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Production and marketing practices of mangrove crab industry towards sustainability in Bataan, Philippines

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ABSTRACT

This showed a comprehensive study on the mangrove crab industry in Bataan, Philippines. Mangrove crab growers (35%) were between 51-60 years old, mostly married with 5-7 family members. Farming was highest (30.77%) between 6-10 years while some were farming for 40 years (1.29%). Monthly income has strong positive correlation (r=676) with production area. *Scylla serrata*, *S. olivacea,* and *S. tranquebarica* were identified using traditional ecological knowledge (TEK). Results revealed 69.57% of the pond used for farming was 1-10 ha employing the polyculture method. About 52.17% used coin-sized crablets while 39.13% fly-sized. Annual production was less than a ton for 46.38% growers while 1.45% have >5 tons. Annual income showed a strong positive correlation (r=0.886 and r=0.815) with production area and annual production, showing a significant difference (p<001). Harvested crabs were marketed live in Orani Port. Grading and pricing were due to sex, weight, and characteristics. Problems include the implementation of FAO 264 s. 2020, weather, market practice, pandemic, and high rejections. Men and women play significant roles where laborious were perceived to be men's sphere while less laborious and financial aspects were for women.

Keywords: Mangrove crab industry, Sustainability, Marketing practices, Crab production, Gender role

Introduction

Mangrove crab (*Scylla spp*.) are widely distributed in the Indo-Pacific Region from Hawaii, Southern Japan, Taiwan, Australia to the Philippines ((Bhuiyan et al., 2021) especially those inhabiting marine or brackishwater areas. In the Philippines, these are considered high value resources abundant in the area (Vince Cruz et al. 2015) thus, many fishers depend on crabs as their livelihood (Castrence-Gonzales et al., 2018). Farming of mangrove crab (formerly known as mud crab) species has long been established in the Philippines including *Scylla serrata*, *S. tranquebarica* and *S. olivacea,* although the preferred species for growing is *S. serrata* (Quinitio and Parado-Estepa, 2017; Orario et al. 2021*).* Morphologically, *S. serrata* has a pointed dactyl prominence same with *S. tranquebarica* while *S. olivacea* is blunted as described by Orario et al. (2021). In terms of the inner carpus spine, it is present in the first two species while absent in the former. These are locally known as "alimango" fetching high value for local and export markets (Orario et al., 2021) making it a great livelihood opportunity making it prone to overfishing as an evident of decreasing harvest over the years (*Castrence-Gonzales et al., 2018)*. The main source of stocks for mangrove crabs are still from the wild-sourced crablets due to its limited supply from the hatcheries (Vince-Cruz-Abeledo et al. 2020).

Mangrove crabs signifies a major economic resource in the country (Vince Cruz et al. 2015) with Northern Mindanao and Central Luzon as major producers (Philippine Statistics Authority 2020). In fact, Central Luzon contributed a mangrove crab production of 24.06%, 20.89% and 22.25% in the national production in the years 2017, 2018 and 2019, respectively earning Php 2,109,462.96 in 2019. In Central Luzon, Bataan is known for bulk production in the region (Philippine Statistics Authority 2020) as the province is known to yearly celebrate "*Alimango Festival*" commanding high prices due to the quality of its meat (Vince-Cruz et al. 2015) and aquaculture qualities. In fact, Bataan ranked 2nd highest-producing province next to the province of Pampanga (Philippine Statistics Authority 2020).

Mangrove crab industry in the province of Bataan starts from either crab gatherers (from the open sea or mangrove areas) or aquaculture which are performed in brackishwater ponds primarily dependent to trash fish and/or shellfish. While considered as trivial product in shrimp in Southeast Asian countries (Sultana et al. 2019), mangrove crab industry has now emerged as an alternative and profitable livelihood when cultured with other aquaculture species. Mangrove crab are good aquaculture candidate as these are less susceptible to disease, easier to culture, more resistant to adverse environmental conditions, and has a high commercial value and market price both locally and internationally thus, provides a source of income (Salam et al. 2012) for coastal fisher folk of Bataan province. Marketing of harvested or collected mangrove crab in the province is a complex system including various middlemen which is both beneficial and disadvantageous, especially to the producers.

Production, marketing and actors in the mangrove crab industry all play integral part in the mangrove crab industry. This is composed of series of intermediaries with their own unique roles in the chain. While studies on mangrove crab have been conducted in the country, comprehensive study on the production and marketing of mangrove crab in the province of Bataan is still in paucity. In spite of its increasing demand and great export potential, issues on different activities in the industry are determined for a sustainable production and food security in the province.

This study was conducted to assess the present status of mangrove crab industry which shall cover the socio-demographic profile of farmers and aquaculture practices. This also showed the marketing network extent in the province and the challenges encountered in the process. In addition, this showed marketing system, actors and their roles in the chain, constraints and challenges encountered in the industry and the role of men and women in the province's mangrove crab industry.

