The Philippines'

Blue Swimming Crab (*Portunus pelagicus*) Fishery **Root Cause Analysis** Report

May 2020

Global Marine Commodities for sustainable fisheries

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INTRODUCTION

In the Philippines, the blue swimming crab (BSC) is considered as one of the most commercially important and well-traded seafood commodities. Just like in the other seafood industries in the country, the BSC industry players are faced with limited supply, as there have been increasing seafood trade activities worldwide.

Because of this, the risk of overharvesting or overexploitation of BSC is high and the concerns to maintain a delicate balance between the requirements for increased production and economic benefits, as well as the need to conserve and protect the resource for long term sustainability, have been increasing.

In 2011, a coalition of stakeholders in the crab industry, in collaboration with the Department of Agriculture - Bureau of Fisheries and Aquatic Resources (BFAR), developed the Blue Swimming Crab Management Plan (BSCMP). Through a Joint Department of Agriculture (DA) – Department of Interior and Local Government (DILG) Administrative Order No. 01, series of 2014, titled "*Regulation for the Conservation of Blue Swimming Crab (Portunus pelagicus)*" the BSCMP was put in effect, specifying its intended activities until 2015 only.

Years after the implementation of the BSCMP, a comprehensive review and enhancement of the plan became necessary. This time, the crafting of the new BSC-NMP was based on a strategic fisheries management framework, with the activities guided by the recommended steps of the Ecosystem-based Approach to Fisheries Management (EAFM).

The said framework likewise includes a fishery sustainability challenge through a

"systems-approach" wherein any problem in the industry is being addressed by looking at the end-to-end process, rather than concentrating on snapshots of the problem.

In order to do this, an in-depth sector analysis for the BSC commodity sector in the country was conducted to investigate and identify the weaknesses, threats, and gaps of the sector towards sustainable fisheries management for the BSC commodity as well as the strengths of, and opportunities for, the industry. These were done to establish the problem tree and the different contributing causes and causality relationships confronting the BSC industry in the country.

The different stakeholders and enablers of the BSC supply chain in the Philippines were engaged in participatory discussions. Results from previous research studies, research publications, government reports, technical and working paper, and records from private sectors were also included in the analysis.

CONCEPTUAL APPROACH TO THE ROOT CAUSE ANALYSIS

Root cause analysis (RCA) is a structured approach in identifying the underlying causes of problems so that the most effective solutions can be identified and implemented. It is considered as a proactive management strategy that is used to identify and analyze the main or the root cause of a problem and the several factors that may have contributed to this problem.

RCA is an important first step in the development of the BSC National Management Plan (BSC-NMP) for the Philippines. The findings in the RCA were specifically applied as a diagnostic tool, and as relevant inputs to the BSC-NMP.

For the RCA of the BSC industry in the Philippines, three types of analyses were conducted. These included the following:

Situation Analysis

Situation analysis of the BSC industry of the Philippines included a systematic collection and evaluation of available data or information. This aimed to identify factors that may have influenced the performance of the BSC industry both at the local and international markets. Sources of data were as follows:

(1) stakeholder consultations that were strategically conducted in Iloilo City (23-24 July 2019) and Cebu City (8-9 August 2019);

(2) key informant interviews and focus group discussions with different stakeholders and enablers;

(3) primary data from the previous works of the National Consultant (see Yap et al. 2017);

(4) secondary data that were culled from research publications, government reports, technical and working papers, and records from private sectors; and

(5) national and local policies and the existing rules and regulations and their implications on the BSC industry.

The factors that affect the BSC industry of the Philippines, as determined by the stakeholders during the consultations were categorized into internal and external factors via the SWOT (Strength-Weaknesses-Opportunities-Threats) Analysis. Internal factors referred to the strength and weaknesses of the industry, while the external factors included the opportunities and threats.

Problem Analysis

To come up with more robust information on the main problems of the BSC industry in the Philippines, other valuable information on the different issues and concerns of the industry, based on the Situation Analysis, were assessed. These included inputs related to the weaknesses, threats, and gaps of the sector towards sustainable fisheries management for the BSC commodity as well as the strengths of, and opportunities for, the industry.

The Problem Analysis of the BSC industry in the Philippines was likewise guided by the concept of the Ecosystem Approach to Fisheries Management (EAFM) that seeks to balance environmental and socioeconomic concerns through improved governance.

In particular, the problems were identified in each of the nodes of the BSC supply chain and these problems were clustered into **environmental** (or ecological), **socio-economic** (or human), and **governance** related problems. The interactions between them were likewise established.

Discussions were conducted to come up with a Problem Tree of the BSC Industry that highlighted three important things: the main or the root causes of the problem, the causes or the factors that contribute to these problems, and the effects of the main problems. A problem tree for the entire BSC industry of the Philippines was constructed.

Solution Analysis

The Problem Tree, as determined in the Problem Analysis, was transformed into a Solution Tree that enabled the identification of the enabling environment necessary for the proposed solutions to succeed. Likewise, the solution analysis paved the way to the crafting of the Vision for the BSC Industry of the Philippines and the goals and objectives for the industry for the next 5 years.

These goals and objectives were focused on three main concerns, namely, **environmental** (or ecological), **socio-economic** (or human), and **governance** related concerns.

SITUATIONER: PHILIPPINES' BLUE SWIMMING CRAB FISHERIES

The Blue Swimming Crab (BSC) as a Marine Commodity. The blue swimming crab, *Portunus pelagicus* (Linnaeus 1758) is a species of phylum Arthropoda, class Malacostraca, order Decapoda (or those referring to organisms with ten appendages), infraorder Brachyura (or true crab), and family Portunidae (or swimming crab).

BSC is a commercially important marine brachyuran decapod which is bilaterally asymmetrical in appearance. It has a rough to granulose, broad, and flattened carapace which varies from being transversely ovate to transversely hexagonal, and sometimes circular. The frontal region of the carapace is composed of four acutely triangular teeth. Each antero-lateral margin has nine teeth on each side, with the very pronounced last pair of teeth resembling horns that are ~2-4 times larger than the preceding teeth (see Mesa et al. 2018).

The clawed legs of the BSC are long, elongated, and rigid, with the last pair functioning as swimming paddles to help pursue potential prey or avoid predators. These edible crustacean species are gonochoric or have separate sexes. The males usually have distinctive blue color and a triangular abdomen, while the females are mottled brown to dull green in color, with a semi-circular abdomen (Figure 1).

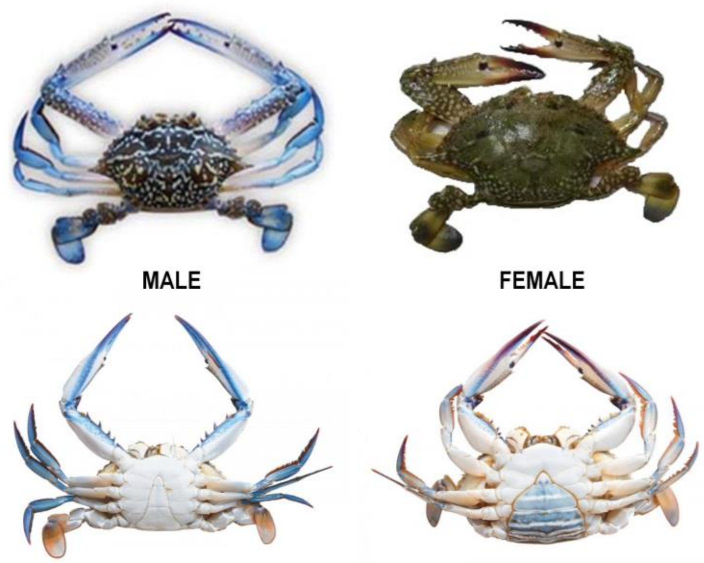

Figure 1. The male (M) and female (F) blue swimming crab, *Portunus pelagicus*, in the Philippines *(Sources: Mesa, 2019; museum.wa.gov.au)*

This species is known in various names, including blue manna crab, blue swimmer crab, blue crab, and sand crab. In the Philippines, it is locally known as "*alimasag*" (Tagalog), "*lambay*" or "*masag*" (Cebuano), and "*kasag*" (Hiligaynon).

Life history. The mating behavior of BSC is usually through pre-copulatory courtship, where the sperm is transferred indirectly through olfactory and tactile cues.

This species exhibits several larval stages before metamorphosing into the crab stage (Figure 2). During its larval stage, it undergoes four zoeal stages (Shinkarenko 1979) that are largely planktonic. The larvae drift up to 80 km offshore and spend up to six weeks in coastal waters (Williams 1982).

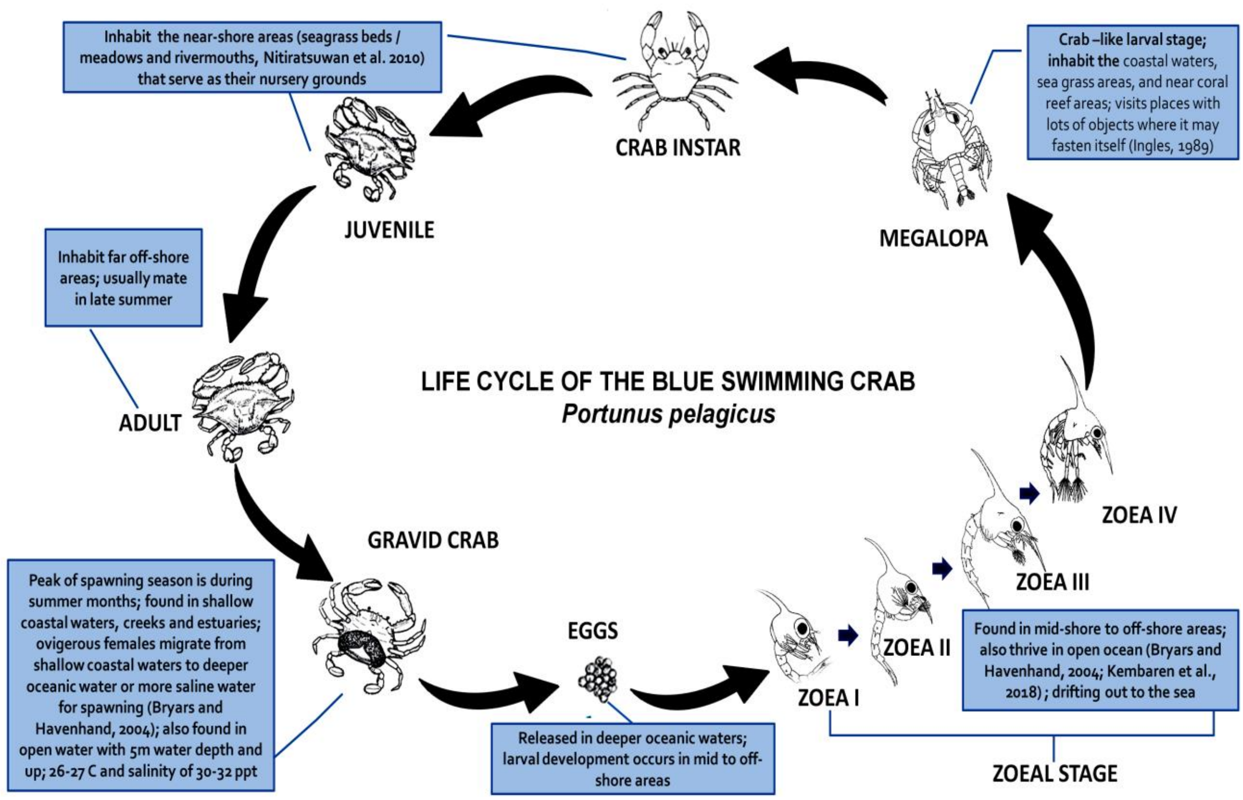

Figure 2. The life cycle of the blue swimming crab, *Portunus pelagicus*

The first zoeal stage is characterized by a carapace length of 0.44-0.54 mm. The eyes are not stalked yet, with the abdomen consisting of five segments plus a telson (length = 1.07-1.23 mm). For the second zoeal stage, the carapace length has increased to about 0.72-0.77 mm after molting and its eyes have become stalked at this point. The general morphology of the cephalothorax and the abdomen are essentially the same as in Zoea I (Junawa et al. 1987), but with added pair of short hair-like projections to the central arch of telson. After 3-4 days, each larva molts into third zoeal stage that is characterized by a carapace length of 0.79-0.87 mm. The abdomen is now composed of six abdominal segments (with spine being absent on the sixth segment). In addition, pleopods buds now appear on the second to six abdominal segments. The larva in the fourth zoeal stage has a carapace with a length of 0.98-1.06 mm and an abdomen-telson length of 2.61-3.03 mm (Josileen and Menon 2004). It also has pleopods that are already well-developed and biramous on the second to fifth abdominal segments (Junawa et al. 1987). The last two stages take about 2-3 days to develop (Arshad et al. 2006). In general, all zoeal stages are characterized by a long rostral, a dorsal spine, and a pair of short lateral spines on the carapace. The exopodites of the first and second maxillipeds are used in swimming (Arshad et al. 2006).

The larva then undergoes major metamorphosis to the megalopa stage. In this stage, the larva appears to be more crab-like in appearance with a broader carapace. Biting claws and pointed joints at the end of its swimming legs are now more developed. The megalopa measures approximately 1.0 mm in width with the duration of the stage for about 3-4 days (Josileen and Menon 2004).

The megalopa then undergoes final metamorphosis to the 1st crab instar, about 15-18 days of development after hatching. The instar stage of BSC now resembles its adult form, with completely curved abdomen below the cephalothorax (Arshad et al. 2006, Josileen and Menon 2004). It is now in benthic form and preys on small shrimps and clams and other benthic invertebrates.

The BSC instar then undergoes several molting until it reaches the juvenile stage. During this stage, the carapace has grown up to 60 mm in width. Some of these juveniles now migrate to the estuarine waters. They forage and grow in nursery shallows, preferably in seagrass beds and near-shore areas (Kenyon et al. 1999).

From this point and until about five to six months after hatching, the BSC will once molt until it finally reaches full maturity (Juwana et al. 2015). Adults mate during late summer and generally spawn either in the entrance channels or in adjacent coastal waters (Banks and Trumble 2011).

The blue swimming crab is a carnivorous species. Their main diet includes bivalves while the octopus is considered as their main predator (Ingles 1996).

Reproductive Biology. This species follows a year-round spawning cycle with the highest spawning activity generally observed between May and October (Potter et al. 1983, Ihsan et al. 2014) in tropical waters. It reaches sexual maturity at a carapace length of about 11.43 cm for females and 22.86 cm for the males (BFAR 2013). Female crabs release up to two million eggs per batch.

According to Sumpton et al. (1994), there are five stages in the reproductive cycle of BSC, exhibiting the changes during its gonadal maturity. Stage I (or the Immature/Virgin Stage) is characterized by being non-ovigerous. As it reaches Stage II (or the Developing/Maturing Stage), it becomes ovigerous, with pale to dark yellow mass, with no visible eyespots in the eggs. In Stage III (or the Mature/Ripening Stage), it is still ovigerous, with yellow to yellow-grey egg mass and visible eyespots. During Stage IV (or the Spawning/Gravid Stage), the crabs are ovigerous, with grey egg mass, and the eyespots and chromatophores becoming discernible. The last stage (Stage V or the Spent or Resting Stage), only the remnants of eggs are present in the abdominal flap.

The movements of BSC in and out of the estuaries and into open ocean waters generally occur in response to lower salinities (Banks and Trumble 2011). The average lifespan of blue swimming crabs is approximately three years (Williams 1982).

Distribution. The BSC is widely distributed in the Indo and West Pacific oceans, from Japan and Philippines throughout Southeast and East Asia, to Indonesia, the East of Australia, and Fiji Islands, and westward to the Red Sea and East Africa.

In the Philippines, the BSC is among the 51 species of swimming crabs. It is found in shallow water areas between 10 to 50 m depth, with sandy to muddy substrate, including areas near reefs, mangroves, seagrass, and algal beds.

Juvenile BSC most commonly occur in intertidal shallower areas, with its age of maturity around 1 year. It feeds on a wide variety of sessile and slow moving benthic invertebrates (such as hermit crabs, gastropods, bivalves, ophiuroids, and gammarid amphipods). This species is almost exclusively carnivorous, that rarely consume plant material.

The habitats of the BSC at its different life stages are schematically presented in Figure 5.

Fishing Gears for BSC. The BSC in the Philippines are caught by a wide variety of fishing gears, such as gill nets, crab pots, crab lift nets, push nets, and trawl. The major crab fishing gears being used are the following:

a). **Crab Entangling Net or Bottomset Gillnet.** This gear (Figure 3) is locally called "*pukot pangasag*", "*palugdang*" or "*palubog*". It is usually operated by 1-3 persons per boat, with 1 person rowing the boat while the other two sets the net in place. The length of the net ranges from less than a kilometer to almost 3 kilometers long. It consists of panels of meshes that are made up of nylon.

In setting up the net, heavy sinkers are placed on the lead line to keep the net on the bottom and the net is set in one place by having anchors at both ends. The setting procedure usually takes 10-15 minutes, depending on the length of the net. Once the entire net has been set, buoys are attached at the end of the head rope.

The crab entangling net is usually set at the bottom before sunset and early the next day, the fishers return to the area to retrieve the net. Firstly, the buoy is retrieved slowly and the net is hauled by hand. While retrieving the gear, the fishers carefully remove each of the entangled crab from the net. With this practice, the soaking time (that is, from the time the crab gets entangled until it is retrieved from the net) ranges from 2 hours to almost 24 hours.

