38.33	48.56	38.4	39.5
ROE	11.76	12.10	14.68	12.72

Table 4. Supply chain efficiency of Northern Mindanao, Philippines, 2014 (Dec. 2013-March-2014)

SUPPLY CHAIN PLAYERS	COST (Php/Kg)
Supply Chain Revenue	1,767.33
Prawn Growers	
Prawn Grower Production Cost	193.48
Transaction Cost	15.42
Sub-Total	208.91
Wholesaler	
Wholesaler Marketing Cost	364
Transaction Cost	35.49
Sub-Total	399.49
Local Trader	
Local Trader Marketing Cost	300
Transaction Cost	22.88
Sub-Total	322.88
Viajeros	
Viajeros Marketing Cost	240
Transaction Cost	21.60
Sub-Total	261.60
Wet-market Vendor	
Wet-market Vendor Marketing Cost	291.67
Transaction Cost	10.50
Sub-Total	302.17
Total Supply Chain Cost	1,495.00
Supply Chain Surplus	272.29
Potential Supply Chain Cost	1,389.16
Profit/Surplus Margin	15.41
Supply Chain Efficiency	92.92

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In all places considered of the supply chain, prawn growers depend so much on wholesalers for their produce about a total of 354.93 kgs were sold to the wholesalers. For local traders, wholesalers also remained a significant market in the distribution channel of prawns in Northern Mindanao (215 kgs).

The higher stocking density gives higher yield compared to less stocking density. Data shows that Lanao del Norte used 30,000 fry per hectare giving an average return of 212.53 kilograms as compared to Ozamis and Tangub-Bonifacio used 20,000 fry/ha. receives a yield of an average of 182.4 kilograms and 180 kilograms, respectively. The use of commercial feeds also brought a difference in yield in each chain. Tangub-Bonifacio chain incurred a cost per kilogram of about Php 16.45 for commercial feeds and Php 23.02 per kilogram for *agehis*. Ozamis chain incurred about Php 16.67/kilogram for commercial feeds and Php 23.33/kilogram for *agehis* which was lower than in Lanao chain which incurred cost per kilogram of about Php 35.29 for commercial feeds and Php 29.64 for *agehis*. As it was noticed that Lanao del Norte used more of the commercial feeds than *agehis*.

Over all, prawn growers in Lanao del Norte were the most profitable group in the supply chain in Northern Mindanao based on the ROE estimates in all chains with an ROI of more than 100% return to capital. It can be argued that prawn traders are on the upper hand players in the industry as revealed in the ROE estimates compared to prawn growers.

Efficiency

On the average, Northern Mindanao supply chain efficiency scores 92.92% which denotes that the chain is 7.08 inefficient so it needs to be addressed to improve the performance of the key players within general (Table 4). Asymmetric market information, poor farm to market road, lack or absence of market weight standards, high transaction cost, among others were among the inefficiencies identified in the study.

Flexibility of Prawn Industry Players

Table 5 implies limitations that prawn producers have higher flexibility as indicated by their low extent of flexibility compared to mean performance ratings of traders. For one, farmers do not influence pricing decisions on their produce, especially small prawn growers. Prices were set solely by the middlemen though prices can sometimes be negotiated amongst them with a score of 3.43. They were solely price takers since the final decision of the price always prevails over that of the buyers at 1.97 score. Furthermore, they moderately rated at 3.44 scores on the how satisfied they were in transacting business with middlemen for they have limited options but to sometimes abide with the traders'

Table 5. Supply chain key players' performance on flexibility in Northern Mindanao, Philippines, 2014

INDICATORS	Prawn Producers		Prawn Traders	
	Mean	Description	Mean	Description
Look for alternative buyers when needed	3.33	Moderate	3.55	High
Willing to negotiate/adjust the price/volume with buyers when needed	3.43	Moderate	3.82	High
Decision always prevails over that of the buyer	1.97	Low	3.72	High
Always abide with the decision of the buyer	1.98	Low	3.36	Moderate
Trading with buyers is self-fulfilling and gratifying business operation.	3.44	Moderate	3.18	Moderate
Overall Mean	**2.83**	**Moderate**	**3.53**	**High**

Legend: Scale Qualitative Description
4.51 – 5.00 Very High Extent 2.51 – 3.50 Moderate Extent 1.00 – 1.50 Very Low Extent
3.51 – 4.50 High Extent 1.51 – 2.50 Low Extent

Table 6. Supply chain key players' performance on over-all satisfaction in Northern Mindanao, Philippines, 2014

PERFORMANCE INDICATOR	Prawn Producers		Prawn Traders	
	Mean	Description	Mean	Description
Happy to procure/deliver quality prawn.	4.45	High	4.90	Very High
The income received is adequately rewarding	3.49	Moderate	4.00	High
Happy with the price I received from the buyers	2.50	Low	3.90	High
Satisfied with the rate of return to investment.	3.25	Moderate	4.09	High
Overall Mean	**3.42**	**Moderate**	**4.22**	**High**

Legend: Scale Qualitative Description
4.51 – 5.00 Very High Extent 2.51 – 3.50 Moderate Extent 1.00 – 1.50 Very Low Extent
3.51 – 4.50 High Extent 1.51 – 2.50 Low Extent

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decision (1.98) most especially during emergency harvest however, some farmers find alternative means to sell their products at a higher price scoring moderately on this area at 3.33.