Material and Methods

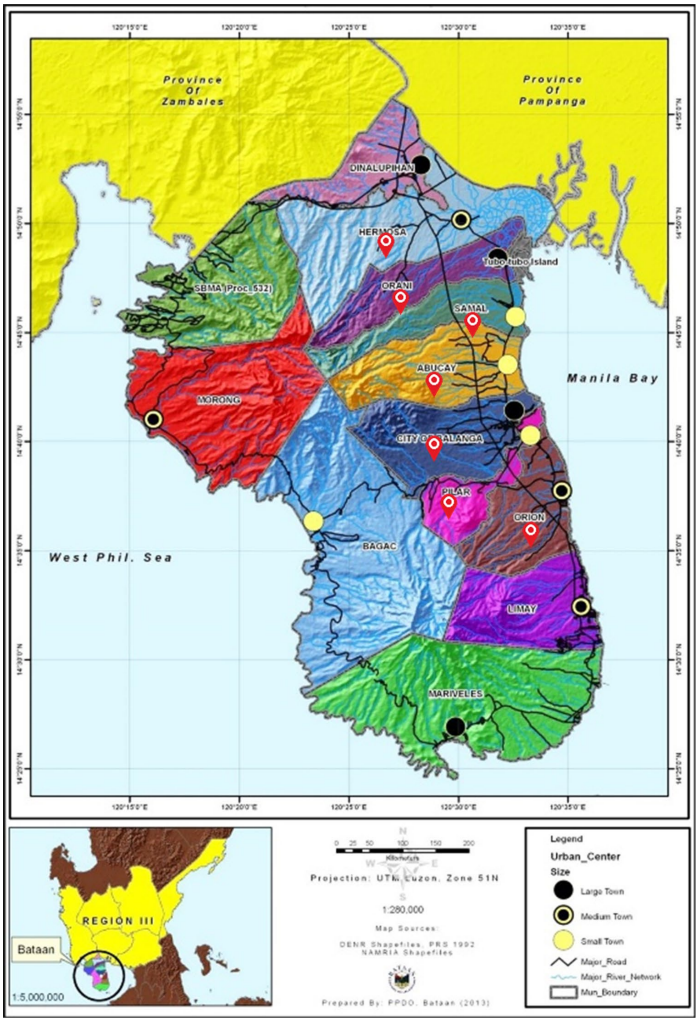
Study Area

The study was conducted from January 2021 to June 2021 in the province of Bataan. The province is a peninsula facing South China Sea to the west and Subic Bay to the northwest, and encloses Manila Bay to the east. It is located 14°41′06″N 120°25′55″E. Study areas were Hermosa, Orani, Samal, Abucay, Pilar, Orion and City of Balanga Identified locations (red locators) were of the major producers of mangrove crabs in the province.

Data Collection

Structured and semi-structured questionnaire were used to primarily collect data from all actors in the mangrove crab industry following and modifying models from SEARCA (2017), Sulatana et al. (2019) and Bhuiyan et al. (2021). Respondents included three (3) input suppliers, nine (9) crab gatherer colleting marketable mangrove crab from the open

sea or mangrove areas, 69 crab farmers, 50 intermediaries and 20 consumers. Key Informant Interview (KII) and Focus Discussion Group (FGD) were applied to collect information from a wide range of actors. All data were recorded. Direct observation during culture and actual marketing activities were also done to observe production and marketing extents in mangrove crab industries. Marketing dynamics were observed and noted including grading, pricing and mode of payments. Secondary data have been collected from published articles, Philippine Statistic Authority (PSA) and from Local Government Units (LGUs). These were used in describing the actors, their roles and interrelationships among other actors.



Source: Bataan provincial planning office

Figure 1. Location of the study

Data Analysis

Both qualitative and quantitative analyses were used in treating the collected data for this study. Qualitative data were encoded and analyzed using Microsoft Excel. Qualitative data were prepared, organized, reduced to themes and were represented in tables, charts and graphs as part of the discussion. For quantitative analysis, data were encoded and analyzed using Microsoft Excel and SPSS 16.0. Data were collected, organized, encoded, treated and interpreted. Results were represented in graphical and tabular form.

Results and Discussion

Mangrove Crab Respondent's Socio-Demographic Profile

Mangrove crab production in the province is primarily comes from aquaculture. Data showed that most of the mangrove crab growers and collectors are between 51-60 years old with 35% of the total population while only 3.84% are between 20-30 years old (Table 1). There are about 92.31% of the respondents were married with a family size of mostly between 5-7 members with 57.69% of the total population (Table 1). Respondents engagement in the mangrove industry were fish farmers (caretakers) at about 67.95% while owners (also fish farmers) were 20.51% and 11.54% were gatherer from the open sea and mangrove areas. The results showed that about 30.77% of the respondents were engaged in mangrove crab industry for 6-10 years, 25.64% were engaged between 21-20 years, 19.23% were engaged for about 11-20 year while there were 10.26% of about 31-40 years of engagement and only 1.28% has above 40 years of engagement, respectively.

The income of farmers and collectors vary from activities, years of engagement and other internal benefits agreed upon. The results showed that 53.85% of the respondents earned Php 5,000-Php 10,000 per month, 32.05% earned Php 10,000-Php 20,000, 10.26% earned below Php 5,000 and 3.85% earned Php 21,000-Php 30,000 (Table 1) with 69.57% respondents with farming a 1-10 ha production area.

Monthly income of the mangrove crab growers, specifically the caretakers (n=53), was correlated with the years of their engagement in farming and the area of production. Results showed that the monthly income of farmers had a very weak correlation (r=0.110) with the years of engagement with no significant difference ($p>0.05$) showing that years of their experience has no bearing when with their monthly wages from their employers. On the other hand, correlation of the monthly income and production area showed a strong correlation (r=676) and a significant difference ($p<0.05$) showing

that as the production area increases, the monthly income of mangrove crab growers also increases (Figure 2).

Most frequent number of mangrove crabs and collectors of 51-60 years of age and showing decades of farming proves that mangrove farming, aquaculture in general, has been widely practiced in the province serving as one of the most important livelihoods in the coastal areas. This supports the same findings described by Quinitio (2015) and Quinitio and Parado-Estepa (2017) suggesting that wide and long farming of wild crabs have been overexploited in the country.

Monthly income of crab growers (caretakers) were found to be significantly correlated with the production area. Caretakers are usually paid on monthly salary, commission basis or both. Study of Torres and Ventura (1983) suggested the same salary scheme observed in Central Luzon. In this study, most of the caretakers have a fixed salary monthly and an additional commission upon a good harvest. There were some who worked for a commission basis, as according to employers, this set-up shall ensure the engagement and dedication of the caretakers in performing well. Monthly salary depends on the pond size as it requires more stocks to be cultured and monitored as well as larger size to be handled and managed. This suggests that monthly salary of caretakers was directly dependent with pond size.

Table 1. Socio-demographic profile of mangrove crab producers and collectors

Characteristics	Categories	No. of Respondents	Percentage (%)
Age Group	20-30	3	3.84
	31-40	15	19.23
	41-50	18	23.08
	51-60	28	35.9
	Above 60	14	17.95
Family size	2-4	25	32.05
	5-7	45	57.69
	8-10	7	8.97
	11-13	1	1.28
Civil status	Married	72	92.31
	Single	6	7.69
Engagement	Caretaker	53	67.95
	Pond owner	16	20.51
	Collector	9	11.54
Engagement in mangrove crab industry (Years)	<5	10	12.82
	6-10	24	30.77
	11-20	15	19.23
	21-30	20	25.64
	31-40	8	10.26
	Above 40	1	1.28
Monthly income (Php)	<5,000	8	10.26
	5,000-10,000	42	53.85
	10,000-20,000	25	32.05
	21,000-30,000	3	3.85
Production area (ha)	<1	1	1.45
	1-10	48	69.57
	11-20	5	7.25
	21-30	9	13.04
	31-40	1	1.45
	Above 40	5	7.25