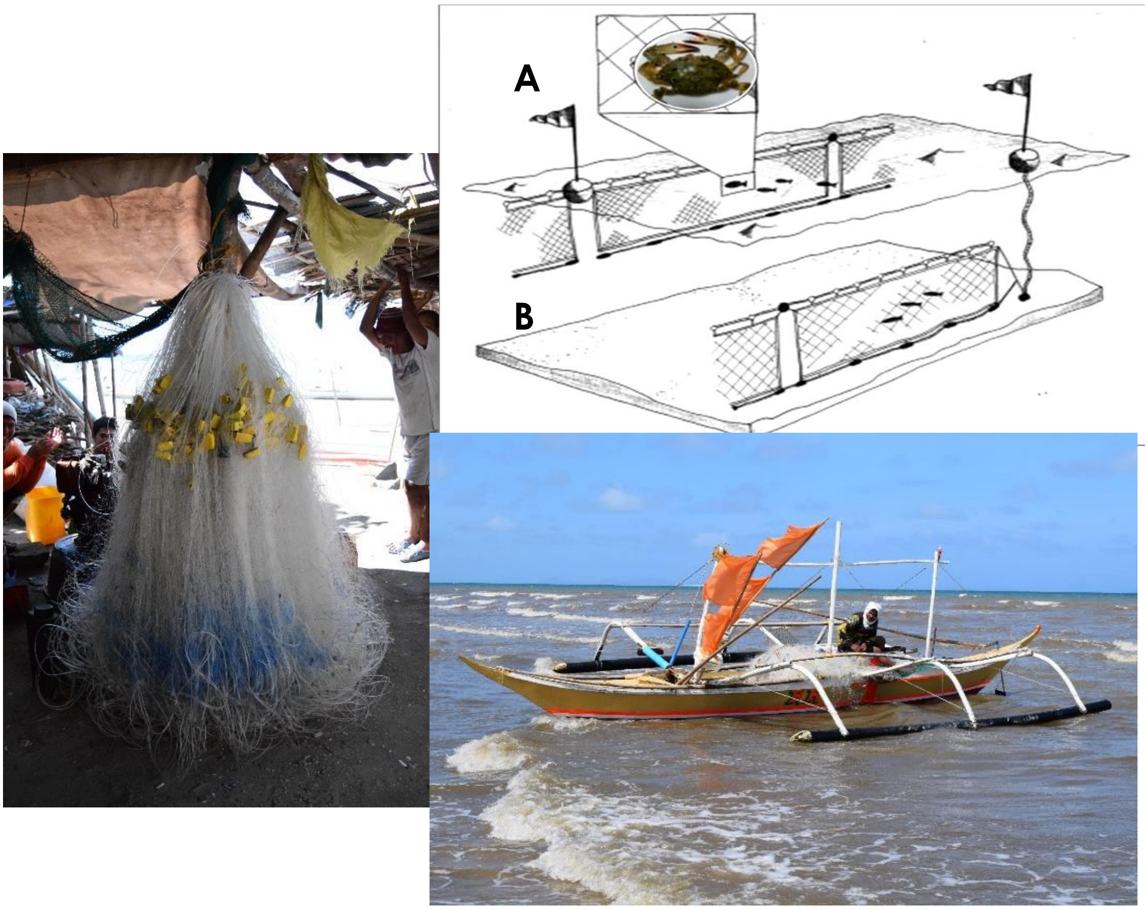

Figure 3. The crab entangling driftnet (A) or bottomset gillnet (B) (Bjordal 2002) being used in the BSC fishery in the Philippines

As soon as the fishers are able to reach the landing area and the catch sent to the buyers, the fishers immediately arrange the net carefully to ensure easy setting during the next operation.

Crab entangling net is prone to by-catch and ghost fishing. By-catch may include fish and marine mammals. It may also catch small and juvenile crabs depending on its mesh size.

b). **Crab pots.** Locally known as "*bubo pangasag*", "*panggal*", and "*timing*", a crab pot is a passive gear that is made up of bamboo and netting material. The frame, which gives shape to the gear and serves as attachment for the net, bait holder, sinkers and retrieving line, is usually made of bamboo.

This fishing gear works by luring (through bait) the organism into an enclosure that may have one or more entrances depending on its design. The different crab fishing communities in the country develop their own crab pot design, based on their preference (Figure 4). For example, the shape of the pot may be circular, rectangular, or square in varied sizes. Crab pots are generally made of different materials, such as bamboo strips, polyethylene net, or synthetic chicken wires, with the frame typically made up of bamboo.

The crab pot operation involves 1 to 3 fishermen, depending on the number of units (usually ranging from 40 to 800 units) and the size of the fishing boat. The use of bait is very crucial, since no bait means no operation for most fishers. The fishers are using different baits depending on what is available in their communities. The most common baits include small fishes, crabs, and shells. The bait is usually placed inside the bait holder which is attached inside the pot, either at the bottom, center, or upper portion of the frame. The soaking time of crab pots ranges from 5 hours to more than 24 hours and the whole fishing operation ranges from 1 to 3 days.

Crab pots that are made of bamboo are one of the most eco-friendly crab fishing gears. It has minimal by-catch and catches less number of small and juvenile crabs especially if the "mesh size" is bigger than 3 inches. Crab pots are usually constructed by fishers themselves or by their wives.

Figure 4. The different crab pots and crab traps being used in the BSC fishery in the Philippines

c). **Crab lift net**. This is a passive gear (Figure 5) used mainly to trap crabs. This gear is composed of a bamboo frame and a netting material. The bamboo frame provides shape to the gear. There are sinkers attached to the tips of the bamboo frame, a float that is used to mark the site where the fishing gears are set, and a retrieving line that is used to pull the gear to the surface. In order to lure crabs, baits, usually chopped trash fish, are placed inside a bait holder.

This gear is usually operated by one person with at least 20 to 120 units of crab lift nets, depending on the availability of capital. It is usually used from morning until night time, with soaking time ranging from 5 to 30 minutes. Hauling of the gear requires some skill as the crab may escape while the gear is being retrieved. The whole operation, however, typically ranges from 4 to 11 hours. Average catch is about 2-4 kgs during peak season and 1-2 kgs during lean season.

This gear is usually operated in more shallow areas and it generally catches smaller sized crabs. This is locally known as "*sapyaw*" (in Bohol) and "*bintol*" (in other areas in the country).

Figure 5. The crab lift nets being used in the BSC fishery in the Philippines

Production. Figure 6 shows the major BSC fishing grounds, located in the different FMAs in the country. Eight (8) of them are found in Luzon, 4 in the Visayas region, and 2 in Mindanao. In 2019, about 57.10% of the total production in the BSC came from the Luzon fishing grounds, 34.00% from Visayas, and 8.90% from Mindanao (PSA 2020).

Since the BSC fisheries is commercially and economically important, it has been experiencing high level of exploitation resulting to fluctuations in catch data as shown in Figure 7. The production of BSC in all producing regions also varies (Table 1), with the top 20 BSC producing provinces also showing fluctuating volumes in the last fifteen (15) years (Table 2).

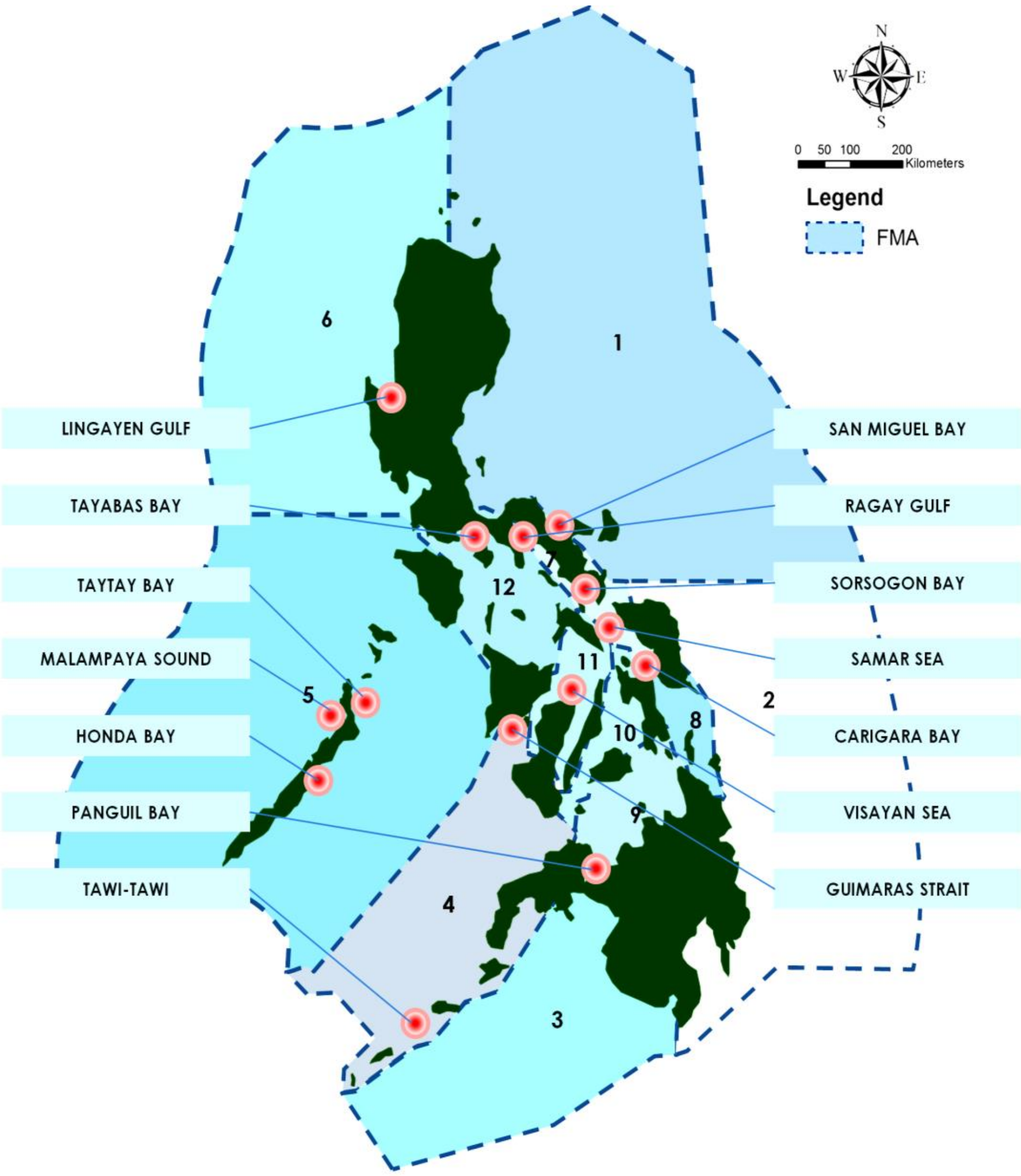

Figure 6. Major fishing grounds for the blue swimming crab in the Philippines that are situated in the different Fisheries Management Areas (FMAs). These fishing grounds include Lingayen Gulf, Tayabas Bay, Ragay Gulf, San Miguel Bay, Sorsogon Bay, Samar Sea, Carigara Bay, Visayan Sea, Guimaras Strait, Taytay Bay, Malampaya Sound, Honda Bay, Panguil Bay, and Tawi-tawi *(Source of data: Ingles,1996; FMA map: USAID Fish Right Program)*

Table 1. Production volume (in MT) of BSC from 2010 to 2019, from the municipal waters of all BSC-producing regions *(Source: PSA, 2020)*

Regions	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Region VI (Western Visayas)	9,383	8,928	8,140	7,873	7,448	7,287	8,692	10,062	10,281	7,108
Region V (Bicol Region)	5,210	4,784	4,080	4,811	4,989	5,540	5,735	5,989	6,105	5,524
Region 4-B MIMAROPA	3,322	3,358	3,570	3,631	4,760	3,810	2,783	2,926	5,221	5,245
Region 3 (Central Luzon)	1,161	1,179	1,073	1,092	1,120	1,066	1,457	2,096	2,783	3,009
Region 4-A (CALABARZON)	1,332	1,913	1,510	1,628	1,705	1,587	1,657	2,362	1,595	1,823
Region 8 (Eastern Visayas)	3,314	2,982	2,457	2,159	2,175	2,221	2,356	1,604	1,870	1,596
Region 9 (Zamboanga Peninsula)	1,287	1,397	1,075	1,161	1,103	1,103	1,921	1,799	1,360	1,087
Region 7 (Central Visayas)	1,428	1,420	1,187	979	847	729	823	1,007	955	1,043
Autonomous Region in Muslim Mindanao	350	443	422	440	437	474	479	474	596	754
Region 1 (Ilocos Region)	117	199	105	117	126	128	146	176	529	561
National Capital Region	271	423	476	425	540	395	371	172	185	466
Region 10 (Nothern Mindanao)	651	553	483	389	420	426	474	440	435	441
Region 13 (Caraga)	105	137	136	143	168	165	190	231	236	268
Region 11 (Davao Region)	91	49	107	129	106	91	54	33	46	47
Region 2 (Cagayan Valley)	100	109	93	84	91	65	47	38	35	32
Region 12 (SOCCSKSARGEN)	49	49	48	44	41	39	32	21	10	16

Although there has been an increase in production from 2016 onwards, reaching 33,930.00t in 2018, but dropping to 29,677.14t in 2019 (Figure 7), BSC traders, processors, and exporters have been experiencing limited supply due to the increasing demand for crabs by the increasing population in the country and elsewhere.

In terms of value, there has been fluctuation but increasing production values from 2004 until 2016, with promising increases in the 2 succeeding years (Figure 8). In 2018, the production value of the BSC industry in the country reached an all-time high of PhP 5.47B, but this was followed by a drop in 2019 to PhP4.55B (PSA 2020). Table 3 identifies the production value of BSC in the different BSC-producing regions in the country, while Table 4 provides the list of the Top 20 BSC-producing provinces all over the country.

Table 2. Production volume of BSC from 2010 to 2019 from the municipal waters of the top 20 BSC-producing provinces *(Source: PSA, 2020)*

Provinces	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Palawan	3,078	3,103	3,327	3,370	4,493	3,538	2,539	2,704	5,052	5,101
Iloilo	6,567	6,500	2,161	1,645	1,810	1,744	4,111	4,981	5,889	3,634
Bataan	770	821	790	810	823	779	1,228	1,888	2,601	2,726
Sorsogon	622	726	638	1,334	1,393	2,351	2,805	2,684	2,879	2,280
Negros Occidental	274	249	3,808	4,219	3,697	3,654	2,634	3,166	2,820	1,928
Masbate	2,357	2,079	1,352	1,258	1,349	1,105	1,209	1,771	1,835	1,886
Quezon	1,109	1,711	1,322	1,450	1,410	1,299	1,326	2,013	1,206	1,255
Capiz	2,051	1,722	1,847	1,719	1,609	1,479	1,557	1,567	1,255	1,238
Samar	2,661	2,390	1,759	1,540	1,490	1,584	1,685	1,226	1,263	1,099
Bohol	554	608	506	509	360	309	300	390	560	682
Tawi-tawi	221	314	307	335	337	384	399	408	533	631
Cavite	113	118	155	157	278	262	304	316	338	518
Camarines Norte	510	478	528	629	676	618	444	426	434	515
Camarines Sur	1,377	1,163	1,166	1,160	1,152	1,098	907	765	638	502
Pangasinan	89	163	7	37	48	48	55	73	412	432
Zamboanga Sibugay	344	401	269	331	256	264	1,104	1,007	611	378
Zamboanga City	363	377	312	316	317	346	370	355	364	376
Cebu	799	748	625	420	450	387	482	570	351	333
Zamboanga del Sur	545	606	468	497	489	441	404	409	355	301
Albay	149	174	267	296	311	280	302	289	270	301

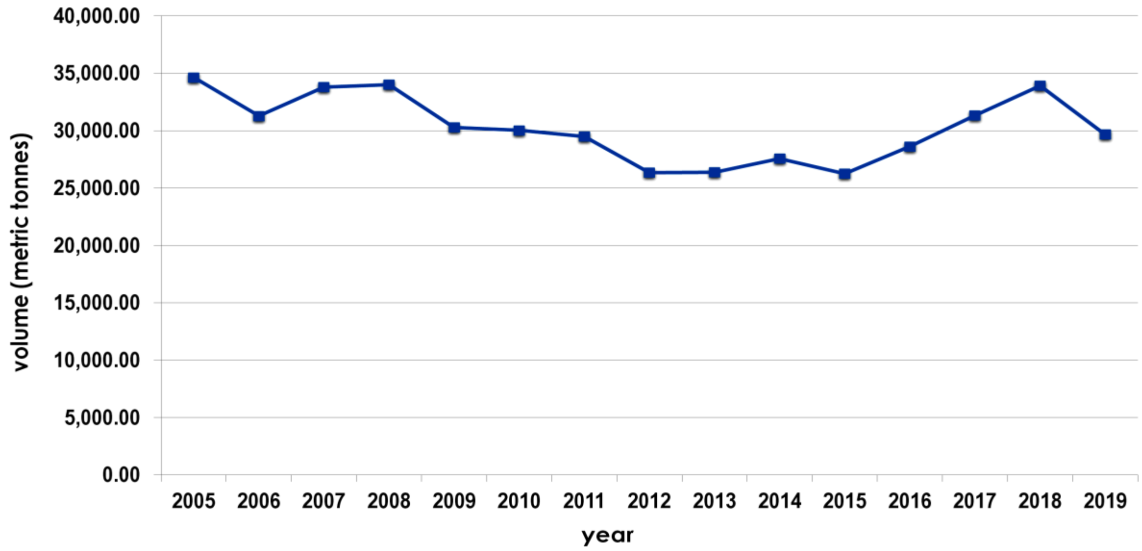

Figure 7. Production volume of blue swimming crabs in the Philippines from 2005 to 2019 *(Source: PSA, 2020)*