Responsiveness of Prawn Industry Players

One of the major draw-backs of the industry is the lower price that the prawn growers have been experiencing. Most of the farmers were not satisfied with the price they received from their produce scoring at 2.50 described as low extent (Table 6). If prices were a lot better compared to previous years, farmers would be better off. For now, with the prevailing price they get, return on investment was moderately satisfactory (3.42).

indicated in their mean scores of 3.09 and 3.45. Like any other commodity, prawns are also subjected to certain environmental factors that are hardly controllable. Hence, the right production cannot always be ensured from the producing sectors. It is also observed that in terms of information sharing and ensuring that the buyers procure the volume of produce as agreed upon, scores both high with 4.55 and 4.45 respectively.

Summary of Prawn Industry Players' Performance

Table 8 summarizes the overall performance of producers and traders in terms of efficiency, flexibility, responsiveness and quality in the supply chain of prawns. Prawn traders live up to their high extent of performance, while prawn growers maintain a moderate extent of

Table 7. Supply chain key players' performance on product quality in Northern Mindanao, Philippines, 2014

PERFORMANCE INDICATOR	Prawn Producers		Prawn Traders	
	Mean	Description	Mean	Description
Always produce and sell quality prawns.	4.12	High	4.73	Very High
Always deliver the right volume/quality of prawns ordered.	3.11	Moderate	4.45	High
Satisfied with the volume produced and sell to the buyers	2.94	Moderate	3.36	Moderate
Always achieve delivery targets	2.37	Low	3.45	Moderate
Always fulfill the orders and deliveries of prawns when needed.	1.94	Low	3.09	Moderate
Share information regarding quality requirements to both traders and other prawn growers.	3.72	High	4.55	Very High
Buyers always procure the volume as agreed	3.12	Moderate	4.45	High
Overall Mean	**3.05**	**Moderate**	**4.01**	**High**

Legend: Scale Qualitative Description
4.51 – 5.00 Very High Extent 2.51 – 3.50 Moderate Extent 1.00 – 1.50 Very Low Extent
3.51 – 4.50 High Extent 1.51 – 2.50 Low Extent

Table 8. Supply Chain Key Players' Over-All Performance in Northern Mindanao, Philippines, 2014

PERFORMANCE INDICATOR	Prawn Producers		Prawn Traders	
	Mean	Description	Mean	Description
Efficiency	92.92			
Flexibility	**2.83**	**Moderate**	**3.53**	**High**
Responsiveness	**3.42**	**Moderate**	**4.22**	**High**
Product and Process Quality	**3.05**	**Moderate**	**4.01**	**High**

Legend: Scale Qualitative Description
4.51 – 5.00 Very High Extent 2.51 – 3.50 Moderate Extent 1.00 – 1.50 Very Low Extent
3.51 – 4.50 High Extent 1.51 – 2.50 Low Extent

Product and Process Quality of Prawn Industry Players

Table 7 indicates high (4.12) and very high (4.73) consideration of producers and traders respectively in their marketing of prawns. It is imperative that product quality determines selling price which also determines profit. Hence, they must ensure that their prawns are always of good quality Likewise, sharing of information on quality requirements of prawns are regarded with high (3.72) and very high (4.55) by producers and traders respectively.

On the other hand, traders could only moderately fulfill the orders and deliveries on the target schedules as

performance in their distribution of prawns in the supply chain.

Critical Logistic Issues and Problems/Inefficiencies

Critical logistic issues on environmental concerns such as pollution, and bad weather conditions were the crucial problems met by prawn growers and traders in the prawn industry. These conditions lead to an emergency harvest thereby resulting in a decrease in production which affects the price and the income. Certain inefficiencies were also identified in the study, such as

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asymmetric market information, poor farm to market road, lack or absence of market weight standards, high transaction cost, among others.

4 CONCLUSIONS

Prawns, being a lucrative and profitable industry in Region 10 has significant economic contributions to the region as it encourages employment and generates foreign currency and is one of the top fishery commodities being exported by the Philippines. But, it is alarming because of the huge reduction of potential culture area due to environmental issues. The prawn industry players are the prawn growers, traders and consumers. Among the prawn supply chains in Northern Mindanao, Ozamis City supply chain is found to be the most efficient (94.4%) while the Tangub-Bonifacio chain was the least efficient. Overall, prawn growers in Lanao del Norte are considered to be the most profitable supply chain in Northern Mindanao based on the ROE estimates with an ROI of more than 100% return to capital. Traders reap the benefits of being the upper hand in the industry key players while the prawn growers were found to be the weakest players in the chain.

RECOMMENDATIONS

The following recommendations are forwarded to the responsible agencies, Department of Agriculture and Bureau of Fisheries and Aquatic Resources to improve the prawn producers' performance in the chain: Strengthened government programs through agri-fishery infrastructures such as farm to market road, Panguil Bay Rehabilitation Program, symmetric market information for both traders and prawn producers and technical assistance through trainings and seminars on water pollution management. Lastly, producers shall be empowered to push for standardized price determination.

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