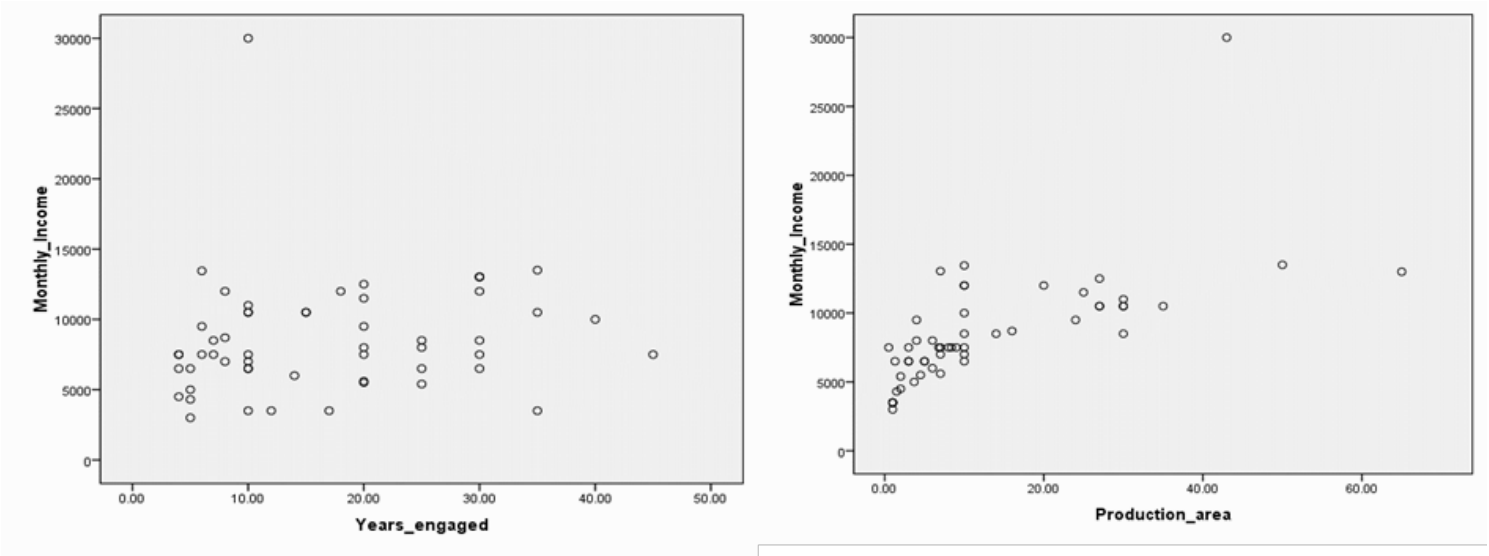


Figure 2. Correlation (r) of monthly income with years of engagement and production area

Production of Scylla spp.

Mangrove Crab Species Cultured in the Province

There were three species produced and collected in the province of Bataan namely Scylla serrata (bulik), S. olivacea (pulahan) and S. tranquebarica (native) (Figure 3). Identification of the species was through observation of the carapace and chelae color. Farmers and collectors identified S. serrata with the one with dark-green color, S. tranquebarica, also called as native by the respondents, was associated with the purplish color and S. olivacea with the red to almost orange in color. This method applied in the identification of species was described by Nakashima et al. (2012) as the traditional ecological knowledge or TEK as cited by Orario et al. (2021). The TEK method was described in the study of Orario et al. (2021) for identifying Scylla juveniles through the color of its ventral carapace and chellae. Apart from it, Bataan farmers also pointed out that same species of the same age, S. serrata was of the largest (Figure 2) among the three.

Of the four of four species in the genus Scylla occurring in the country (Orario et al. 2021), there were three existing in Bataan province namely S. serrata, S. olivacea and S. tranquebarica. Of the three, S. serrata "bulik" was the most preferred species for culture as experience showed that this was the fastest growing species. Despite the preference of S. serrata, results showed wild caught crablets were combination of the three species. This was also revealed by Walton et al. (2006; 2006b) as these species have overlapping ranges.

Left to right: a) Bulik (Scylla serrata); b) Native (S. tranquebarica); c) Pulahan (S. olivacea)

Figure 3. Three species identified in the ponds of Bataan province

Aquaculture Engagement

Results showed that about 69.57% of the mangrove crab growers are faming ponds with 1-10 hectares in size while 13.04% were farming 21-30 hectares. On the other hand, big ponds of 31-40 and above 40 hectares are farmed by 1.45% and 7.25% of mangrove crab growers, respectively. Production cycles are usually done thrice a year with 60.87% while some grow crabs twice a year with 17.39% and four times a year with 21.74%, respectively.

Mangrove crab species grown in the province showed a mixed or combination of species (bulik, pulahan, purplish-Figure 3) grown in ponds with 59.42% while 39.13% disclosed that they have grown a pure "bulik", S. serrata in their ponds. Growers have a low preference with purplish crab with 1.45% and no growers have grown pulahan or S. olivacea solely. Culture method employed in the province was a 100% polyculture i.e. milkfish-crab, milkfish-crab-shrimp, milkfish-crab-prawn.

Results showed that 52.17% of the growers used coin-sized or single-an as seed stocks while 39.13% cultured fly size or langaw langaw. Only 8.70% of the growers revealed using both sizes due to availability and growth performance. Despite the prohibition of Fisheries Administrative Order (FAO) 264 series of 2020 to collect and transport of fly-sized or langaw langaw juvenile, records showed that farmers still opt to use the langaw langaw.

While results showed that majority of the growers (52.17%) used coin-sized as seed stocks, the use of fly-sized crablets was still evident. Fly-sized crablets were also used for grow-out in different provinces including Pampanga, Bulacan and Roxas (Ballad and Bañares 2019). Growers claimed that fly-sized were used due to its lower price compared to coin-sized resulting to same or more harvest. No comparative study has done to verify this claim.

Further, volume of production showed that about 46.38% of the growers are producing less than a ton annually. There were 40.58% harvesting between one to three tons, 10.14% between 3.01 to 5.0 tons while both 1.45% were recorded harvesting 5.01-7 tons and above 7 tons.

There were various pond sizes used in mangrove crab farming in the province used for polyculture of milkfish, crab and/or shrimp. The growers did not recommend monoculture of crab. Crabs were considered as the 'jackpot' species increasing income however, culturing it alone will cost high inputs and the risk of low survival will end up farmers to empty pocket. Polyculture tends to decrease input cost as this could be divided to the species farmed. Khor et al. (2022) revealed that polyculture ponds produce higher aquaculture revenue and profits than monoculture ponds.

Annual income covering the polyculture of aquaculture species showed that 37.68% were earning Php 100,000-Php 200,000 while 24.64% obtained below Php 100,000. Results also showed that 15.94% had earned Php 200,001-Php 300,000, 15.94% had a whooping above Php 500,000 annual income while there were 4.35% who earned Php 400,001-Php 500,000.