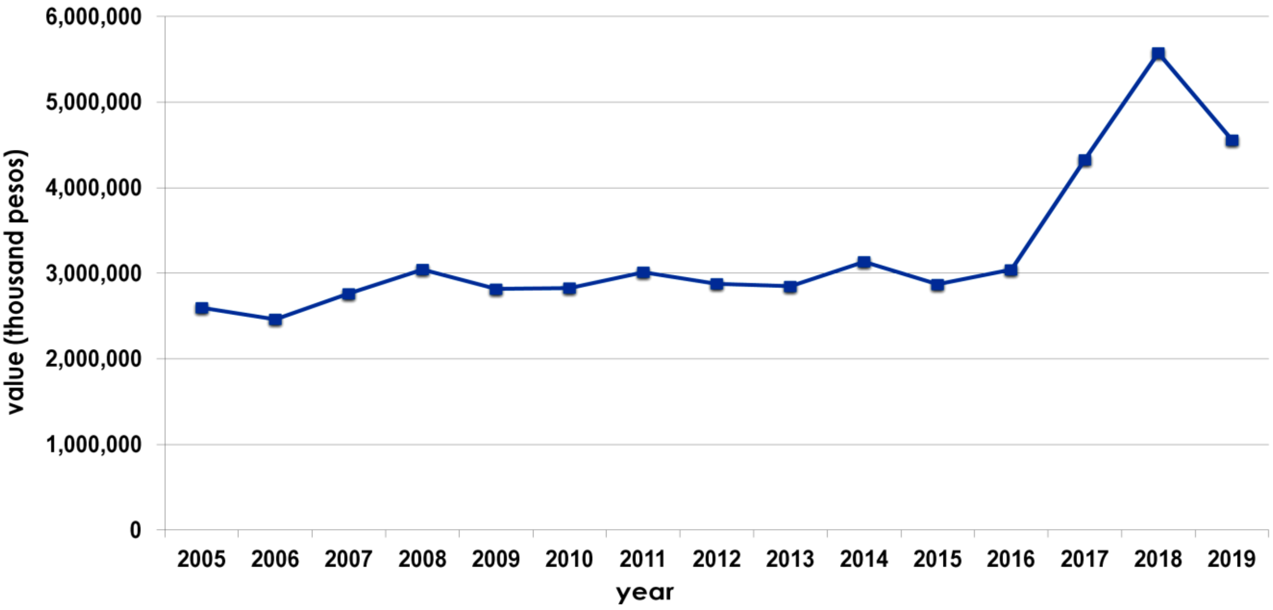

Figure 8. Production value (in thousand pesos) of BSC in the Philippines from 2005 to 2019 *(Source: PSA, 2020)*

Table 3. Production value (in thousand pesos) of BSC in the Philippines from 2010 to 2019, from the municipal waters of all BSC-producing regions *(Source: PSA, 2020)*

Regions	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Region 6 (Western Visayas)	886,162	979,265	992,807	971,697	973,018	818,117	949,206	1,713,517	2,057,820	1,458,464
Region 5 (Bicol Region)	540,363	498,662	414,019	461,330	522,791	565,791	584,368	790,045	1,010,273	711,997
Region 4-B MIMAROPA	243,847	266,251	346,328	331,675	464,804	385,566	256,164	306,573	709,122	603,198
Region 3 (Central Luzon)	103,087	114,875	104,638	109,977	111,521	105,604	136,721	232,135	408,891	452,661
Region 4-A (CALABARZON)	152,112	226,230	178,921	180,949	202,746	200,953	199,358	319,215	262,591	352,107
Region 8 (Eastern Visayas)	324,195	315,879	280,994	260,326	272,298	278,976	298,321	187,535	289,131	261,984
Region 7 (Central Visayas)	181,769	188,380	158,749	129,521	130,926	110,694	105,053	154,128	161,183	176,070
Region 9 (Zamboanga Peninsula)	78,270	93,559	70,529	76,929	73,183	76,488	147,383	158,049	126,838	95,308
Region 1 (Ilocos Region)	11,958	21,975	11,306	11,760	13,203	13,201	18,214	22,377	57,754	85,394
Autonomous Region in Muslim Mindanao	21,621	26,789	34,540	41,226	42,318	47,184	48,402	48,383	61,052	79,393
National Capital Region (NCR)	27,421	50,209	55,769	47,570	59,976	48,006	44,950	25,736	36,727	75,035
Region 10 (Northern Mindanao)	52,316	46,129	40,612	32,567	36,234	37,935	43,372	41,135	42,077	45,089
Region 13 (Caraga)	8,337	12,732	14,224	16,984	19,958	21,451	25,477	32,878	31,879	41,543
Region 11 (Davao Region)	7,082	3,882	11,394	12,541	13,124	10,055	5,440	3,788	7,529	7,400
Region II (Cagayan Valley)	9,312	10,251	8,783	8,623	9,230	7,567	5,371	4,489	4,364	3,964
Region XII (SOCCSKSARGEN)	3,260	4,033	3,975	4,579	5,105	5,198	4,577	2,954	2,161	2,247

Table 4. Production value of BSC in the Philippines from 2005 to 2019 from the municipal waters of the top 20 BSC-producing provinces *(Source: PSA, 2020)*

Provinces	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Iloilo	703,102	813,620	283,847	203,983	257,420	220,684	465,693	950,146	1,229,811	861,542
Palawan	225,858	246,790	327,430	311,299	443,693	364,065	236,583	286,759	691,329	583,615
Bataan	74,140	87,635	82,083	88,027	88,499	82,270	116,357	211,981	389,268	422,046
Negros Occidental	34,347	31,502	559,337	628,565	576,374	452,881	334,750	591,448	593,554	371,816
Sorsogon	55,684	66,110	70,839	119,295	158,254	210,081	265,821	368,720	529,977	269,416
Masbate	310,983	277,650	180,945	169,924	187,686	157,907	149,274	259,381	310,438	247,452
Quezon	125,447	197,527	153,393	157,139	167,764	161,111	150,349	271,540	193,659	241,579
Samar	269,607	264,057	214,046	201,709	204,520	215,779	213,766	152,219	205,235	188,401
Capiz	100,078	89,004	117,935	109,841	104,441	101,536	103,803	129,215	188,773	177,537
Bohol	63,502	74,626	66,382	68,566	52,706	44,796	33,459	50,923	88,764	108,137
Cavite	12,691	16,374	20,014	19,708	31,602	35,173	43,955	41,880	59,172	101,285
Camarines Norte	36,348	34,457	31,492	37,612	41,210	60,245	46,089	43,850	50,204	81,108
Camarines Sur	115,241	98,524	104,600	105,429	107,326	103,961	88,374	86,502	85,939	75,163
Pangasinan	9,263	18,881	704	4,094	5,705	5,416	6,419	8,836	42,528	69,678
Cebu	111,150	107,832	86,237	56,164	74,324	62,474	69,097	100,037	69,319	64,642
Tawi-tawi	7,811	14,469	22,860	30,145	31,661	36,950	38,793	40,481	53,214	63,069
Zambo Sibugay	28,106	34,071	18,134	20,963	19,054	21,371	87,544	95,622	66,036	38,265
Northern Samar	33,143	26,879	28,823	23,735	21,491	19,291	18,062	15,904	29,313	37,325
Albay	8,779	10,442	16,776	19,235	20,156	26,776	29,497	26,700	28,451	34,070
Zamboanga City	29,957	31,353	27,895	29,102	26,880	29,341	30,900	30,200	31,082	32,621

As to the state of the BSC stocks, evidence reveals overexploitation. For example, as shown in Figure 9, a study on the BSC in the Western Visayas Sea shows a decreasing trend in catch per unit of effort (CPUE). The CPUE in 2017 alone shows that, on an average, a bottom set crab gill net can catch 1 crab per panel (Mesa et el. 2018).

The data on Maximum Sustainable Yield (MSY) likewise shows a decreasing trend with an accompanying increase in the effort or the number of panels per boat (Figure 10). This figure clearly shows that the crab gillnet fishers in Western Visayan Sea tend to increase the length of gillnet in order to catch more crabs.

In general, this evidence reveals that Western Visayan Sea is experiencing overfishing in the last several years.

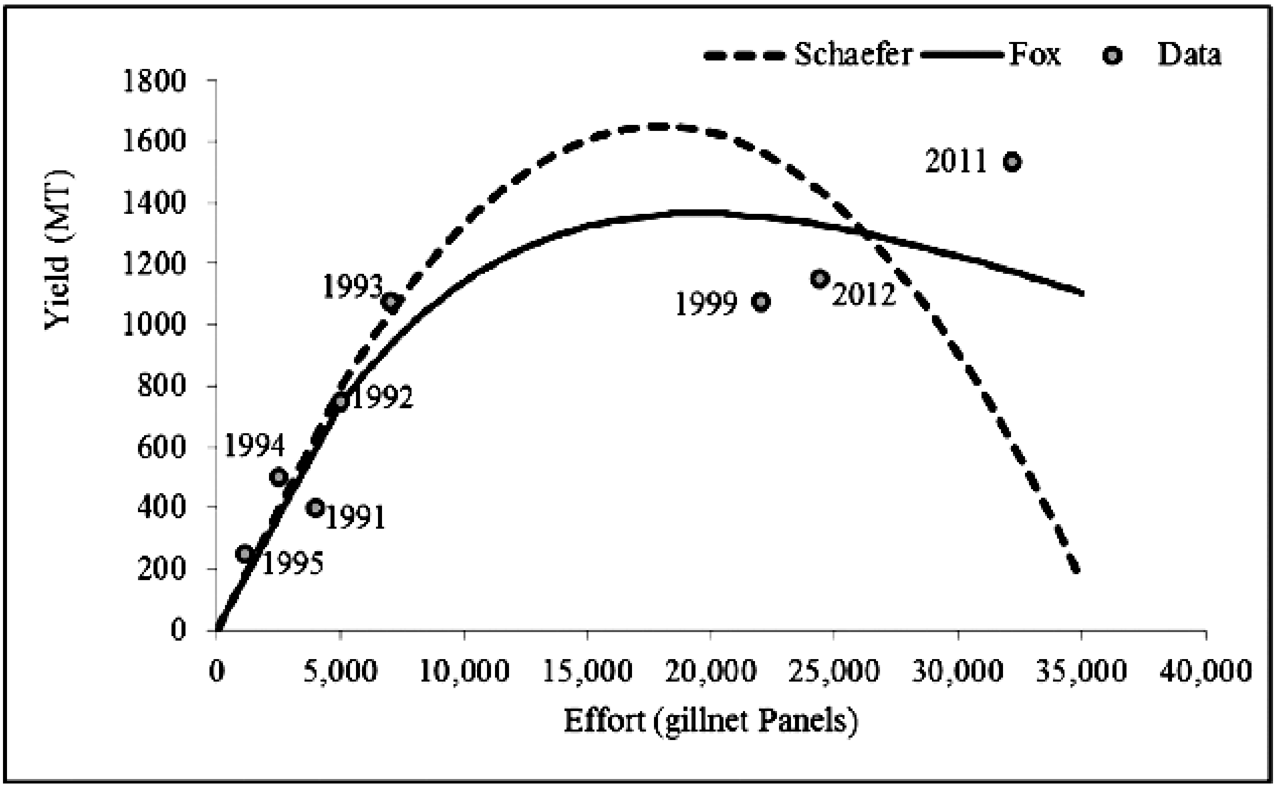

Figure 9. Estimates of the maximum sustainable yield (MSY) and maximum sustainable effort (f_{MSY}) for the crab fishery of Western Visayan Sea at different period using Schaeffer ad Fox models *(Source: Mesa et al, 2018)*

Utilization. The BSC is mostly consumed fresh in the Philippines. However, due to high consumer demand in the international market and the economic benefits derived from this species, a significant part of the BSC production in the country goes to the export market. This has led to a dramatic increase in the average local retail price per kilogram of the BSC within a 15-year period, from PhP118.85/Kg in 2004 to PhP292.97/Kg in 2018 (PSA, 2019).

Such increasing demand in the international market places BSC as one of the top export fisheries commodities of the country. The volumes of exported crab products that are processed as pasteurized crab meat are shown in Table 5, and are mainly exported to the United States and to some Asian markets.

Just like any other fishery commodities that are traded in the international market, the exporters must show proof that they are following quality and safety standards in the manufacturing of pasteurized crab meat in cans. Table 6 shows the number of crab processing facilities that are BFAR approved (non-EU approved), EU approved, and GMP Recognized fishery and BSC-based establishments.

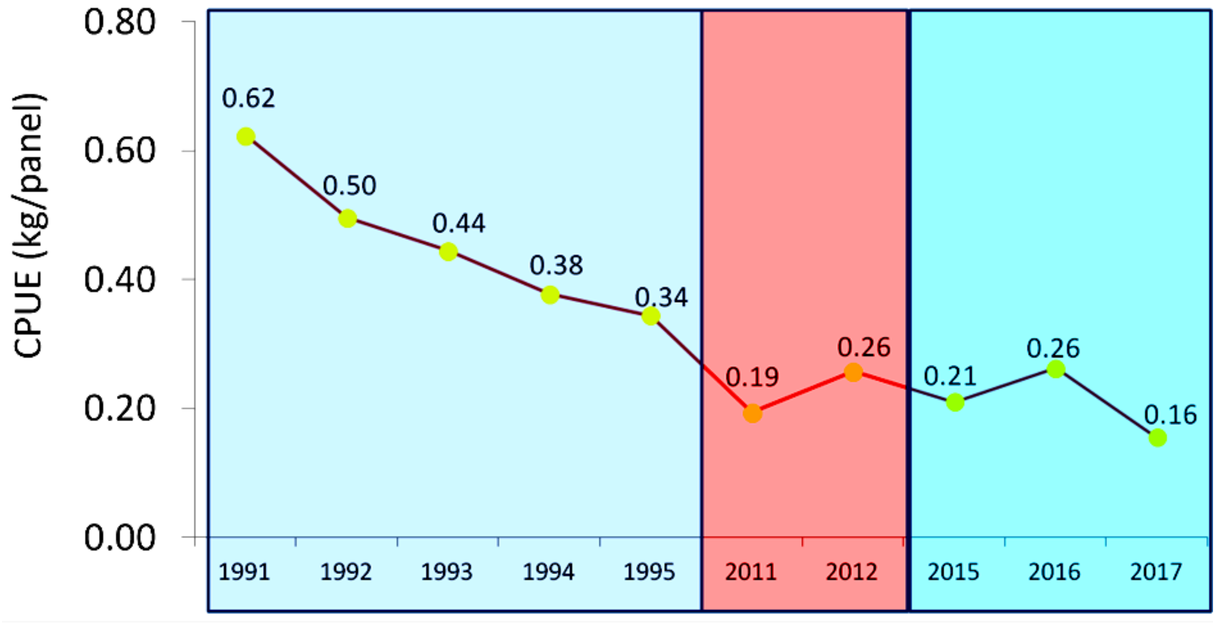

Figure 10. Annual catch per unit effort (cpue) in Kg/panel of crab gillnet in the Visayan Sea from 1991 to 2012 *(Source: Mesa, 2019)*

Table 5. Export volumes of different crab products from the Philippines from 2008 to 2016 *(Source: BFAR, 2008-2016)*

PRODUCT TYPE	2008	2009	2010	2011	2012	2013	2014	2015	2016
Live, Frozen/Fresh or Chilled	1,689	3,011	3,368	4,240	5,207	11,579	8,217	7,568	10,292
Crab fat (Prepared/Preserved)	356	110	303	181	26	812	451	445	467
Crab meat (Prepared/Preserved)	1,542	1,236	2,124	1,743	1,682	1,495	3,246	3,451	3,401

Incidentally, the Bureau of Agriculture and Fisheries Standards issued in 2016 the Philippine National Standard (PNS): Pasteurized crab meat (PNS/BAFS 178:2016). This PNS specifically "*aims to provide a common understanding on the scope of the standard, product description, process description, essential composition and quality factors, food additives, contaminants, hygiene and handling, packaging and labeling, methods of sampling, examination and analysis, definition of defectives and lot acceptance*" for pasteurized crab meat.

Table 6. Number of BFAR approved (non-EU approved), EU approved, and GMP Recognized fishery and BSC-based establishments in the Philippines, per region (as of 30 September 2019). (Source: BFAR 2019)

REGION	Number of BFAR Approved Establishments	Number of BFAR Approved BSC Establishments	Number of EU Approved Establishments	Number of EU Approved BSC Establishments	GMP Recognized Establishments	GMP Recognized BSC Establishments
1	2		1		0	
2	0		0		0	
3	8		3		6	
4a	13		3		3	
4b	9		1		6	
5	4	1	0		3	1
6	12	5	1		5	3
7	15	3	4	2	6	6
8	2		0		5	2
9	7		12		17	1
10	0		1		0	
11	4		0		0	
12	8		24		11	
13	2		0		3	
NCR	30		15		3	
ARMM	0		0		4	
CAR	0		0		0	
TOTAL	116	9	65	2	72	13

THE PHILIPPINE BLUE SWIMMING CRAB VALUE CHAIN

Value chain analysis. The value chain analysis is an analytical tool used in understanding the policy environment, in terms of efficiency in allocating resources within the domestic economy, while simultaneously understanding the manner in which firms and countries participate in the global economy (Jacinto 2004).