Estimated annual income was correlated to production area (ha), annual production and number of cycle per year (Figure 4). Results showed that annual income had a very strong positive correlation with production area (r=0.886) and annual production (r=0.815) showing significance at 0.01 level.

On the other hand, number of cycle per year showed a weak to no correlation to estimated annual income, production area and annual production (Figure 4). Results revealed that number of cropping per year do not necessarily affect the changes in annual income and annual production.

Correlation of estimated income, production area (ha) and annual production suggests that as the production area increases, annual production and estimated annual income also increase for brackishwater ponds. Study suggested that brackishwater ponds could generate a higher profit, but this was largely due to farm size (Irz and Mckenzie 2003), thus the potential to increase stocking density which could lead to higher production.

Marketing

Market Trends

Data collected showed the market trend of estimated mangrove crab supplied in Orani Fish Port for the last three years. Highest recorded supplied mangrove crab was in 2019 with 999,442.50+24,074.63 kgs (Table 3). There were 561,102.50+15,731.46 kgs and lowest observed supplied crab was recorded at 553,437.50+18,026.48 kgs.

Mangrove crabs are mainly marketed in the whole live form. Presently, the major market of mangrove crab and seafood products is Orani Fish Port (Consignacion). Collectors used to sell their product directly to the buyers or at the municipal market at small volume. Larger volume of mangrove crabs have been transported and marketed either at Balanga City public market or Orani Consignment. On the other hand, most of the mangrove crab growers brought their product in Balanga City and Orani Consignment. Nearby province, Pampanga became an option to some municipalities such as Hermosa and Orani when the current price in Bataan was relatively low. While Bulacan and Manila were considered as existing markets for traders, these were seen by most of the growers to be part of their options in the coming cycles.

Crabs are marketed live in the area and sold per piece commanding a higher price than selling it in kilo. Wholesalers supplying exporters and retailers (restaurants and nearby provinces) were directly negotiating in Orani Fish Port.

Table 2. Production engagement of mangrove crab farmers in Bataan province

Characteristics	Categories	Number of Farmers n=69	Percentage (%)
Production area (ha)	<1	1	1.45
	1-10	48	69.57
	11-20	5	7.25
	21-30	9	13.04
	31-40	1	1.45
	Above 40	5	7.25
Number of Cycle Per year	1	0	-
	2	12	17.39
	3	42	60.87
	4	15	21.74
Species cultured	Bulik (*S. serrata*)	27	39.13
	Pulahan (*S. olivacea*)	0	-
	Purplish (*S. tranquebarica*)	1	1.45
	Mixed	41	59.42
Type of culture	Monoculture	0	-
	Polyculture	69	100
Seed size	Fly size	27	39.13
	Coin size	36	52.17
	Mixed	6	8.70
Annual Production (Ton)	Below 1	32	46.38
	1.00-3.00	28	40.58
	3.01-5.00	7	10.14
	5.01-7.00	1	1.45
	Above 7.00	1	1.45
Estimated Annual income (Php)	Below 100,000	17	24.64
	100,000-200,000	26	37.68
	200,001-300,000	11	15.94
	300,001-400,000	1	1.45
	400,001-500,000	3	4.35
	Above 500,000	11	15.94

Adopted and modified from Bhuiyan et al. (2021)

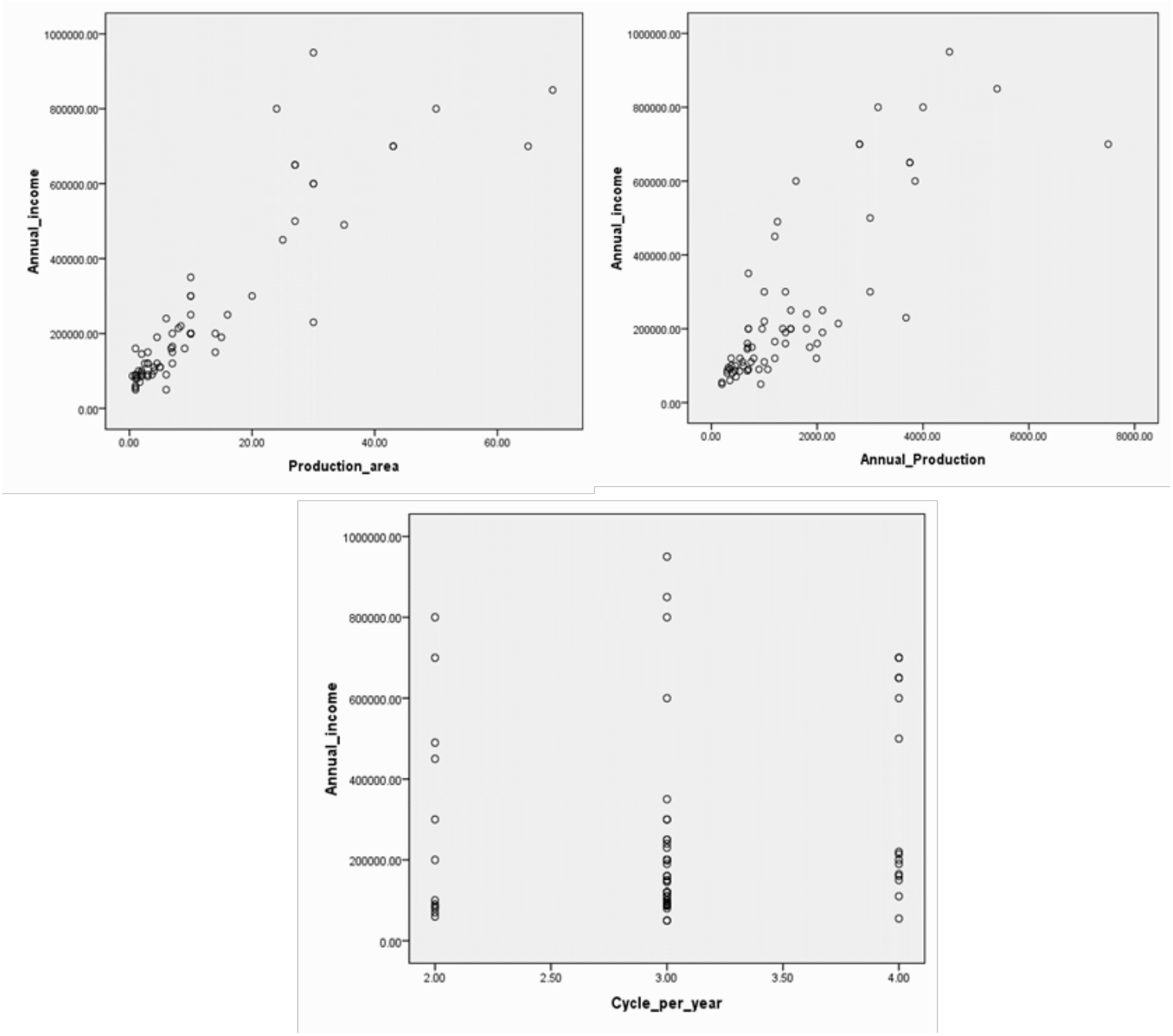


Figure 4. Annual income (Php) in correlation with production area (ha), annual production and cycle per year