The application of value chain in fisheries and aquaculture is growing in number (e.g. Gudmundsson et al. 2006; Islam 2008; Janthaya & Silva 2010; Loc et al. 2010; Mai et al. 2010; Jiménez-Toribio & García-del-Hoyo 2010; De Silva 2011).

In the Philippines, value chain analyses have been extensively done for different fishes (e.g. milkfish, siganids, roundscad, sardines, red coral trout, yellowfin tuna, frigate tuna, and anchovies) and non-fish / invertebrates (e.g. black tiger shrimp, abalone, sergestid shrimp, mud crab, blue swimming crab, and seaweeds), as reported by Pido et al. (2018).

Value chain analyses have been done for BSC, covering 18 sites in 7 regions, i.e. Regions 3, 4B, 5, 6, 7, 8, and NCR (Yap et al. 2017), and other areas such as Sulu archipelago (Rosales et al. 2017) and in

Danajon Reef in the province of Bohol (Armada et al. 2009).

The application of the concept of value chain in fisheries takes into consideration the ecosystem and the human communities that are affected by the fisheries. In particular, mapping of seafood value chain networks must focus on the identification of inefficiencies in the marketing system, or economic inequalities that emerge between stakeholders, such as fishers and middlemen (see Yap et al. 2017).

The main actors in the BSC industry. The supply chain map of the BSC in the Philippines is shown in Figure 11. In each of the nodes in the map, there are main actors or key players that include the fishers, processors (including pre-processors and small, medium, and large scale processors), traders (including consolidators, distributors, wholesalers, and retailers), consumers. There are also the enablers that include the resource managers, concerned government agencies, non-government organizations, civil society groups, and others.

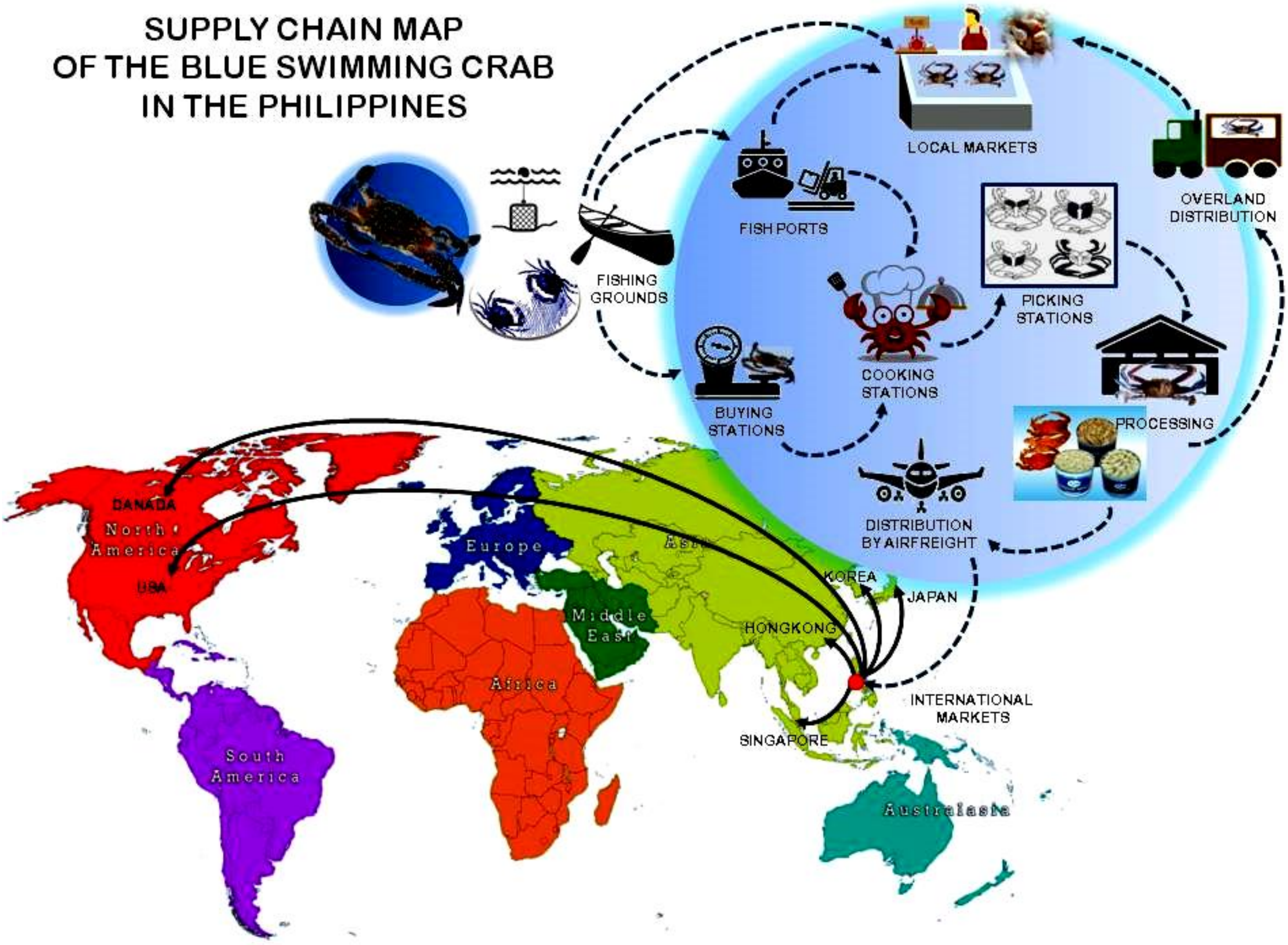

Figure 11. The supply chain map of the BSC in the Philippines (Source: Yap *et al.*, 2017)

The relationship between the main actors of the BSC industry. Individual actors operate quite differently in the various parts of the country. For example, the BSC fishers are either the boat owners or they rent the boat from another person or from the boat owners.

The crabbing activities generally happen on the same site where most of the fishers reside, since these fishers limit their fishing activities in their respective municipal waters. Some fishers transfer to other nearby fishing grounds in pursuit of better catch volume while other fishers frequently visit large span of fishing areas.

After catching, primary trading usually happens in the traditional fish landing sites or fish ports near the fishers' residence. The middlemen or traders serve as consolidators of raw crabs, financier to some fishers, and as traders in some rural and urban markets.

From the trading sites, crabs for local consumption go directly to the local wet markets or are sold directly to the consumers in the landing sites. Those crabs for processing go to the buying stations that are mostly situated near these landing sites.

Most of the pre-processing activities in the cooking and picking stations occur in the same areas where the primary trading activities take place. There are areas, however, that do not have cooking stations. Thus, buyers from these areas have to sell their crabs to nearby areas or municipalities.

The medium scale processors mostly own the buying, cooking, and picking stations that are peppered in high crab producing provinces. Some large scale processors have satellite stations (cooking and picking) where they assign company workers (purchasing and quality control officers) to oversee the operations.

From the picking stations, the goods are transferred to the processing plants. These main processing plants are mostly concentrated in Cebu (Region 7) and Bacolod (Region 18), with some plants also located in Naga City in Region 5, Catbalogan in Region 8, and Concepcion in Region 6.

Once processed as pasteurized crab meat in cans, the products mostly go the international market and then to the consumers.

Figure 12 outlines the flow of products from the source (i.e. municipal and commercial waters) to the consumers.

Practices in post-harvest handling, processing, and marketing of blue swimming crab. Raw crabs, immediately after capture, are traded in local wet markets in the same rural areas where the fishers reside, or in nearby areas.

Premium quality raw crabs for domestic consumption are usually traded in the regions where most of the big urban cities are located, i.e. Iloilo City in Region 6, Cebu City in Region 7, Catbalogan and Tacloban in Region 8, and Naga City in Region 5.

In the Luzon provinces, most of the traders bring their raw crabs to Manila. This is apparently due to the demand of the institutional markets (e.g. hotels, resorts, restaurants, etc.) and the high price of crabs in these metropolitan areas.

Premium quality raw crabs for international markets are consolidated by traders and/or sold in buying stations that are directly sending the crabs to the cooking stations. Crabs are cooked as fast as they can to avoid spoilage. Different practices on cooking of crabs can be observed in different parts of the country.

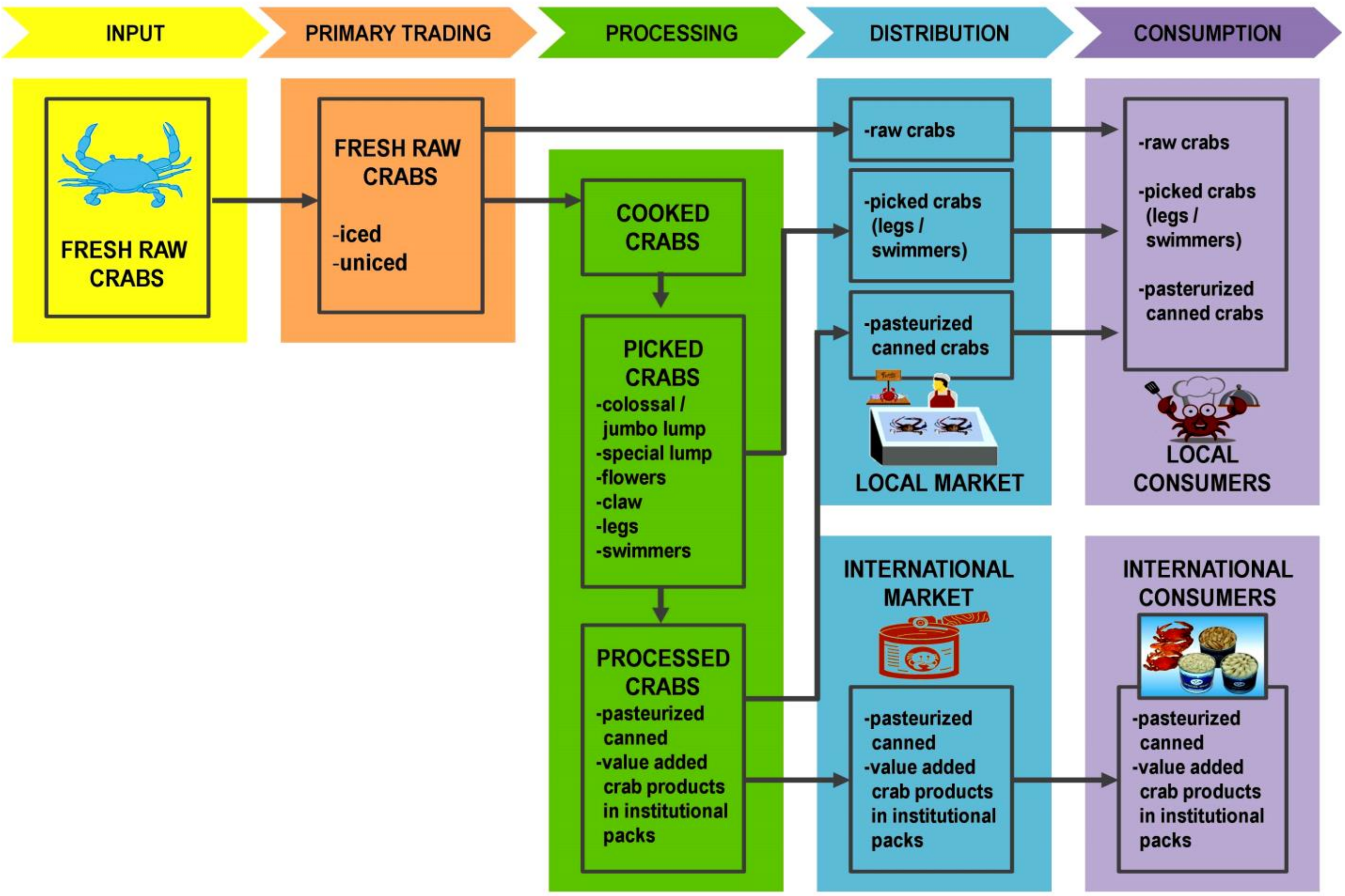

Figure 12. Product flow along the supply chain of the BSC in the Philippines (Source: Yap *et al.*, 2017)

The cooking and picking stations pre-process crabs with the size of >4". The pickers sort the crab meat based on the prescribed forms: colossal lump, jumbo, lump, claw (Figure 13).

The crab meats are separately placed in plastic tubs and are placed under refrigerated conditions until transport to the processing plants, usually by land (in big trucks). These crab meats are then processed either as pasteurized crab

meats in cans or as value added crab products.

Pasteurized canned crabs are mostly intended for the export market, with some marketed in select supermarkets in the big cities in the country. The processing plants are strictly following the specifications of their respective international buyers.

Figure 14 shows the standard process in processing of crab in the Philippines.

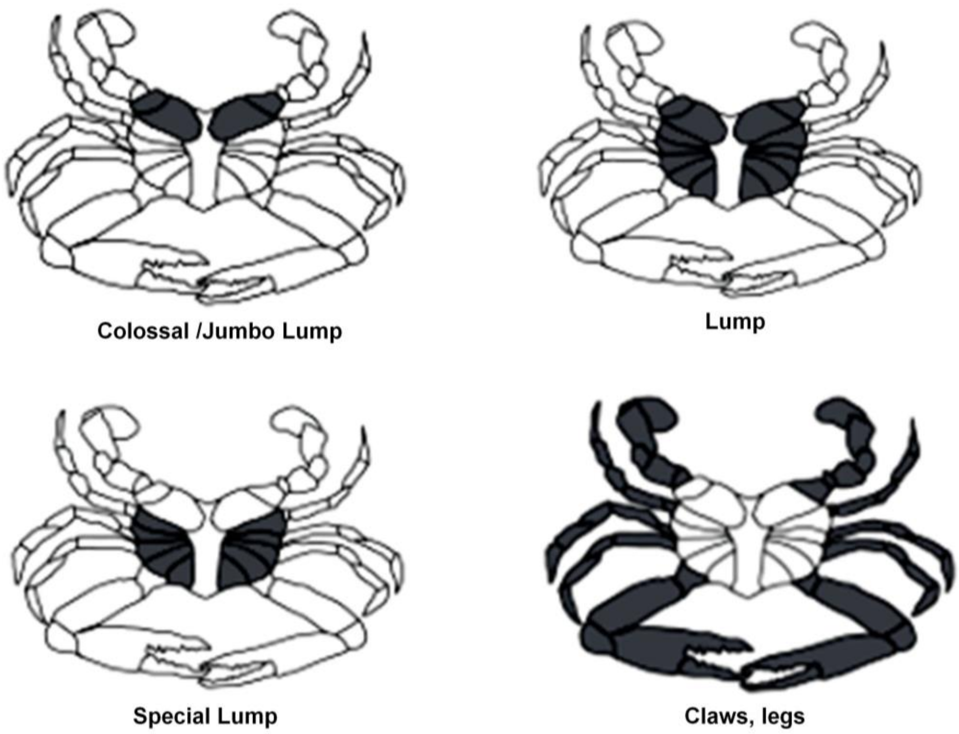

Figure 13. Classification of crab meats in the Philippines

The role of women in the blue swimming crab fisheries in the Philippines. Women are involved in the series of activities along the blue swimming crab supply chain, from fishing preparation and operation, including gear construction, to marketing and processing.

Crab fishing is mostly dominated by men. However, the participation of women is valuable before (preparation and construction of gears) and after fishing operations (e.g. gathering of crabs from different fishing gears and repair and maintenance of gears).

Such sharp distinction between the roles played by men and women has been prominent for a long time (e.g. Siason 1998; Tietze *et al.* 2007; Macalagdag et al. 2014; Yap *et al.* 2017), wherein men still remain the fishers because of the strenuous fishing activities, while women are designated to do light load of mending nets, preparation of nets prior to fishing, and other similar activities.

Active involvement of women is observed in the processing of blue swimming crab (i.e. in picking, sorting, cleaning/sanitation, supervising, and ensuring product quality) and selling of crabs in the wet markets. Interestingly, women are also involved in the top level management of several crab processing plants in the country.