Table 3. Mangrove crab quantity supplied, type and markets

Quantity supplied (Kilo)			Product type	Existing market (from the producers)	Potential market
2019	2020	2021			
999,442.50 SD=24,074.63	561,102.50 SD=15,731.46	553,437.50 SD=18,026.48	Live	Local market, Bataan, Pampanga	Bulacan, Manila

Adopted and modified from SEARCA (2017)

Grading and Pricing System

Crabs could be marketed according to grades, weight, meat characteristics and shell condition. Results showed that there were three (3) classifications of mangrove crab for marketing in the province. Classifications were male, female and the immature or locally termed as bakla. Highest grade for males was XL having > 500 g in weight fetching P 1,025.00+230.12 each crab while lowest grade was the reject fetching a price of P179.58+146.79. Rejected crabs were those of different sizes with physical damage, no claws, under sized and with soft shell (Table 4).

Grading of female crabs included primera (F1) for highest grade followed by segunda (F2), tresera (F3) and reject as the lowest grade. Highest grade was usually observed at > 500 g marketed at Php 920+313.89 while reject has the same characteristics as those of the males fetching Php 252.50+106.10 (Table 4).

Immature, locally termed as bakla, are the crabs, which were not fully developed into females. These were graded as primera (F1) and segunda (F2) of weight at about 350 g and 250 g. These were sold at Php 305.25+212.74 and 223.64+100.13, respectively (Table 4).

Grading of crabs vary due to sex, weight, characteristics and markets (exporters and retailers). Results an almost similar grading system of crabs in other countries which vary due to sex, weight and domestic and international market (Mahmud and Mamun 2013; Ferdoushi et al. 2010; and Huq 2010). In this study, exporters decide on what crab sex and weight is demanded for the day. Size grading is almost similar to the Philippine National Standards (PNS) for the male while female was categorized in PNS as XL with >400 g weight. Males were marketed for its full meat and hard shell condition. Females were marketed for its full hard gonad characteristics. These are marketed as due to its partial development of gonad and meat in one.

Market Channels in the Mangrove Crab Industry

Figures 5 and 6 presents the marketing channel of a mangrove crab collector and farmer. The market channel from collecting crabs showed that from crab collector, crab are sold in different ways (Figure 4). Crabs are sold directly to the consumers, supplied to the retailers or brought to the fish port through consignment. Shortest chain was observed in the first channel while longest was recorded in the last chain.

Table 4. Grading and classification of mangrove crab (Scylla spp.)

CLASSIFICATION	GRADE	WEIGHT (G)/PIECE	CHARATERISTIC	SHELL CONDITION	PRICE (Php/kilo)
MALE	XL	≥500	Full meat	Hard	1,025.00±230.12
	L	≥400	Full meat	Hard	820.83±133.92
	M	≥300	Full meat	Hard	662.50±149.43
	S	≥200	Full meat	Hard	288.33±158.74
	REJECT	Variety	No claws, soft shelled, under sized	Hard/Soft	179.58±146.79
FEMALE	Primera (F1)	≥500	Full hard gonad	Hard	920±313.89
	Segunda (F2)	300-400	Full hard gonad	Hard	807.08±260.35
	Tresera (F3)	≥200	Full hard gonad	Hard	681.25±235.76
	REJECT	Variety	No claws, soft shelled, under sized	Hard/Soft	252.50+106.10
IMMATURE (*Bakla*)	Primera (F1)	350	Partial development	Hard	305.25±212.74
	Segunda (F2)	250	Partial development	Hard	223.64±100.13

Adopted and modified from Bhuiyan et al. (2021) and Sultana et al. (2019)

Channels in farming crabs include the input supplier, grower, fish port (consignment, wholesaler, exporter or retailer and consumer (Figure 5). Input supplier served as the link between the crab catchers (usually from Bicol Region) in the chain. All harvested crabs were directly brought in the fish port (Orani, Balanga City or Pampanga) due to its bulk. The first channel was input supplier to grower to fish port to wholesaler to exporter to consumer. The second channel involved input supplier, grower, fish port, wholesaler, retailer and consumer. Exporter in the former involves processors located at Paranaque while retailers in the latter referred to restaurants and local markets of adjacent and nearby provinces.

The present market channels of mangrove crab depend from the origin of the production. Mangrove crab collectors revealed a simple channel directly supplying to the consumer. A more complex channel involving few intermediaries was also found in this study when the volume of catch was high. For mangrove crab growers, channel starts at input supplier passing different intermediaries from consignment, wholesalers to retailers and exporters. Ballad and Bañarez (2019) reported that collection and trading systems of crablets in Cagayan involved series of intermediaries, from gatherers to consolidators to grow-out operators including Bataan province.

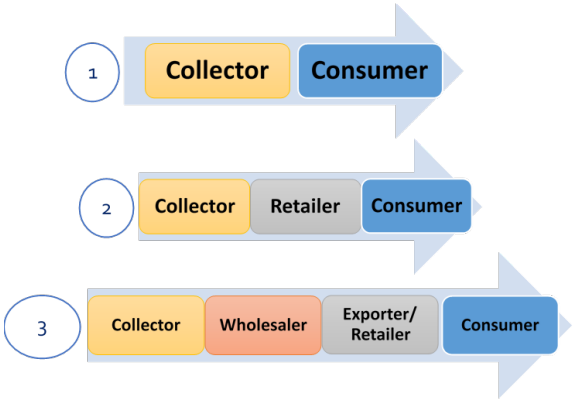


Figure 5. Mangrove crab collector's market channel

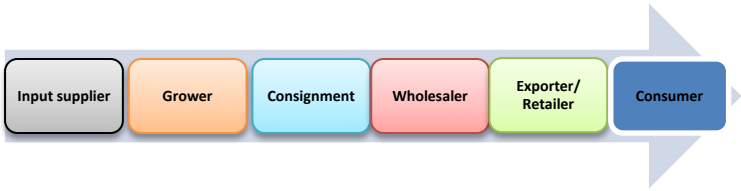


Figure 6. Mangrove crab farmer's market channel

Mode of Payment and Transportation

The payment activity was found to be dependent on the mutual understanding between the parties (Table 5). Payment was done through cash, check or credit in the study area. Input suppliers were found to demand cash-basis payment from the mangrove growers. Study revealed that mangrove crab growers were paid either cash, check or credit. Cash were handed immediately upon completion of the transaction provided that the consignee owner has available cash-on-hand while check was issued in the absence of cash. Credit was practiced between consignment and mangrove crab growers where payment was done between 2-3 days after transaction. Consignment was found to allow credit to wholesalers who travel their products in Manila and practiced payment 5-7 days upon transaction. Study showed that wholesalers demand cash and check basis from exporters while cash and credit basis for retailers. Retailers were allowed to pay the wholesaler 2-3 days upon transaction. Retailers practiced cash-basis from consumers. Credit was practiced through mutual and verbal agreement between parties.