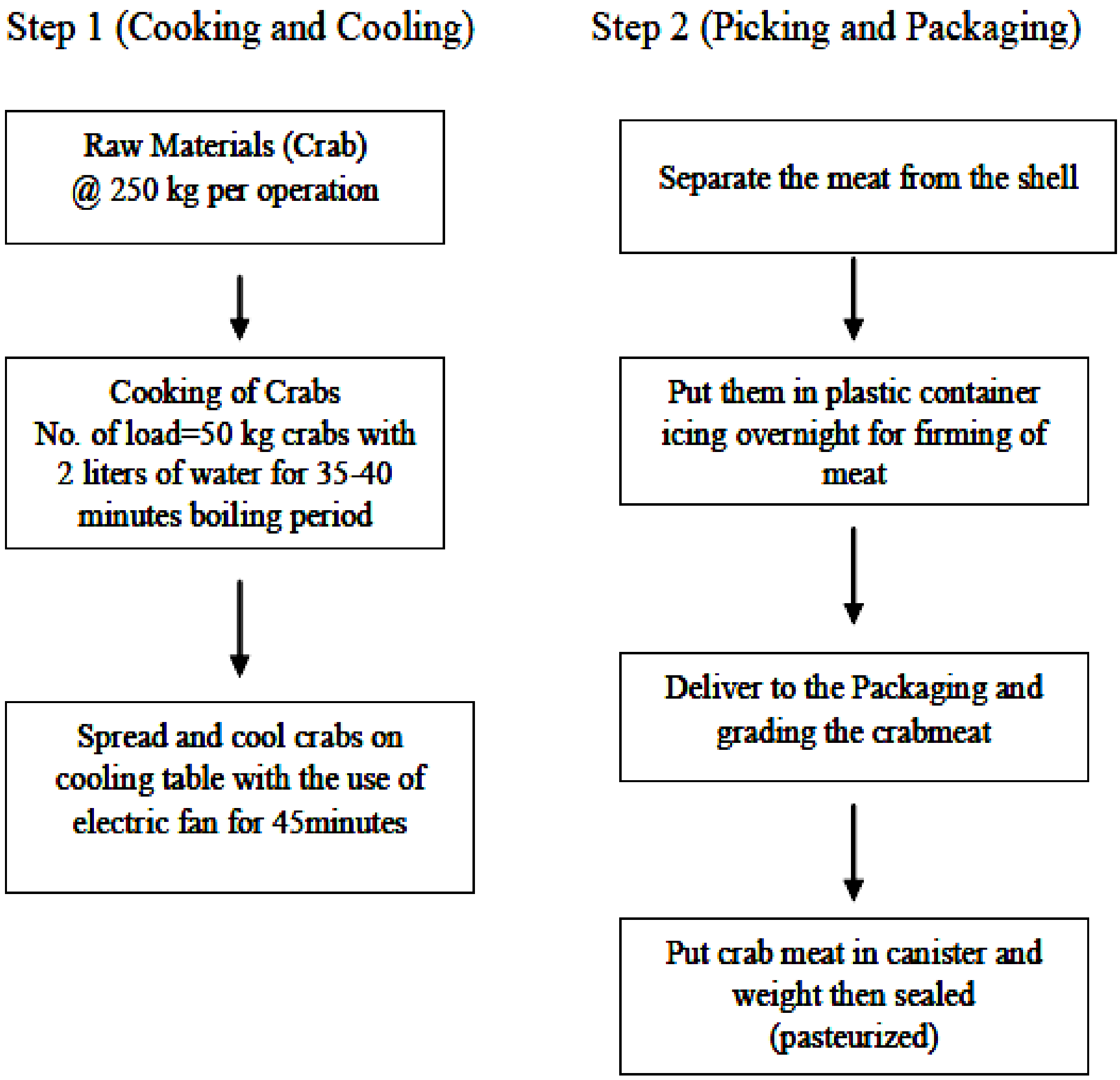

Figure 14. The recommended steps in the crab cooking and picking stations, as stipulated in the Blue Swimming Crab Management Plan (2014)

SITUATION OF THE PHILIPPINES' BLUE SWIMMING CRAB INDUSTRY

The following strengths, weaknesses, opportunities, and threats, as identified by the industry stakeholders, confront the BSC industry of the Philippines:

Strengths of the Philippine blue swimming crab industry

FISHERS
Have the skills in catching of BSC
Know how to make fishing gears and how to mend them
Know where to catch high volume of BSC
Can identify prohibited fishes
Have additional income generating jobs

Are members of fisherfolk associations
Receive trainings from government and non-government organizations
Strictly implement rules on catching gravid BSC in some areas
Get full support from LGU (e.g. Manapla) such as provision of gears, etc.
Are registered through FishR and BoatR of BFAR
Can get from BFAR more support and assistance if registered
TRADERS / PRE-PROCESSORS (COOKING)
Provide employment/source of livelihood/income to local communities, especially to women, PWDs, LGBTs, etc.
Provide financial assistance to employees
May increase commodity value
PRE-PROCESSORS (PICKING)
Provide employment/source of livelihood/income to local communities, especially to women, PWDs, LGBTs, etc.
Have access to loans/financing
Have the ability to diversify to other commodities
PROCESSORS / EXPORTERS
Provide employment/source of livelihood/income to local communities, especially to women, PWDs, LGBTs, etc.
Are internationally recognized as compliant to food safety requirements (e.g. HACCP, FSSC, BRC, EU, etc.)
Have access to loans/financing
Exercise process flexibity to meet customer requirements
Increase commodity value
Increase Philippine export volumes due to strong market demands
Have the ability to produce huge volume of crab meat
Engage in diversification of products
Can have vertical integration
Are members of an organized trade association (i.e. PACPI)
Adhere to “social compliance” requirement of the buyers
ENABLERS
Presence of CNFIDP that defines the development agenda for BSC
Existing Policies (JAO 01 s. 2014; RA 8550 as amended by RA 10654; EO 70 on Convergence Approach; laws on the creation of FARMCs; other policies/programs on the conservation and protection of coastal and marine ecosystems
High BSC Production for Region VI
Presence of suitable coastal habitats for BSC production
Availability of suitable place for conservation of BSC (e.g. in Guintaboan-Ubay)
Availability of science-based data (NSAP, researches; academe); research output/data; technical persons; science literatures on BSC biology
Awareness of stakeholders on the status of BSC stocks
Capacity in Empowering Fisherfolk
Available funds (lending/loans) to small fisherfolk
Existing POT (Stock enhancement; ecofriendly crab gears)
On-going FishR and BoatR programs of BFAR
On-going BSC seeding program and presence of hatcheries (e.g. in Sirandigan, Ubay, Bohol hatchery as a joint project of BFAR and PACPI) and skilled technicians
Presence of skilled manpower/expertise in monitoring and surveillance
Strong cooperation and linkage between traders and enablers
Law enforcement/Task Force Bantay Dagat
Presence of Visayan Sea EAFM Framework Plan

LOCAL GOVERNMENT UNITS
Committed Agricultural Extension Workers
Presence of Municipal Fisheries Officers/ Provincial Ord. Fisheries
Presence of Provincial / Municipal/City Ordinances (Envi.)
Active Convergence of BFAR-BANTAY DAGAT TEAM of Iloilo Province
Organized FARMC/Fisherfolk Association
Presence of crab condominiums for gravid crabs (lying-in cages) in some areas
Strong Supportive of Elected Officials
Strong Collaboration between NGOs/LGUs
Supportive Fisheries Workers
With Provincial / MC Ordinances (Envi.)

Weaknesses of the Philippine blue swimming crab industry

FISHERS
Engage in illegal fishing
Have low income
Lack knowledge on the fishery laws and regulations (e.g. catching of juveniles and gravid brabs
Lack capital
No insurance for all the registered fishers
Report inconsistent operation of Bantay Dagat
Low catch
Report resource use conflicts (e.g. use of "bubo" and "lambat"
Have limited alternative livelihood activities in some areas
Experience decrease in sources of baits
Some are not FishR registered
Lack fishing gears
Low prices
Lack training in catching BSC and other alternative fishing methods
Unstable prices
Can only avail of insurance if boat is totally damaged
Theft in the area
Lack information on government projects
No fisherfolk ID for registered fishers in some areas
Have no insurance coverage
Some do not receive benefits such as PhilHealth
TRADERS / PRE-PROCESSORS (COOKING)
Experience competition among cooking stations / price war in all buying stations
Have weak compliance to management regulations (e.g. buying of small crabs, etc.) that result to low quality cook crab meat
Have non-standardized cooking temperature-chilling combination resulting to poor quality and reduced price of crabs
PRE-PROCESSORS (PICKING)
Experience competition among picking stations (both registered and non-registered or backyard picking stations)
Some are non-compliant to food safety standards (GMP, HACCP)
Experience food quality issues (e.g. rejects, etc.)
Lack pickers especially during peak season
Have problems related to waste management

PROCESSORS / EXPORTERS
Experience competition among exporters from the Philippines
Cannot compete with the low price of crabs from other exporting countries
Contribute to overfishing
Compromise quality of meat due to buying from backyard picking stations to meet the demand
Have problems on declining supply of crabs
Have work suspension during lean season (no work, no pay)
ENABLERS
Lack of concerted effort in the enforcement of policy and adoption of LGU (JAO 01 s.2014)
Limited manpower (project monitoring; technical persons)
BSC not a priority commodity (management support & intervention initiatives; seasonal availability of stocks)
Limited access to research data/results (as unpublished data)
Limited capacitated staff on BSC conservation
Science basis for the POT of gear initiatives implemented (POT not updated; POT from fishers more updated as introduced by traders)
Low effort on the IEC campaign on BSC (JAO-01) to local stakeholders
Limited fund (for research)
Limited technology on grow-out culture / aquaculture technologies for BSC
No BSC Road Map
Lack of cooperation between enablers
Conflict on the issuance of boat and gear license for FishR and BoatR registered fishers
Lack of manpower
Limited technical expertise on BSC biology and taxonomy especially among law enfrcers
Limited knowledge / skilled persons to prepare and conduct feasibility studies for BSC
Limited access to financing programs (stringent document compliance for loan access)
LOCAL GOVERNMENT UNITS
Weak law enforcement; municipal ordinances not fully implemented, especially the provisions of JAO No. 1, s.2014
Non cooperative/support from fishers towards CRM Programs
Limited budget and support of LGUs
Limited IEC on BSC management
Weak support of LGUs in the implementation of BSC enhancement programs and other programs resulting to depletion of the resource
Absence of BSC regulation management plans (municipalities and provinces)
Unorganized BSC crabbers
Unlicensed boats and gears operating in municipal waters
Insufficient IEC on EAFM particularly on BSC
Weak market denial
Limited succession of aging fishery employees
Limited number of fisheries technicians in the field
Insufficient PNP support
Lack of ordinances governing BSC for some LGUs
Insufficient funds to support the implementation of existing laws and ordinances

Opportunities for the Philippine blue swimming crab industry

FISHERS
Receive help from LGUs (e.g. Banate and Barotac Viejo)
Get support from BFAR through livelihood projects, including provision of fiber glass pump boats and fishing gears (e.g. "pukot", etc)
Are recipients of BFAR projects such as the lying-in cages, livelihood projects, etc.
Get support from the private sector (e.g. payment of licensing fees, etc.)
Have own fish landing center in some areas
Have access to available crab culture technologies
Can avail of benefits as registered fishers
Have access to lending institutions, e.g. LBP gives help via ACPC that has low interest rate
Presence of many BSC processing plants where the fishers can sell their catch
Fishing gear from BFAR/LGU for the fishers
Restrictions on catching of gravid and juvenile BSC
TRADERS / PRE-PROCESSORS (COOKING)
Have access to legitimate financial institutions
Experience decreasing prices especially during peak season
Are covered by the LGU regulations on crab fishing
Can access sustainability programs of BFAR such as lying-in cages
PRE-PROCESSORS (PICKING)
Have access to loans/financing
Can access sustainability programs of BFAR such as lying-in cages
Can engage in diversification of products
Have access to some waste utilization technologies / practices
PROCESSORS / EXPORTERS
Contribute to local economic growth
Can engage in stock enhancement programs using juveniles from crab hatcheries
Engage in vertical integration to drive changes down the supply chain
Can be certified by MSC and other sustainability related programs
Can tap emerging markets
Can engage in diversification of products
Can engage in traceability initiatives to increase market
ENABLERS
High demand of BSC for domestic and international market
Presence of NGO partnership for BSC conservation
Organize fisherfolk associations for BSC fishers
Existence of scholarship grant for children of fisherfolk
Provision of trainings/seminars/technical assistance
Researches & management shift to FMA & EAFM
Funding support for BSC stock assessment and trainings in coastal communities under the coastal development programs
Cooperation/collaborations of PPPs
Open access database (NSAP Data availability)
Availability of ACEF, Land Bank, and ACPC loan / funding windows / facilities
Availability of markets; can be tourist-driven opportunities
HACCP accredited BSC processing plants
Liberalized lending to small fisherfolks (thru ACEF)

Establishment / Construction of Community Fish Landing Centers
LOCAL GOVERNMENT UNITS
Enactment of Provincial Municipal Ordinances
Political environment (terms of office of LCEs)
High market demand, both local and export
Livelihood/ income generation programs
Availability of scientific information
Strengthened *Bantay Dagat* personnel/ law enforcers
Partnership with NGOs, academe, enablers
Increased community awareness on the declining fishery resources
Established revenue generation initiatives through permits etc.
Existing business and job opportunities

Threats to the Philippine blue swimming crab industry

FISHERS
Bad weather; climate change
El Nino that causes low catch
Penalties whenever they fish in different municipalities
Fishing gears that are destroyed by commercial fishers
Sell to other areas because they have no picking station in their area
Absence of *Bantay Dagat* operations in some areas
Overfishing in their areas
Use of "tangkop" that can catch juvenile BSC
High licensing fees of LGUs
Encroachment of commercial fishers in the municipal waters
Not equally distributed assistance from the government
High interest by financial lending institutions and other non-formal lenders
Other fishers using "palupad" and "pamo" that destroy their crab pots
Weak JAO implementation by the LGUs
Increase in price of fish meal used as bait
Effects of coal powerplant
Cannot fish during "Amihan" season
Limited assistance from LGU, BFAR, and other government agencies
Unregistered voters do not receive help
Not strict implementation of laws on catching gravid and juvenile crabs
TRADERS / PRE-PROCESSORS (COOKING)
Seasonality of crabs
Bad weather conditions/ changing weather patterns
Low supply of crabs
Stop buying schemes
Spoilage of cooked crabs
Weak compliance with regulations such as gear licensing among fishers due to expensive cost
No standard licensing system or procedures among LGUs
Weak enforcement of food safety standards by LGUs
Weak enforcement of regulations on juvenile and gravid crabs by LGUs
Increase in local price and demand; price war in all buying areas
Price fluctuation – global market
PRE-PROCESSORS (PICKING)
Seasonality; natural calamities

Changing weather patterns
Global market Ccompetition
Presence of backyard picking plants
BFAR Requirements for Food Safety
PROCESSORS / EXPORTERS
Changing consumer preferences (demand for sustainable, traceable products)
Price fluctuations in the global market
Declining supply due to ecological factors
Global market competition ; cannot compete with the low price of crabs from other exporting countries; supply war
Need to subsidize the fishers' cost for fishing license and registration as pre-requisite of BFAR for plant registration
No electronic catch documentation scheme needed for traceability requirements of importing countries
Compliance to Import requirements (SIMP)
ENABLERS
Climate change
Non-compliance of LGU of the provisions of JAO 01 s. 2014 on law enforcement
Increasing population
Fluctuating BSC production
International trade regulations (shift of market demand)
Limited compliance on solid waste management
Knowledge on financial literacy of small fisherfolks
Lack of socio-economic and cultural studies among crab fishers
LOCAL GOVERNMENT UNITS
Terms of office of local chief executives
Continuous destruction/ degradation of marine habitat
Illegal fishing activities; prevalent catching of juvenile BSC (e.g. municipality of Ubay)
Presence of undersize (< 10.1cm) and berried crabs in the market
Inactive FARMC's in some coastal municipalities
Unregulated use of crab pots with very small mesh size ("timing"); active fishing gears (e.g. trawl, push nets); multiple fishing gears
Declining catch of BSC and other fishery commodities
Some fisherfolk with no concern on the conservation of resources, especially BSC resources in municipal waters
Overfishing (growth, recruitment, economic)
Increasing number of BSC fishers
Low salary for technicians in the field
Modification of fishing gear
Loss of biodiversity due to unsustainable BSC collection / harvesting
Improper waste disposal to the sea
Catching of undersized BSC and gravid Crab
Negative impacts of climate change
Insufficient available scientific information
No hazard pay

PROBLEMS OF THE PHILIPPINES' BLUE SWIMMING CRAB INDUSTRY

Just like any other fishery industry in the Philippines or elsewhere, the BSC industry in the country is beset by different problems or challenges that have been identified by the different stakeholders during consultations. The results of the SWOT analyses were used in determining these problems.

These problems that were categorized as **environmental** (or ecological), **socio-economic** (or human), and **governance-related** issues and concerns, are as follows.

Environmental (or Ecological) Issues and Concerns

The environmental or ecological problems that are confronting the BSC industry of the Philippines are illustrated in Figure 15.