Live mangrove crabs were generally transported to the Fish Ports. Crabs were put in trays with open holes (side and bottom). Some growers were found to be transporting the harvest using boats while others rent vehicles. Areas adjacent to the fish port spent little transportation cost than those who were of a relative distance.

Table 5. Payment scheme in mangrove crab industry

Actor	Mode of payment	Payment scheme
Input supplier to Source	Cash basis	Immediately after transaction
Mangrove crab to Input supplier	Cash basis	Immediately after transaction
Consignment owner to Grower	Cash basis, check or credit	Immediately; 2-3 days
Wholesaler to Consignment owner	Credit basis	5-7 days
Retailer to Wholesaler	Cash; credit	Immediately; 2-3 days
Exporter to wholesaler	Cash	Immediately after transaction

Actors, Roles and Interrelationship

Data were collected through direct interview, FGD and KII. The study revealed that there are two sources of mangrove crab production in the province: collection and aquaculture. The former was considered as minimal to low production contribution while the latter was considered as the major. The marketing channel for aquaculture in the province was found to start from the input supplier while collectors directly gather crabs from the sea. Different actors and intermediaries were discussed in the Table 6.

Actors Roles and Interrelationships

Input supplier The input suppliers are the main source of crablets in the province, thus playing a vital role in the industry. They serve as the link between mangrove crab growers and the crab catchers. Since crab catchers were mostly from Bicol Region, they are the responsible link to order and negotiate desired number from the growers. Growers and input suppliers agree to a certain price to close the deal. Verbal understanding serves as their main agreement. Hundred percent (100%) of the input suppliers were commission basis. Their main inputs were mouth and cellphone communication. They have the capable of controlling the price of crablets. Mangrove crab growers were bound to agree to be able to avail crablets for their pond operation. Payments were made directly to the input suppliers.

Mangrove Grower

Growers are the main producers and key actors who buy crablets of either fly size or coin size. Culture for fly size usually takes 5-6 months while coin size farming takes 3-4 months. Fly size are bought at P5.00/each while coin size were commonly bought at P32.00/each. There were 52.17% growers who used coin size as seed stocks while 39.13% still use fly size and 8.70% of the growers used either of the two despite the Fisheries Administrative Order (FAO) 264 series of 2020 prohibiting the collection and transport of fly-sized or langaw langaw juvenile, records show that farmers still opt to use the langaw langaw size due to its lower price compared to the coin-sized.

Collector

Crab collectors are those collecting crabs seasonally of which most abundant were during the –ber months. Collector collects crabs from the open sea 3-7 times a week with > 3 kgs catch per day. Low volume collected crabs are usually marketed directly to consumers who are waiting in the port or sold directly by house to house. Given a great number of catch, collectors are saving the catch and bring to fish port (consignment) where price is higher.

Fish Port (Consignment Owner)

Consignment, some termed it depot, are the main market of mangrove crab and other sea foods in the province. Orani, Bataan was the most known Consignment. Consignment owners and producers (growers or collectors) commonly have verbal agreement in the marketing of the products. Consignment will sell the harvested mangrove crab at the highest possible price since its income depends on it. Consignment trades the crabs and get 6-7% as commission. In addition, a cha-cha as they termed was also implemented in the consignment on which, every 40-50 pcs of crabs there will be 1 crab deduction which according to the consignment are for the staff. Same goes with shrimp where an actual 15 kgs will be deducted with ½-1 kg as cha-cha. Much as the producers felt aggrieved with cha-cha, they have to agree for them to sell their harvest.

Wholesaler

Wholesalers were the actors who acquire crabs from the consignment. They are the bulk buyers, sometimes called as Viajero (Byahero) bringing the crabs in either exporter or retailer (restaurants) or marketing them in adjacent and nearby provinces. They are sometimes retailers, too. They can control the price of the crabs as they are the direct contacts of the exporters or restaurant owners. If the customers tell that they are in need of this certain crab species and sex at a given amount, the wholesalers negotiate with each other and make an agreement on the ceiling price of the goods. In addition, they also decide if the product could fetch a low or high price. They acquire the products from the consignment in a credit-basis, where they pay the amount due in a week or two. No document serves as binding agreement but verbal negotiation.

Retailer

Retailers are actors who usually acquire crabs from the wholesaler. They could be restaurants or a stall owner in the local wet market selling the goods per piece or per kilogram. Retailers (restaurants) usually change the form of the crabs adding value such as ingredient of soup or added with spices.

Exporter

Exporters are the part of the channel playing significant role in the uplifting of the price. Crabs are bought from wholesalers and the crabs are processed for export. There are about 10 exporters supplied by the wholesalers.

Table 6. Actors and their roles in the mangrove crab industry

Actors	Roles and interrelationships
Input supplier	The input suppliers are the main source of crablets in the province, thus playing a vital role in the industry. They serve as the link between mangrove crab growers and the crab catchers. Since crab catchers were mostly from Bicol Region, they are the responsible link to order and negotiate desired number from the growers. Growers and input suppliers agree to a certain price to close the deal. Verbal understanding serves as their main agreement. Hundred percent (100%) of the input suppliers were commission basis. Their main inputs were mouth and cellphone communication. They have the capable of controlling the price of crablets. Mangrove crab growers were bound to agree to be able to avail crablets for their pond operation. Payments were made directly to the input suppliers.
Mangrove grower	Growers are the main producers and key actors who buy crablets of either fly size or coin size. Culture for fly size usually takes 5-6 months while coin size farming takes 3-4 months. Fly size are bought at P5.00/each while coin size were commonly bought at P32.00/each. There were 52.17% growers who used coin size as seed stocks while 39.13% still use fly size and 8.70% of the growers used either of the two despite the Fisheries Administrative Order (FAO) 264 series of 2020 prohibiting the collection and transport of fly-sized or *langaw langaw* juvenile, records show that farmers still opt to use the *langaw langaw* size due to its lower price compared to the coin-sized.
Collector	Crab collectors are those collecting crabs seasonally of which most abundant were during the –ber months. Collector collects crabs from the open sea 3-7 times a week with $\geq$ 3 kgs catch per day. Low volume collected crabs are usually marketed directly to consumers who are waiting in the port or sold directly by house to house. Given a great number of catch, collectors are saving the catch and bring to fish port (consignment) where price is higher.
Fish Port (Consignment Owner)	Consignment, some termed it depot, are the main market of mangrove crab and other sea foods in the province. Orani, Bataan was the most known Consignment. Consignment owners and producers (growers or collectors) commonly have verbal agreement in the marketing of the products. Consignment will sell the harvested mangrove crab at the highest possible price since its income depends on it. Consignment trades the crabs and get 6-7% as commission. In addition, a *cha-cha* as they termed was also implemented in the consignment on which, every 40-50 pcs of crabs there will be 1 crab deduction which according to the consignment are for the staff. Same goes with shrimp where an actual 15 kgs will be deducted with ½-1 kg as *cha-cha*. Much as the producers felt aggrieved with *cha-cha*, they have to agree for them to sell their harvest.
Wholesaler	Wholesalers were the actors who acquire crabs from the consignment. They are the bulk buyers, sometimes called as *Viajero* (*Byahero)* bringing the crabs in either exporter or retailer (restaurants) or marketing them in adjacent and nearby provinces. They are sometimes retailers, too. They can control the price of the crabs as they are the direct contacts of the exporters or restaurant owners. If the customers tell that they are in need of this certain crab species and sex at a given amount, the wholesalers negotiate with each other and make an agreement on the ceiling price of the goods. In addition, they also decide if the product could fetch a low or high price. They acquire the products from the consignment in a credit-basis, where they pay the amount due in a week or two. No document serves as binding agreement but verbal negotiation.
Retailer	Retailers are actors who usually acquire crabs from the wholesaler. They could be restaurants or a stall owner in the local wet market selling the goods per piece or per kilogram. Retailers (restaurants) usually change the form of the crabs adding value such as ingredient of soup or added with spices.
Exporter	Exporters are the part of the channel playing significant role in the uplifting of the price. Crabs are bought from wholesalers and the crabs are processed for export. There are about 10 exporters supplied by the wholesalers.

Challenges in the Mangrove Crab Industry

Various factors affecting the crab industry have been identified through direct interview and Focus Group Discussion (FGD). Respondents were allowed to choose as many challenges as they can but encouraged them to pick the top concerns. Varying factors have been identified in each actor (Table 7). Seeds and transportation have been marked with 100% as main constraints for the input suppliers. Low to no collection and weather at 100% were the challenges for the collectors. Mangrove crab growersrevealed that weather has the greatest impact in their farming with 79.71% and the price of crablets with 50.72%. Among other challenges faced by the growers include water quality (37.68%), the occurrence of the pandemic (36.23%), marketing practices (21.74%) which includes the deceiving of growers in grading and pricing system and the system of cha-cha.

Traders identified their constraints including the high rejection of the crabs (100%) and occurrence of pandemic (100%). Season of the year which can also be associated with the supply and demand was also identified with 56% response. Consumers on the other hand, all (100%) agreed to have been cheated with the quality of the crabs and buying too expensive crabs. Crabs for the consumers were usually served during meetings, conferences, family occasions and holidays.

Table 7. Challenges in the mangrove crab industry

Actor	Problems	Response	Response (%)
Input Supplier (n=3)	Seeds	3	100.00
	Transportation (Inspection)	3	100.00
Collectors (n=9)	Low to no collection	9	100.00
	Weather	9	100.00
	Water quality	3	33.33
	Garbages	3	33.33
Mangrove crab growers(n=69)	High crablets price	35	50.72
	Weather	55	79.71
	Water quality	26	37.68
	Marketing practices	15	21.74
	Pandemic	25	36.23
	Supply/Demand	14	20.29
Traders (n=50)	High rejection	50	100.00
	Pandemic	50	100.00
	Season (Supply/Demand)	28	56.00
	High Transportation Cost	18	36.00
Consumer (n=20)	Cheated in quality	20	100.00
	High price	20	100.00

Several challenges were observed in every step of the of mangrove crab industry. Input supplier revealed that source and transportation of seeds, specifically the fly-sized, due to the implementation of FAO 264, s. 2020. In has become worse when the pandemic hits the country where mandatory checkpoints were implemented in every boundary. Mangrove crab growersrevealed that most challenging part in aquaculture is having no to little harvest which could be a result of typhoon, mortality and water quality or the combination thereof. Pandemic has also affected the production sector when movements were restricted which caused price increase in aquaculture inputs. Traders disclosed that high rejection rates and pandemic affected their livelihood the most. High rejection was attributed to the quality loss of the product thus, goods were sold at very low price if not thrown away. The pandemic stopped all activities resulting to low income. Both led to economic loss for the traders.

Role of Men and Women in the Mangrove Crab Industry, Fisheries Sector in General

Activities in the mangrove crab industries have been identified (Table 8). Respondents were asked to identify their gender based on the social norms, behaviors and roles associated with woman, man, girl or boy. Respondents were asked to describe how gender plays role in the mangrove crab industry. Trainings were determined from an agency conducting fisheries trainings through KII. Activities were categorized into two: laborious and less-laborious as how the respondents perceived it.

Crab gathering (100%), pond operating/owning (81.25%), pond constructing (100%), pond preparing (94.34%), feeding and monitoring (84.91%), harvesting (100%) and aquaculture training (93.75%) were revealed to be men dominated activities while marketing and trading (74%) and fish processing training (85%) showed a women dominated activities (Figure7). It however revealed that both genders are performing feeding and monitoring (15.09%) and pond preparing (5.66%).

Chi-square test revealed a significant (f=0.000) association between activities and gender. Activities are not independent from gender but the other way around.

The study revealed that men and women both played important roles in the mangrove industry. Activities were categorized as laborious and non-laborious. Laborious activities were those which productive works requiring physical strength, spending more time to do works and decision-making. On the other hand, less laborious activities were defined as lesser physical strength involved, short to limited time of involvement and focus more on financial management. Results revealed that laborious activities were men's sphere while less laborious were for women. Involvement of women in pond preparing and feeding and monitoring (8%) were more on supportive role like handing over supplies and materials. Nabayunga et al. (2021) found out that women could play a supporting role in aquaculture activities.