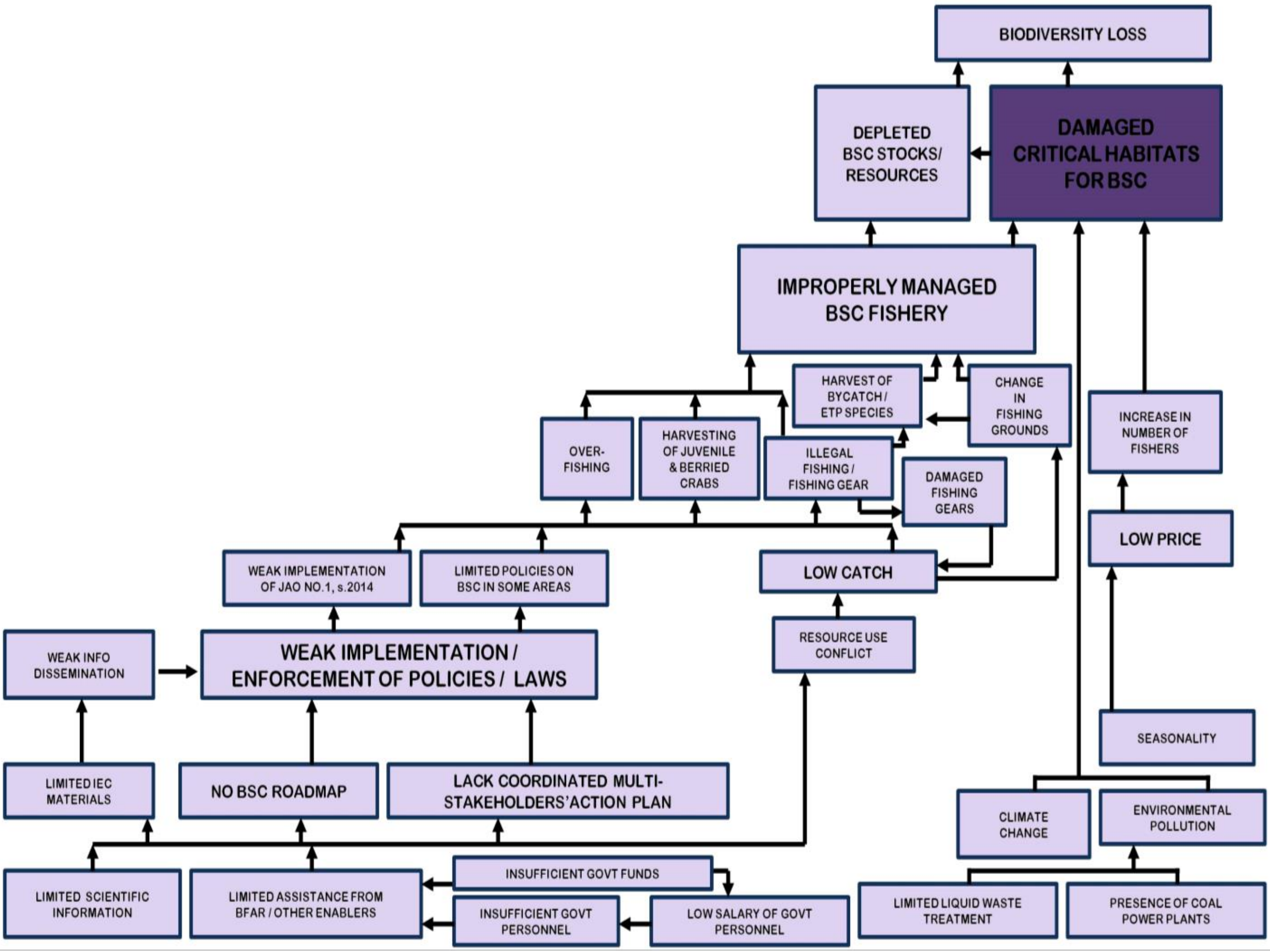

Figure 15. The environment (or ecological) problems facing the Blue Swimming Crab Industry of the Philippines

Probable effects of El Niño/Southern Oscillation (ENSO) and climate change. Among the different potentially notable natural or man-made phenomena, the effects of El Nino / Southern Oscillation (ENSO) on the BSC fisheries appear to be the most significant. In fact, based on the fishers' and other stakeholders' perceptions, they believe that the decrease in their catch can be due to ENSO.

ENSO and climate change may likewise affect the seasonality of the BSC in the

Philippines. Previous reports show that August is the common peak month/season for blue swimming crab fishing while March and April are considered the lean months (BSCMP 2014). However, more recent data reveal that the crab fishers identified the start of the peak months, generally, in June, August, or September depending on the region (Yap et al. 2017).

In comparison with the published peak catching seasons for the BSC in the different crab fishing grounds in the country (BSCMP 2014), the peak season of this species had been longer in the more recent years. The lean season, on the other hand, generally starts either in December, January, or February and lasts for 3-5 months in the recent years.

The differences in the onset of the peak seasons and lean season in the different BSC producing regions in the country in the recent years could probably be due to the changing transition patterns in the switching of wind directions from the hot and humid wind during the "habagat" months to the cool northeast trade winds during the "amihan" months.

Since the state of the environment of the fishing grounds varies seasonally, these variations affect the abundance of the BSC in these areas,

Status of Fishing Grounds for, and Declining Supply of, Blue Swimming Crab.

As noted above, most municipal fishers do their crabbing activities nearby. Most of them do not have any fishing arrangements with other nearby municipalities, while some of them have different arrangements with other municipalities, such as issuance of fishing permits or license, an agreement not to go inside declared fish sanctuaries, payment of fish landing fees and taxes, not to engage in illegal fishing activities, and the catch to be sold in the municipality where it was caught.

However, majority of the fishers change the areas where they usually catch crabs and quite apparently, these areas are the ones either farther from the shore but not necessarily outside their municipal waters or areas covered by the other municipalities (see above).

Accordingly, fishers tend to go to other nearby fishing grounds in pursuit of higher amount of catch. They believe that recent BSC catch has been decreasing as compared to the amount of crabs they had ten years ago.

The study of Mesa et al. (2018) further provides scientific evidence to show the apparent overfishing in the BSC fishery in Western Visayas Sea. As shown in Figures 9 and 10 above, the decreasing CPUE and the intensity of fishing pressure, coupled with growth and recruitment overfishing brought about by the apparent catching of crabs during its spawning season, all point to the increasing concern on the proper management of the BSC resource in the Philippines.

Other man-made factors causing degradation of BSC habitats. Environmental pollution due to the presence of some coal power plants and the continuous non-utilization or improper utilization of wastes (including those from crab processing plants) affect the habitat of BSC in most parts of the country (Figure 15).

In summary, at this point, both natural and man-made causes of the degradation of BSC habitats, coupled with the improper management of the BSC resources in the country, resulted in the unsteady production of BSC over the last several years.

Socio-economic (or human) Issues and Concerns

The socio-economic or human problems that are confronting the BSC industry of the Philippines are illustrated in Figure 16.

Use of different fishing gears for blue swimming crab

There are three (3) types of fishing gears commonly used by the crab fishers, namely crab lift net, crab pots, and gill nets. Crab pots are mostly used in Region 6, crab lift net in Regions 5, 7, and 8, and gill net in Regions 4B, 5, 6, 7, and 8.

These fishing gears have different capture mechanisms, operational requirements, handling, and stress response. Different gears likewise require different costs of operation, with crab gill net having the biggest cost of fishing per day, due to the cost of gasoline and their nets.

The income of the crab fishers is generally not enough for them to meet the needs of their families. Even during the peak season, crab fishers incur deficits in terms of income that may even reach up to more or less PhP 1,000 per day. The same observation is true during the lean season.

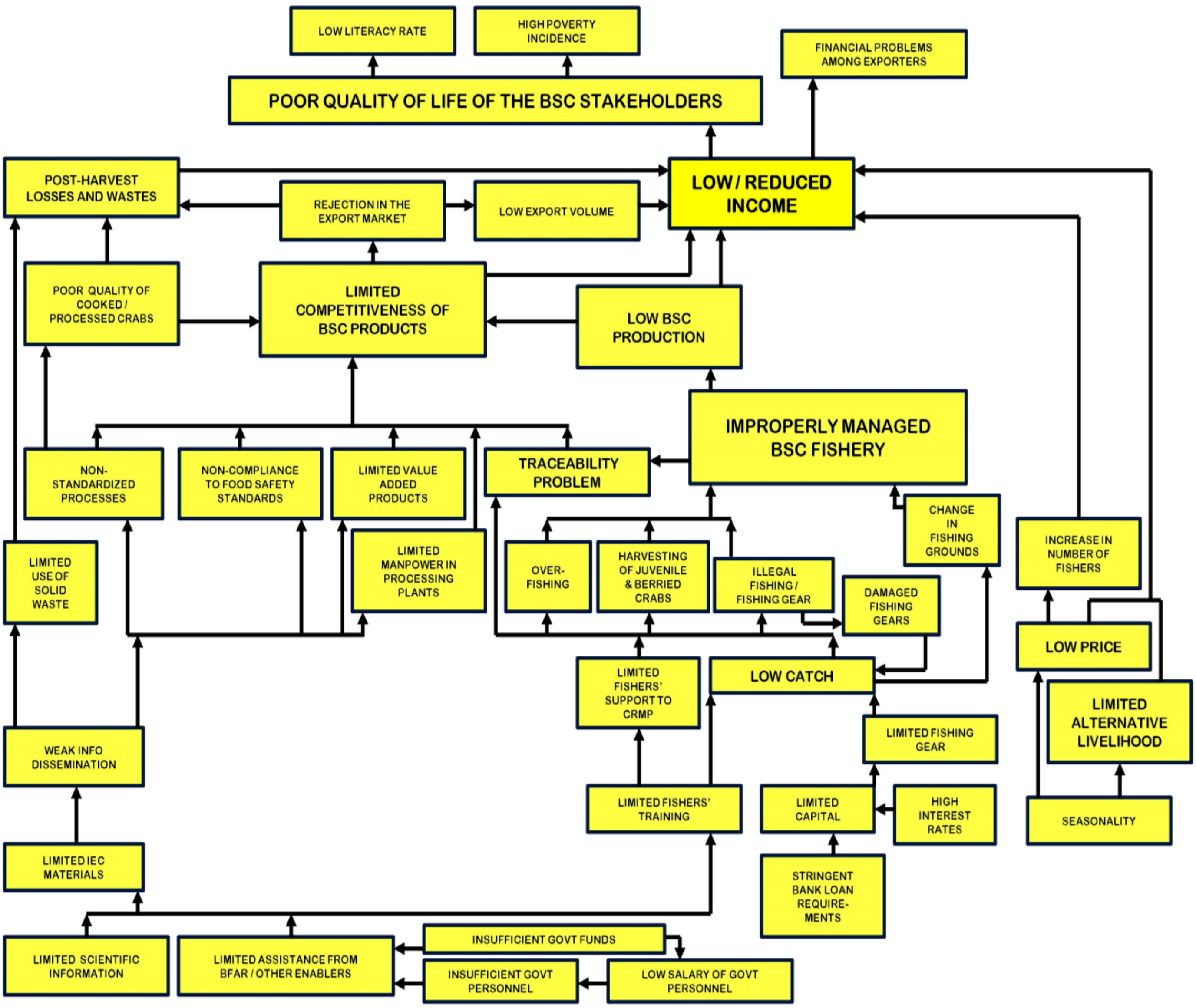

Figure 16. The socio-economic (or human) problems facing the Blue Swimming Crab Industry of the Philippines

This could plausibly be the reason why some of them resort to using other fishing gears such as push nets, and trawl, or even crab pots with small mesh sizes. Some of them even engage in illegal fishing activities that inflict major and multiple damages to the crab fisheries e.g. Danish seines and trawls (Figure 14; also see Ingles 1996; Ingles and Flores, 2000).

Other fishers, on the other hand, resort to the use of fishing gears that tend to damage the gears of crab fishers, resulting in low catch and therefore low income among fishers. More importantly, these practices lead to indiscriminate overfishing in the BSC-fishing grounds.

Low catch among fishers can likewise be due to the limited fishing gears that they use. With limited capital to invest on the appropriate gears that they can use, coupled with the limited access of the fishers to financial support as a result of high interest rates and stringent bank loan requirements, these fishers always experience low catch causing poor quality of life among the BSC fishers.

Possible negative impacts of entering into responsible fishing and sourcing

Seafood Watch reported in 2018 that the use of crab pots and gill nets must be avoided in catching BSC both in the Visayas Sea and Palawan areas. Gillnets, in particular, reportedly have moderate to high levels of by-catch and have some interactions with other species of concern such as sharks, sea turtles, and others. Crab pots, on the other hand, exhibit strong potential to interact with mammals, corals and other biogenic habitats. These findings placed the crab pots and gillnet fisheries in the Visayas Sea and Palawan under the “red” or “avoid” rating (Seafood Watch 2018).

To reduce fishing pressure on the existing BSC resources and its effects on other fisheries in the country, it becomes imperative to thoroughly look at the type, number, size, and efficiency of the fishing gears that are now being used by our fishers. A study of Mesa et al. (2018) noted that in the Western Visayas Sea alone, majority of the crab fishers have been using either crab pots or gillnets (Table 7)

Should the present Seafood Watch rating persist, the Philippine crab products in the export market may be jeopardized. However, banning the use of these gears may have some deleterious effect on the fishers. Since each gear is operated by different numbers of individual fishers (for instance, a crab pot is usually operated by 1-3 persons while a gill net is often operated by 1-2 persons), restricting the use of these gears would have negative impact on the lives of those in the coastal communities.

Local crab fishers resort to catching undersized and gravid / berried crabs to increase production

Local consumers have been complaining that they rarely see mature crabs in the wet markets in rural and urban areas recently. Even if they see them in the supermarkets in the urban areas, the prices are too prohibitive.

Table 7. Municipal fishing gears operating in the Western Visayas Sea in 2011 (Source: Mesa et al. 2018)

FISHING GEAR	COMMON LOCAL NAME	NO. of UNITS
Bottom-set gillnet	Palugdang, pukot, pukot-pangasag	325
Crab pot	Bubo pangasag, panggal, timing	479
Crab trap	Bubo pangasag	36
Modified Danish Seine	Hulbot-hulbot	131
Fish coral	Punot	195
Filter net	Tangaban	32
Fish trap	Bubo	49
Manual push net	Hud-hod, sungkit	21
Otter trawl	Trawl	111
Surface-set gillnet	Pukot	21

The transactions between each of the main actors in the supply chain of the blue swimming crab are controlled, in terms of value and volume, by the exporters. The latter deploy their own buying, cooking, and picking stations, and the people manning these stations have the greatest control.

This scenario greatly affects the fishers, for they cannot get the best value for their catch. This also has effects on the local consumers, for they cannot get good crabs, since the priority of the fishers is to sell their catch to the consolidators from the buying stations.

These consumers usually end up having small, juvenile crabs, or even berried crabs at very high price, or they do not get any crabs at all. Anecdotal evidence show that fishers still get juveniles and/or berried crabs, although some crab fishers immediately return undersized and/or gravid crabs to their natural environment. Nonetheless, majority of them reported that they either consume or sell these undersized and/or gravid crabs. Some of them put the gravids either in the lying in sites provided in the area or they just simply discard them.

The apparent disregard of fishers to existing BSC rules and regulations and their limited support to government programs on Coastal Resource Management can be due to several factors, including the limited dissemination of information about these rules and regulations; limited training support for the fishers, limited assistance being given to them, and a whole set of governance related problem (see discussion below).

Governance related Issues and Concerns

Some of the problems of the BSC are basically due to some governance related issues and concerns, as shown in Figure 17, include the following:

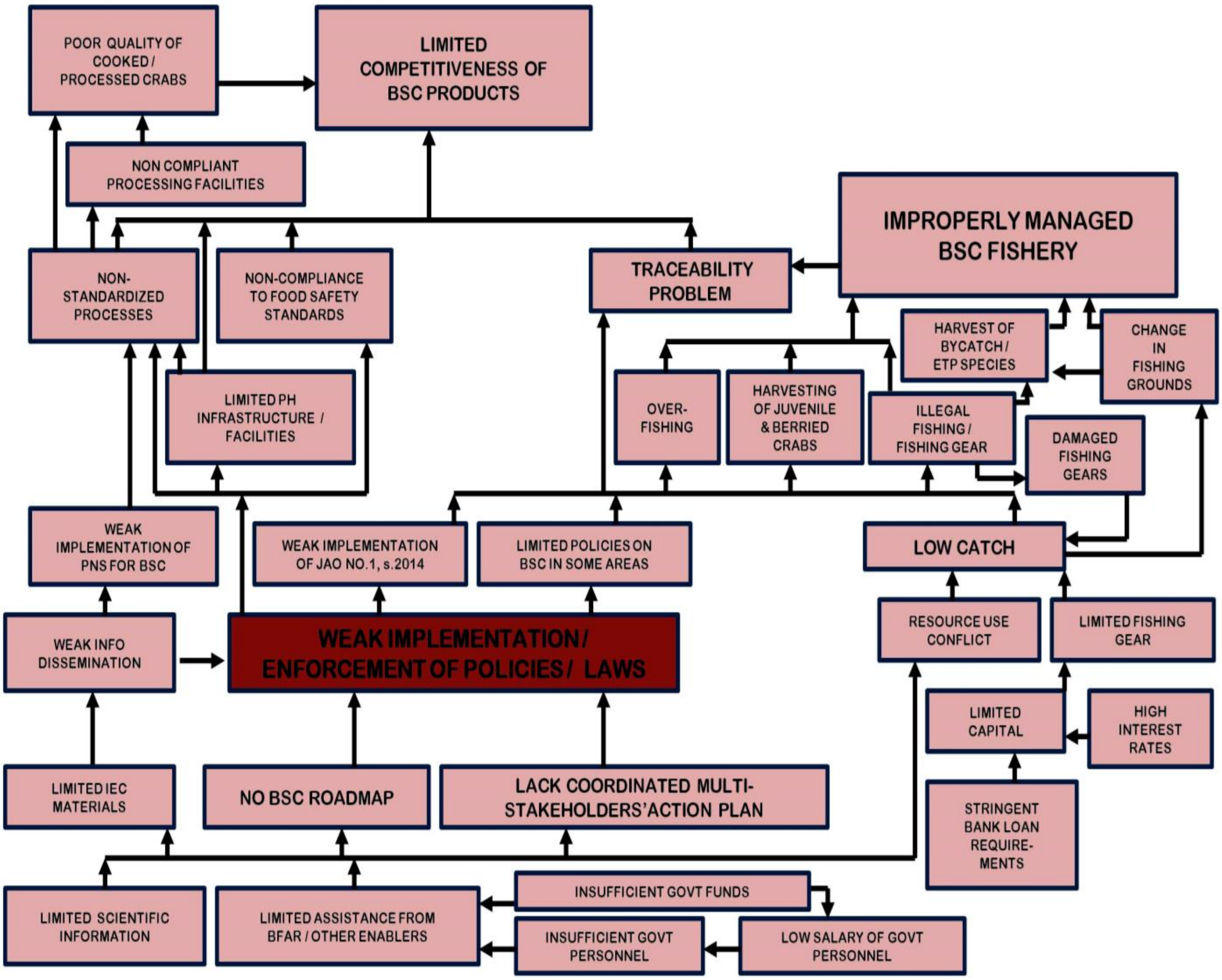

Figure 17. The governance-related problems facing the Blue Swimming Crab Industry of the Philippines

Management strategies to protect crab populations

The legal framework for the management of the BSC industry has already been established. In particular, management strategies securing crab population through fishery laws and regulations are in place, with specific provincial and municipal ordinances being implemented in several areas in the country.

Figure 18 schematically illustrates the legal framework that covers the management and conservation of the BSC industry in the Philippines while Tables 8 and 9 specify the specific provincial and some municipal ordinances for the BSC industry, respectively.

Most of these provincial and municipal ordinances, however, were implemented and are all in place even before the issuance of JAO No. 1, series of 2014. In fact, five (5) years after the issuance of this order, the provisions, as stated therein, as well as the other rules and regulations on BSC, were not fully implemented and were not even disseminated widely to the stakeholders of the industry.

Figure 18. The legal framework for the BSC industry in the Philippines

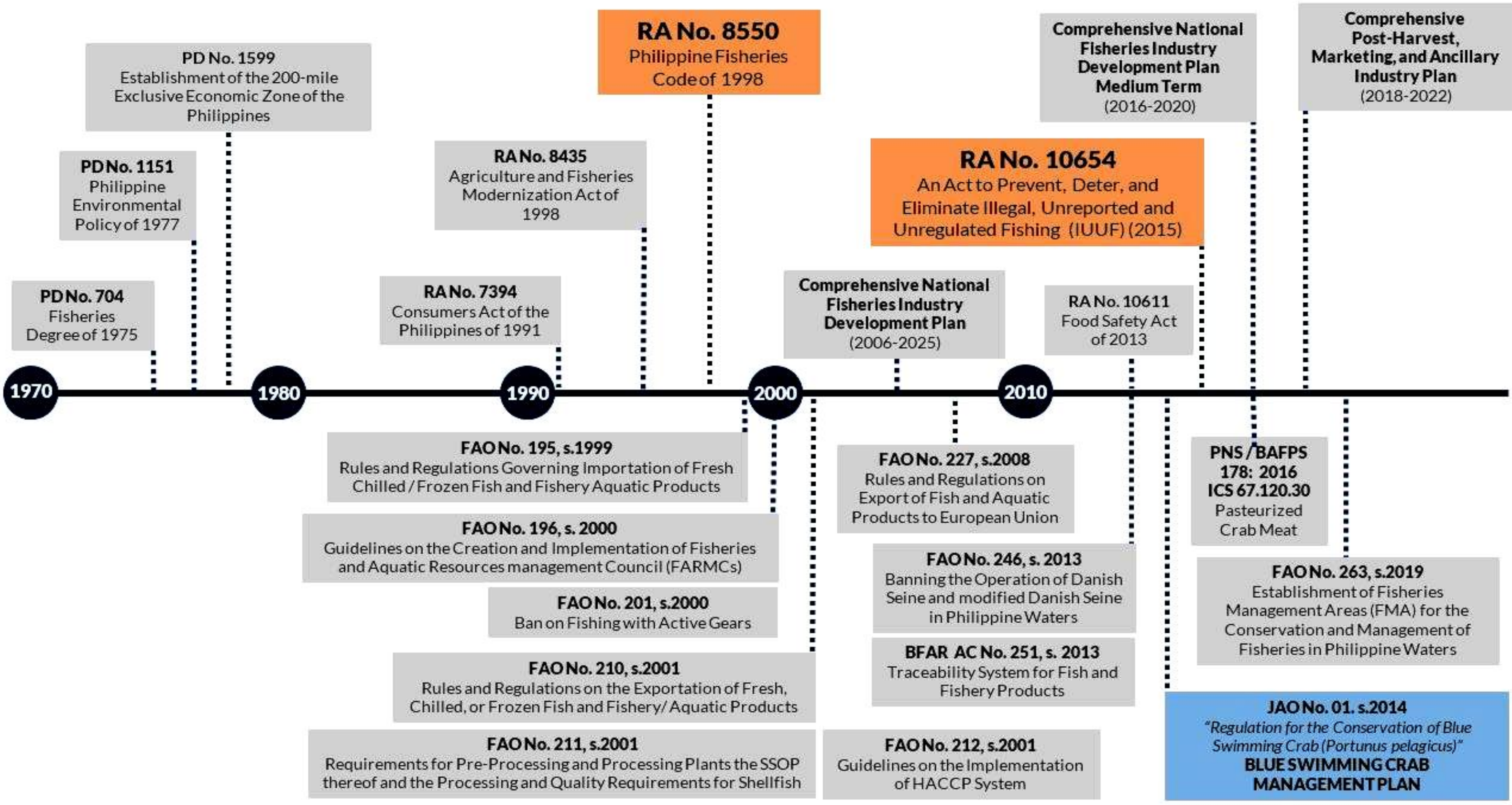

Table 8. List of provincial ordinances that govern the local BSC industry

Location	Ordinance number	Year of implementation	Title	Provision on crabs
PROVINCIAL ORDINANCES				
Province of Negros Occidental	Provincial Ordinance No. 019	2003	An Ordinance Regulating the Catching, Selling and Possessing or Buying of Gravid Blue Crabs and Crablets in the Province of Negros Occidental	To address the problem of resource depletion of blue crabs in municipal and city waters in the Province, and to utilize properly blue crabs as sustainable source of livelihood
Province of Iloilo	Provincial Ordinance No. 2012-093	2012	An Ordinance Regulating the Catching, Selling and Possessing or Buying of Gravid Blue Crabs and Crablets in the Province of Iloilo"	Limits crab catch size of 11 centimeters (cm) and depth of 50 mesh size for gill net.

Table 9. List of municipal ordinances that govern the local BSC industry

Location	Ordinance number	Year of implementation	Title	Provision on crabs
MUNICIPAL ORDINANCES				
EB Magalona, Negros Occidental	Municipal Ordinance No. 30 series of 2009	2009	An Ordinance providing for the sustainable management, conservation, and development of coastal and fisheries resources of the municipality of EB Magalona, Province of Negros Occidental	Section 27. Establishment of the Blue Crab Sanctuary for Sustainable Management of Blue Crab Industry of the Municipality. 1 hectare crab sanctuary in Brgy. Tomongtong.
Buenavista, Guimaras	Resolution No. 2007-312	2007	Resolution to enact an ordinance providing for the sustainable management, conservation, and development of coastal and fishery resources of the municipality Buenavista, Province of Guimaras amending for such purpose the existing fishery Ordinance no. 75 series of 1993 and other fishery ordinances of this municipality	Section 47: Taking, Catching and Gathering of Crablets and Spawning crabs.
Estancia, Iloilo	Ordinance no. 2004-12	2004	An Ordinance providing for the sustainable management, conservation, and development of coastal and fisheries resources of the municipality Estancia, Province of Iloilo	Section 80. Prohibition of the catching, selling, processing and transporting of gravid crabs and lobster (mud crabs, blue crabs, "Cruzan" crab, pitik-pitik. Section 81. Prohibition of Crablets
Bantayan, Cebu	Municipal Ordinance No. 08 Series of 1999	1999	A modified ordinance regulating fishing and/or fisheries in the municipality of Banatayan, Province of Cebu	None

The weak implementation or enforcement of the provisions of JAO No. 1, series of 2014, or any other rules and regulations that are related to BSC, including the Philippine National Standards for BSC, are due to the following identified weaknesses of the industry (see above): (i) weak information dissemination (also see discussion below); (ii) lack of coordinated multi-stakeholders action plan for BSC; (iii) the absence of a BSC Roadmap; and (iv) the limited assistance from BFAR and other enablers of the BSC-industry. Such weak implementation results in improper management of the BSC fishery in the country that results to depletion of the BSC stocks / resources in the country.

<u>Existing initiatives/projects in the Philippines</u>

One of the recent initiatives of the Bureau of Fisheries and Aquatic Resources (BFAR) is the voluntary registration of the fishers in the coastal communities all over the country. Known as "FishR", it is a program "designed to enhance, fast track, and complete the Municipal Fisherfolk Registry of coastal Local Government Units (LGUs)", in pursuance to the pertinent provisions of RA 8550 (Fisheries Code of the Philippines). This project aims, among others, to use the data in the FishR "to design fisheries management and biodiversity conservation measures".

However, since the implementation of the FishR Program of BFAR in 2014, some of the fishers are still not FishR-registered fishers, and accordingly, those registered fishers receive different incentives from the government. Inconsistent implementation of benefits and information are likewise noted by some of the stakeholders. In addition, there are other relevant information such the declaration of crab gears being used by the fishers, that are missing in the database of the FishR program.

Another BFAR project is the National Stock Assessment Program (NSAP). Formally started in 1997, this program was conceptualized in order to come up with standardized and continuous information on the different fishery resources in the country. The program plays a critical role as a repository of valuable scientific information necessary in the crafting of fishery management programs in the country. In BFAR Region 6 alone, a total of 105 Fish Landing Sites (FLS) are being monitored by its NSAP Team, 22 of which are directly monitoring the BSC fisheries in the Western Visayas Sea (Mesa 2019). Figure 19 shows the FLS in the Western Visayas Sea where BSC is being monitored.

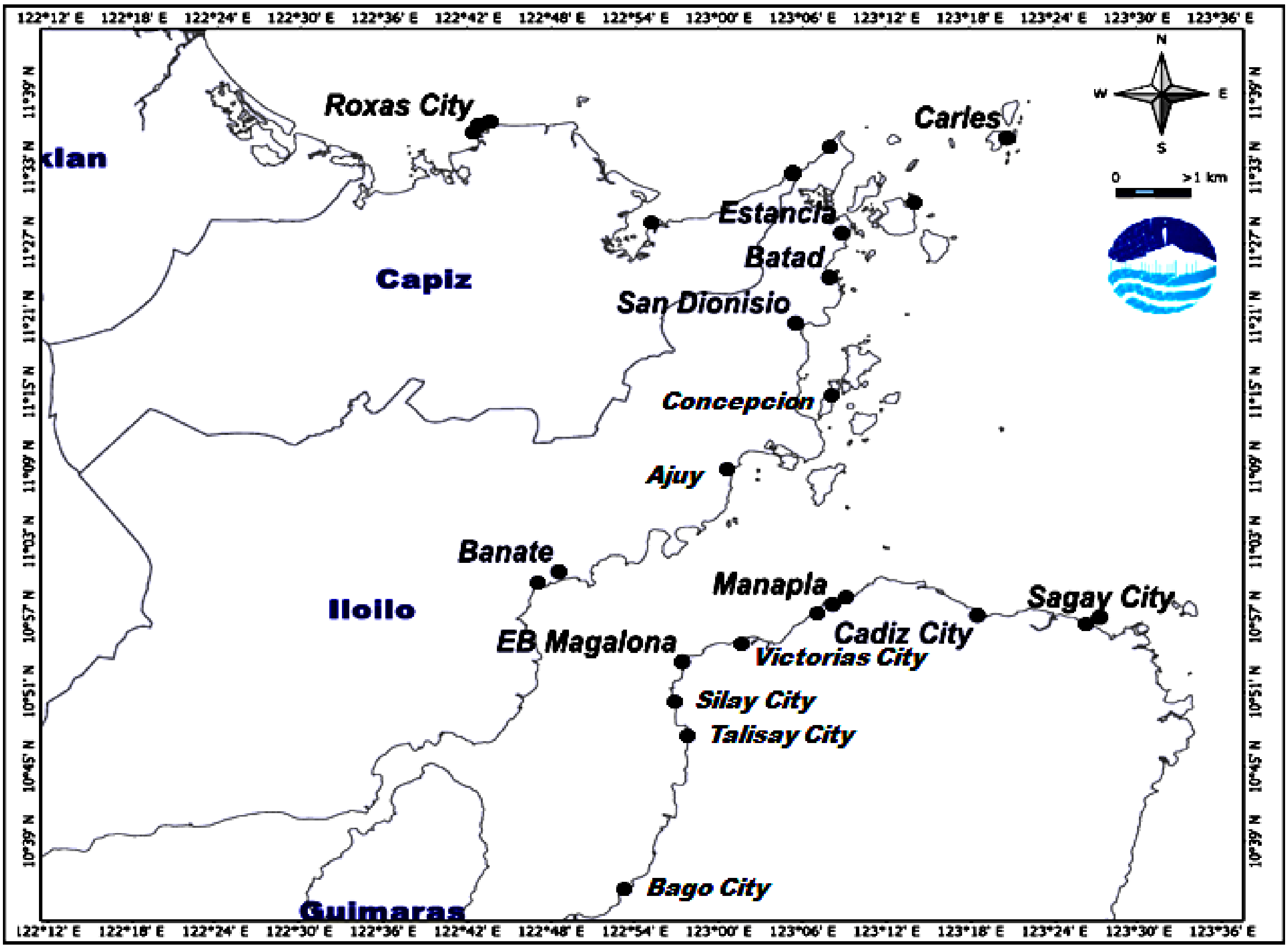

Figure 19. Monitoring stations of the Blue Swimming Crab in the Western Visayas Sea, under the National Stock Assessment Project (NSAP) (Source: Mesa 2019)

Figure 20. A photo of a reseeding activity in Guiuan, Eastern Samar, a Fisheries Improvement Project of the Philippine association of Crab Producers Incorporated (PACPI)

In terms of Fisheries Improvement Projects on BSC (Figure 20), most of them are included in the PACPI Action Plan. The said plan includes the different Fisheries Improvement Projects that are geared towards sustainable utilization of BSC in the country, with identified implementing partners and collaborators.

Weak dissemination of information, education, and communication (IEC) materials. Despite the presence of pertinent rules and regulations, as well as Fishery Improvement Programs, the BSC industry is still facing problems in terms of sustainability, equitable access, and global competitiveness. This can partly be explained by the weak dissemination of relevant initiatives or programs of the government. The non-registration of some of the fishers to FishR, for example, can partly be explained by the limited dissemination of information about this program.

Another proof to this is the apparent lack of knowledge or awareness among the majority of the fishers and other stakeholders on the existence of specific rules on BSC, such as the prohibition on the catching of undersized and/or gravid crabs, the use of lying in stations for the gravids, and other rules.

Limited competitiveness of BSC products in the markets and post-harvest losses. One of the direct results of the weak implementation of pertinent rules and regulations on BSC is the limited competitiveness of BSC products both in the local and international markets This limited competitiveness of BSC products can be due to several factors, including: (i) use of non-standardized processes; (ii) non-compliance to food safety standards; (iii) limited value adding activities; (iv) limited post-harvest facilities; (v) limited manpower in pre-processing and processing plants; and (vi) traceability related problems.

For example, although the Philippine National Standard for Pasteurized Crabs have been released in 2017, there is still a need to have well defined industry protocols that will answer the concerns on the quality and safety of the fresh and processed crab products and the post-harvest losses in the industry.

In terms of food quality and safety, processors are required to comply with the specifications as required by the export markets. However, some cooking stations mix meat from other species, but still declare in their label that the species used is BSC (see Figure 21).

Figure 21. Other species of crabs, other than blue swimming crabs that are processed and mixed with the meat of blue swimming crab

Another problem involves the maintenance of cooking stations, as new cooking stations are being put up every time, depending on the crab supply and the crab peak seasons in the area.

Despite the presence of the recommended steps in cooking crabs (see Figure 14), different cooking and cooling practices are observed in the different regions in the country. These practices lead to different quality and safety concerns, including meat discoloration, textural problems, undercooking, overcooking, and inconsistent quality of cooked meat.

Since the choice for the construction of cooking stations largely depends on the availability and abundance of crab in the area, the availability of ice making/ice storage facilities poses a problem leading to unsteady supply of ice in the stations that supposedly ensures the quality of the cooked crab meat.

Improper cooking and cooling temperatures of crabs may lead to deterioration of meat quality, especially during the ice transport of the cooked crabs. Unfortunately, different practices are observed in different cooking stations wherein cooling times vary from 30 min to 3 hrs.

For those engaged in the exportation of crab products, the processing establishments must be accredited by different bodies. Table 6, indicates the number of establishments in the country that are engaged in pre-processing (cooking and picking) and processing (pasteurized crab and/or value added crab products). The same table indicates the number of establishments that are with Hazard Analysis and Critical Control Point (HACCP) accreditation from the Bureau of Fisheries and aquatic Resources (BFAR).

Clearly, almost all of the pre-processing facilities are not HACCP-accredited. These are the facilities that are not run nor under the supervision of the processing plant. Most of these pre-processing facilities are not even registered as compliant to the basic Good Manufacturing Practices (GMP). On the other hand, most of the processors are with HACCP accreditation, as shown in Table 6. This is expected since these are export companies that are required to follow quality standards, as dictated by their international buyers.

For the traders, there are instances when they cannot sell their crabs due to the following: the time when there is an abundant supply of other species of fish, hence the wet markets are flooded with these fishes; when the crabs are either dead or have black spots; when crabs are not iced well; and from cooking stations, when the crabs are either overcooked or undercooked.

Other problems encountered by the traders include: low price (as dictated by the processors); fluctuating price of crabs in the market; delayed payment of processors or no payment from the processors at all; inconsistent supply of crabs from the fishers; loss in quality due to incessant quest of buyers for better looking, heavy crabs; and rejection of the crabs by the processors due to lower quality, and other factors.