Table 8. Gender roles in the mangrove crab industry

Category	Activity Indicator	Men	Women	Both	Laborious	Less Laborious
Collection	Crab gathering (n=9)	9	0	0	9	0
Pond owners	Pond operating/owning (n=16)	13	3	0	16	0
	Pond constructing (n=53)	53	0	0	53	0
	Pond preparing (n=53)	50	0	3	53	0
Aquaculture	Feeding & monitoring (n=53)	45	0	8	45	8
	Harvesting (n=53)	53	0	0	53	0
Marketing & Trading	Marketing (n=50)	13	37	0	18	32
	Aquaculture training (n=48)	45	3	0	45	0
Training & education	Fish Processing training (n=140)	21	119	0	140	0

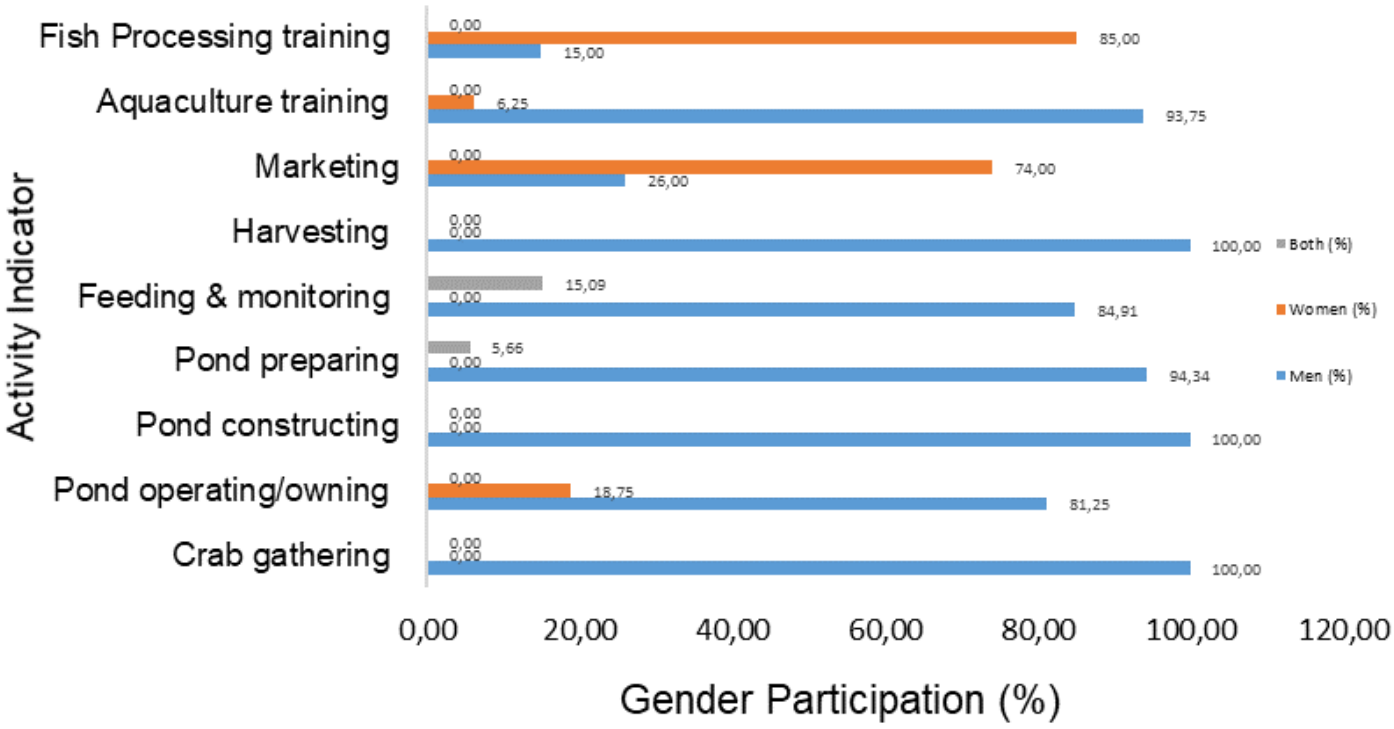


Figure 7. Role of Men and Women in mangrove crab industry

Women, according to men respondents, still need to attend their children at home thus, marketing is suited for them as it only takes few hours. In addition, most of the respondents suggested that women are more particular on finances rather than men. Iguban et al. (2017) reported that the shrimp industry was a men's sphere, where more men were identified to be actively engaged as owners or members of the shrimp catching operation crew. Thus, supporting claims that in fishing communities, women are less engaged in productive work but generally for housework (Iguban et al. 2017)

This study revealed that men acknowledged the roles of women in the mangrove crabs however, men perceived that letting women work on laborious activities was likely to be ungentlemanly. In addition, it would take more time for women to do a man's day job.

Conclusion

Mangrove crabs are valuable seafoods with high demand both for local and export purposes. Crab collection and farming, fisheries in general, has long been a source of livelihood in the province. Majority of the mangrove crab growersworked as caretakers depending on their salary as their main income. Monthly salary was found to be directly dependent on the size of the pond. A 5-10% commission was usually granted upon good harvest. *Scylla serrata* was the most preferred species for culture however, results showed overlapping of three species cultured in brackishwater ponds. Despite the implementation of FAO 264, s. 2020, growers were found to be using fly-sized crablets as seedstocks. Pond sizes vary in the province preferably using polyculture as this shows higher profitability than monoculture.

Intermediaries play significant roles in the crab industry. Input players serve as the main link between crablet catchers while consignment serves as the main link between growers and the market. Highest gross profits and markups was attained by wholesaler as he/she can has the sole control on how to price the crabs from the consignment to the exporters and retailers. Of all actors, crab growers were the most affected as they cannot complain from the price set by the input supplier as they depend their stocks from them. *Cha-cha* implemented by the consignment was found to be not beneficial to growers.

Several problems in the mangrove industry include the implementation of FAO 264, s. 2020 for input suppliers, weather, market practice and crablets price in aquaculture sector while pandemic and high rejections for market traders.

Men and women both play significant roles in the fisheries sector. Laborious/productive activities were perceived to be men's sphere while less laborious and financial aspects were for women. Results of this study is anticipated to be beneficial to different stakeholders to ensure sustainability of mangrove crab and fisheries industry in general.

Compliance with Ethical Standards

Conflict of interests: The author declare that for this article they have no actual, potential, or perceived conflict of interest.

Ethics committee approval: Ethics committee approval is not required for this study.

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