Clearly, significantly large quantities of crabs are lost or wasted the Philippines during capture, post-harvest handling and processing, distribution, and storage. Losses typically happen during the production, storage, processing, and distribution of crabs while wastes refer to either whole raw crab or its parts that are not utilized nor consumed, but are typically discarded, either on board fishing vessels or in fish landing sites, in processing facilities, or in the point of sale of the finished products.

Unfortunately, both crab post-harvest losses and wastes in the Philippines and elsewhere, are difficult to quantify and qualify. For example, except for the volumes of products that have been rejected in the export market, all other losses associated with poor practices (e.g. inappropriate handling techniques, temperature during handling and storage, etc.) are not quantified.

Limited information is available on the amount of discards when using different fishing gears, although Romero (2009) noted unwanted, untargeted species comprising half (or 50%) of the discards, when using bottom gillnets, but for the highly selective crab pots, the estimated amount is only *ca* 5%.

Other wastes that include physically damaged crabs, soft-shelled crabs and other crab body parts are simply thrown away and are not quantified at all. The high percentage of non-utilizable crab parts is quite alarming since it creates a significant amount of wastes that are discarded to the environment.

In general, both the limited competitiveness and post-harvest losses contribute to low income among the fishers, traders, and workers in pre-processing (cooking and picking stations) and processing plants, while reducing the income or profit of the exporters.

Lack of institutionalized monitoring mechanism for BSC-related initiatives

As shown in Figure 20, the root causes of the problems besetting the blue swimming crab industry in the Philippines include the weak implementation of relevant rules and regulations and the absence of both a coordinated multi-stakeholder action plan and the roadmap that serves as a guide for the initiatives for the improvement of the BSC industry in the country.

Other contributory causes involve the different enablers of the industry, such as the Bureau of Fisheries and Aquatic Resources, the different local government units, and other government and non-government agencies.

In addition, the absence of any institutionalized monitoring mechanism for all BSC-related initiatives significantly contributes to weak implementation of the relevant rules and regulations in place. Simply put, there should have been an institutionalized governing body that will oversee the accomplishments of all the action plans and programs for the BSC industry of the country.

Relationship between the environmental (or ecological), socio-economic (or human), and governance-related issues and concerns

The different clustered problems besetting the entire BSC industry in the country are inter-related, as schematically summarized in a BSC Problem Tree (Figure 22). This interrelatedness encourages a more defined, well organized, and systematic solution to these problems that is aimed to ensure that the sustainability, conservation, and management of the BSC resource in the country are well-grounded and are geared towards the improvement of the lives of the major players of the industry.

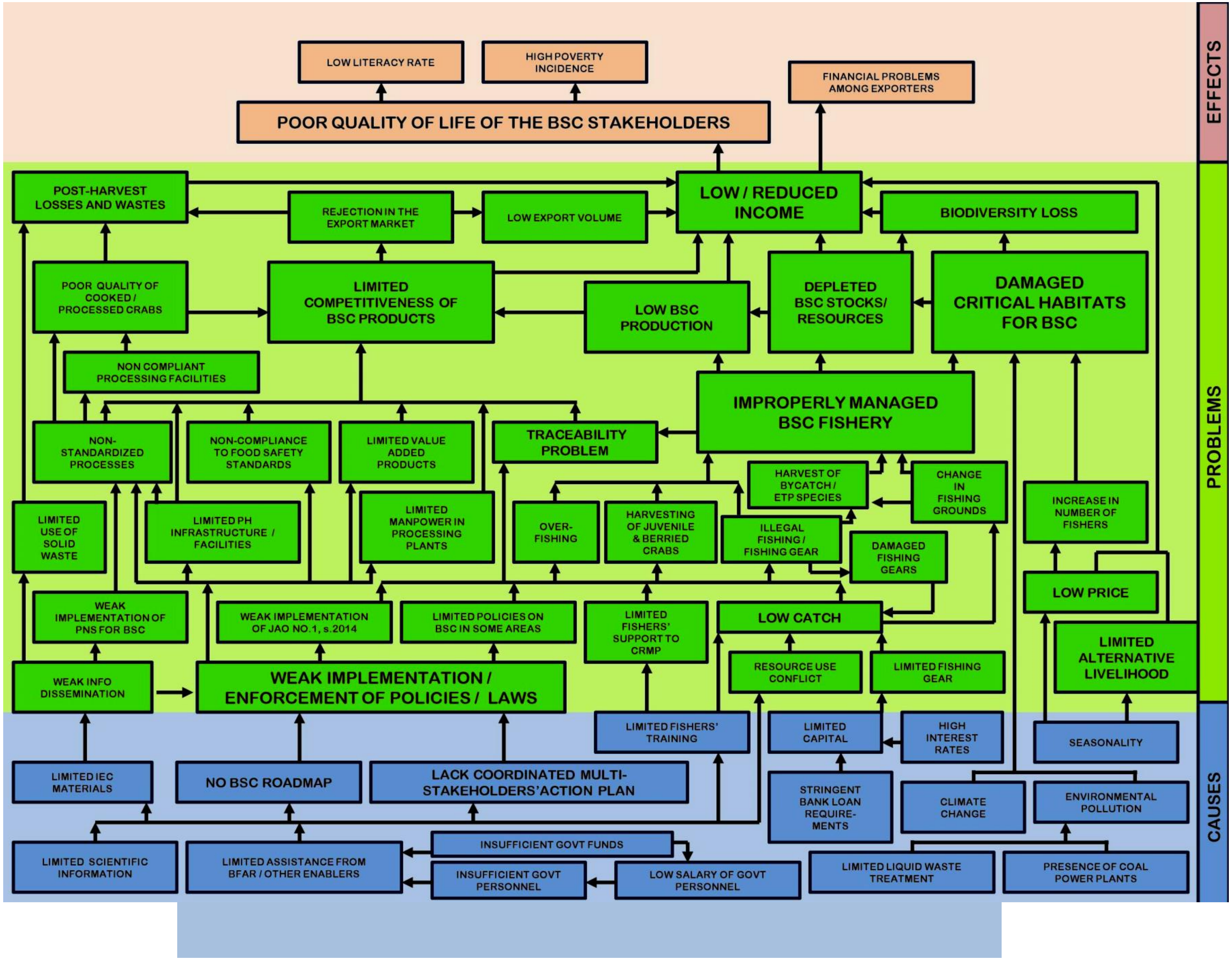

Figure 22. The PROBLEM TREE of the Philippine Blue Swimming Crab Industry in the Philippines

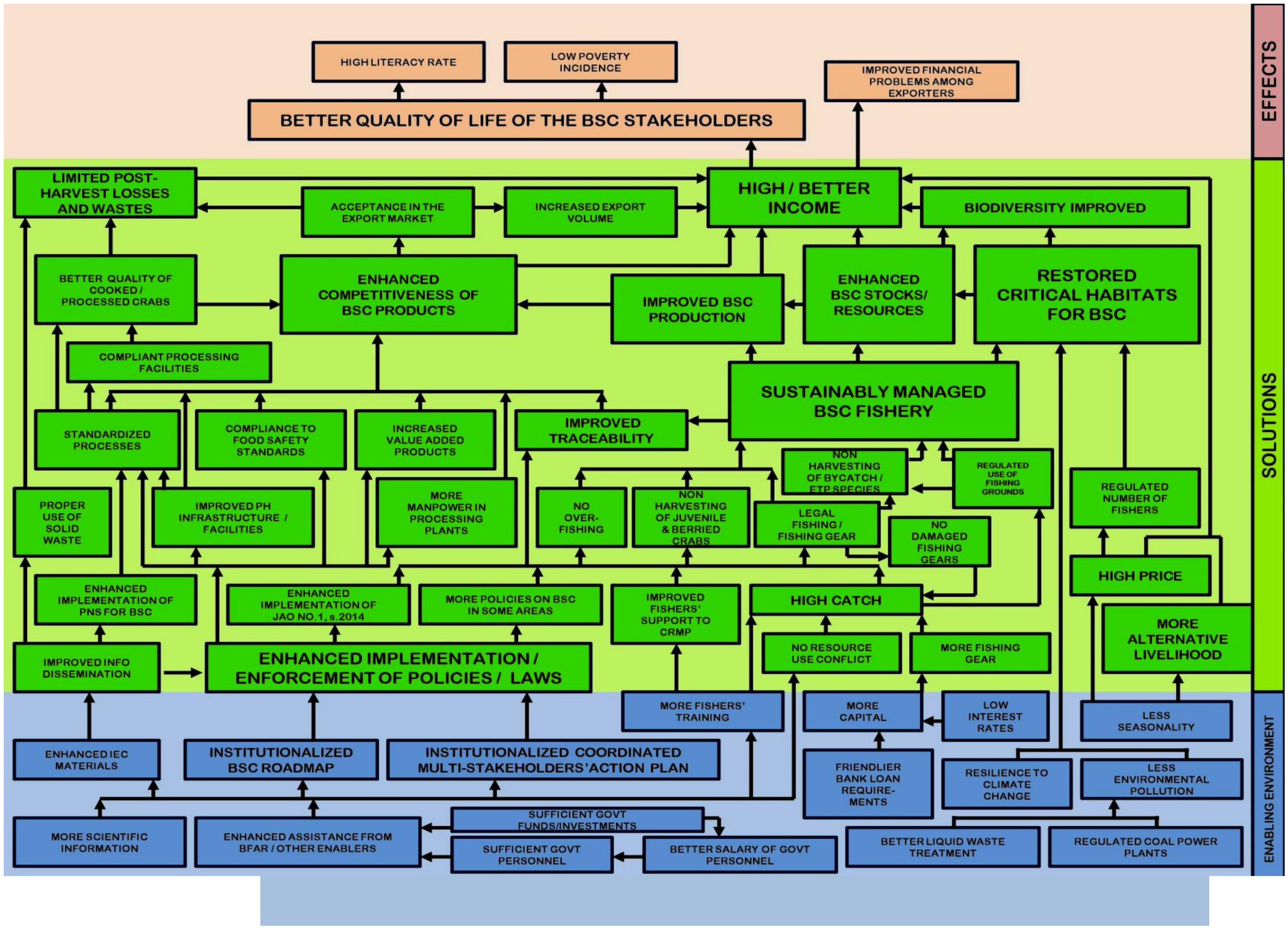

Figure 23. The SOLUTION TREE for the Philippine Blue Swimming Crab Industry in the Philippines

SOLUTIONS FOR THE PHILIPPINES' BLUE SWIMMING CRAB INDUSTRY

The Problem Tree, as determined in the Problem Analysis, was transformed into a Solution Tree (Figure 23) that enabled the identification of the Vision, goals, and objectives for the BSC Industry of the Philippines (Table 10). Said goals were focused on three main concerns, namely, **environmental** (or ecological), **socio-economic** (or human), and **governance** related concerns.

Table 10. The Vision for the Blue Swimming Crab industry in the Philippines and the goals and objectives needed to attain this Vision.

VISION: ***A sustainable, equitably accessed, and globally competitive Philippine Blue Swimming Crab industry***	
GOALS	**OBJECTIVES**
Rehabilitated marine habitat for increased BSC production	To conduct BSC resource mapping and determine the impacts of the fishery to the ecosystem
	To increase BSC production by 10% in 5 years through the improvement and development of technologies in at least 19 BSC production areas
	To promote the use of eco-friendly fishing gears in different fishing grounds in 5 years
	To increase the BSC stock biomass by 10% in FMAs where BSC is one of the key fishery of interest
	To establish a network of MPAs (Marine Protected Areas) for BSC in 5 years
	To minimize the level of environmental pollution due to crab meat industry wastes
Increased compliance with BSC regulations for sustainable management of BSC fishery	To institutionalize a multi-stakeholder BSC council by 2020
	To institutionalize the BSC Roadmap in 2020
	To adopt and integrate the BSC-NMP into the local executive legislative agenda and implement the BSC-NMP in all LGUs (where BSC is a major commodity) in 5 years
	To increase awareness on all BSC regulations by 80% of the key players (fishers, traders, processors, exporters, enablers, resource managers) in 5 major BSC fishing grounds in 5 years
	To increase regulatory compliance in the BSC fisheries (e.g. catch documentation, size regulations, catching of berried and juvenile crabs, food safety and quality standards, traceability, and social compliance) by 20% annually over 5 years
Sustainable income and enhanced global competitiveness of BSC products for improved quality of life of BSC stakeholders	To increase access to, and strengthen, the extension and business development services for BSC stakeholders
	To increase all BSC fishers' net income by up to50% in 5 years
	To improve inclusiveness for all gender and circumstances (e.g. PWDs, etc.) to opportunities in BSC
	To increase the competitiveness of BSC products in the local and international markets by 2% in 5 years
	To increase access to market/trade and market information by 10% annually over 5 years
	To increase access of all BSC fishers to appropriate financial services by 10% annually over 5 years

The Solution Tree also allowed the identification of the enabling environment that can be pursued in order to come up with effective strategies to solve the problems besetting the industry (Figure 23).

Rehabilitation of marine habitat for increased BSC production. Effective utilization of the BSC resources in the country must start from the production node of the supply chain since the post-production nodes (i.e. the processing, marketing, and distribution) rely heavily on the availability of the resources and the absence of any strategies to effectively utilize these resources may lead to the collapse of the entire fisheries supply chain in the future.

In line with the effective utilization of the blue swimming crab resources, the ways by which the crabs are extracted from the source must be considered. These, however, are very much dependent on the presence of reliable database on production and utilization figures, among others. At present, the legal data are provided by the Philippine Statistical Authority. One may argue against the validity of these data, but these are the recognized official data sets. As such, the need to harmonize these data, together with the data gathered by NSAP, the export data from the exporters themselves, and others, is paramount.

Well-grounded harvest control rules need strong scientific data from different ecological indicators that are used to construct reference limits. There are bits and pieces of information from scientific research from different institutions in the country. Said information need to be collated in order to come up with a compilation of solid evidence for any rules to regulate the catching of BSC in the different parts of the country. Needless to say, this information is expected to serve as well-grounded basis for efficient resource management strategies that ensure the sustainability, conservation, and management of the BSC resource in the country.

As part of the development of resource management strategies, key activities may include the stocktaking of all initiatives and published scientific information related to the different ecological indicators needed for the construction of site-specific reference points (e.g. levels of biomass, spawning potential ratio, fishing mortality, catch, and catch rates (or catch per unit effort), and others), reproductive biology, genetic stock structures, existing practices related to fishing methods and gears, and other BSC-related information, must be conducted. This can to be done through a BSC Summit that will: (a) highlight BSC-related research initiatives and findings; (b) come up with a thorough evaluation of existing research gaps; (c) the charting of the research and development (R&D) agenda for the BSC fisheries of the country; and (d) organize an R&D network of BSC researchers/research institutions.

Other strategies such as the establishment of Marine Protected Areas for BSC and institutionalization of some mechanisms that will enable increased compliance on BSC-specific rules and regulations must be in place. In addition, there should always be ways to mitigate the effects of climate change and make the industry more resilient to ENSO and climate change. Also, focus may also be given to the solutions to present environmental pollution that threatens the BSC production in the country.

These are all aimed to restore the marine habitats that will subsequently lead to increased BSC production in the country in the next 5 years.

Increased compliance with BSC regulations for sustainable management of BSC fishery. Key to the increased compliance with pertinent BSC regulations for proper and sustainable management of the BSC fishery in the Philippines is the development of the BSC Commodity Roadmap that is an integral part of a National Management Plan (NMP) for the commodity.

The said NMP will have to include, among others, the detailed multi-stakeholder action plans and the provisions that will institutionalize a decision-making body or council that will oversee the sustained implementation of the plan. These will basically ensure that an enabling environment is present for the improved performance of the entire BSC industry of the country.

Other solutions include the adoption among local executives in coastal municipalities of Municipal Fishery Ordinances with BSC-specific regulations based on science. This is to expectedly improve the compliance of the BSC stakeholders to fisheries regulations.

Another way forward to make sure that the components of a BSC management plan are properly implemented and the BSC fisheries is managed properly, organizing inter-LGU alliances for a more harmonized implementation of different BSC-specific MFOs must be targeted.

Sustainable income and enhanced global competitiveness of BSC products for improved quality of life of BSC stakeholders. There should be intensified capability building mechanisms that are focused on the different players of the industry that will help them achieve more balanced economic opportunities. These can be done through the conduct of more focused and directed training programs that will increase the engagement of the fishers and other players in entrepreneurship.

There could be incentive programs and smart financing schemes that will benefit those fishers who are following local ordinances, existing laws and regulations, and sustainable fishing practices. Introduction of more fishers' cooperative in some select sites in the top blue swimming crab producing regions can also be done. These cooperatives may then be the place for the fishers to bring their catch and will serve as the trading place for the fishers. When the volume of crabs in these cooperatives gets large enough, the cooperative may then be able to demand high prices for the crabs, thus giving more income to the small fishers.

CONCLUSION

Through an inclusive, stakeholder-oriented process, the findings, as stipulated in this RCA report, and the performance evaluation of the earlier implementation of the BSCMP, as well as the current PACPI FIP Action Plan for BSC, a new BSCNMP that pursues the overall sustainability of the commodity can be developed.

The results of this RCA provide strong foundation for the development of the new BSC National Management Plan. It captures the problems besetting the BSC industry, the establishment of the industry's problem tree and the different contributing causes of these problems and causality relationships confronting the BSC industry in the country. In the process, the transformation of this problem tree enabled the formulation of the Solution Tree that provides the enabling conditions to come up with the industry's vision, goals, and objectives. These are all needed to come up with a new BSCNMP that is more responsive and relevant to the needs of the BSC industry of the country.

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