Changes in the Coastal and Fishery Resources and Local Ecological Knowledge (LEK) About Fishery Practices as Perceived by the Fisher Folks in Selected Coastal Municipalities of Zambales, Philippines

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This study was conducted to carry out a perception study on the changes in the coastal and fishery resources and the local ecological knowledge (LEK) about fishery resources and practices in selected municipalities in the province of Zambales. The researchers conducted a survey interview with the fisher folks living along the coastal areas to assess their knowledge and perception of the coastal and fishery resources in the four coastal municipalities, namely Palauig, Masinloc, Candelaria, and Sta. Cruz in Zambales, Philippines and documented their local ecological knowledge concerning fishery resources.

The majority of the fisher folks responded that there was already a decrease in fish population in the coastal and fishery resources, while half replied that the seashore and coastline aesthetic appearances had been destroyed. However, there were no changes in mangrove and seagrass ecosystems. Instead, most of them alleged that the main reasons for these problems are human activities and overexploitation.

The local ecological knowledge (LEK) is still rich and varied among the different coastal communities considering their cultural differences, practices, and topography. However, results revealed that most of the documented LEK focused on the fishing practices in coastal and fishery resources for fishing serves as their main livelihood. Only half of those interviewed from Palauig, Candelaria, and Masinloc, and Sta. Cruz followed and observed their old ways of fishing, such as using *payao, sunggapong,* and *kawil,* while some of them implemented the modified

ways like *hila-hila* and l*ambaklad*, among others. LEK in fishing practices and coastal and fishery resources are now very scarce, and only a few fishermen are well informed of this traditional knowledge. Also, it seems that these practices have been modified, revised, and converted by the younger generation of fishers. These traditional knowledge, systems, and practices are at a declining rate due to the continuing loss of interest of the young fisher folks.

In the face of ongoing environmental changes, and cultural and biological diversity, the coastal and fishery resources are likely to be severely impacted. Moreover, local resilience capacities suffer from this loss of traditional and local ecological knowledge. Thus, if LEK will continue to be harnessed, adapted, and practiced by the local fishers, this could be a holistic management tool in conserving fishery and coastal resources in the changing environmental conditions.

Keywords: fishery resources, coastal resources, fishing practices, ;local ecological knowledge (LEK)

INTRODUCTION

Zambales is a coastal province with a total coastal area of 56,792.25 ha and 232.6 km coastline. The coastal municipalities of this province have various aquatic ecosystems such as rivers, lakes, wetlands, seagrasses, coral reefs, mangroves, and tropical rainforests (Rivera, 2014). These ecosystems are declared protected areas locally and by the national government, such as the Masinloc-Oyon Bay Seascape and Landscape, Uacon Lake, Panglit Protected Area (San Salvador Island), Hermana Mayor, and Hermana Menor and Mt. Tapulao, among others.

Zambales, covering 361,110 hectares, shares common boundaries with Pangasinan in the North, Tarlac, and Pampanga in the East, and Bataan in the South. The entire stretch of the province in the West is rimmed by the crystal-clear waters of the vast China Sea. The 13 sprawling towns dotting the province from the North to South, most of them along the shoreline, are Sta. Cruz, Candelaria, Masinloc, Palauig, Iba, Botolan, Cabangan, San Felipe, San Narciso, San Antonio, San Marcelino, Castillejos and Subic. Until it became a chartered city, Olongapo was the 14th town (Provincial Government of Zambales Official Website, n.d.)

The coastal ecosystems in the province of Zambales have been facing many pressures from anthropogenic activities such as overexploitation, dynamite fishing, illegal fishing, solid wastes problem, and others that have been exacerbated by the changing climate and occurrence of natural hazards. Impacts from human activities on the ecosystems on

land and in the water can influence ecosystems greatly. Climate change, ocean acidification, polar ice caps melting, habitat loss, eutrophication, stormwater runoff, air pollution, contaminants, and invasive species are other sources of problems affecting the coastal ecosystems (Statistics Canada, 2015.)

Local ecological knowledge (LEK) has been existent as part of human life in the past, and it is essential in the formation and realization of how people interact with their environment. However, several scholars have different views of what LEK or indigenous knowledge entails (Fabiyi & Oloukoi, 2013). According to Kelman et al. (2012), LEK is viewed as indigenous/ local knowledge or traditional knowledge derived from local communities. Agrawal (1995) defined LEK as the knowledge passed down from one generation to another, gained and expanded from the information of the environment and surroundings, which is revealed through intuition, dreams, or visions. On the other hand, another researcher stated that indigenous knowledge refers to what local people know, recognize, and do for many generations that have evolved through trial and error and proved to cope with change (Melchias, 2001). Finally, Chianese (2016) agreed that LEK is the knowledge and know-how accumulated across generations, tested and adapted through millennia, guiding the local people in their interactions with their environments. A closer look at all these concepts supports that indigenous knowledge is locally grown, passed down from one generation to another and that the knowledge is gained over many years.

LEK is vital to broadening people's understanding of environmental changes, especially in fishery resources. The LEK of fishers may be of use in order to obtain first-hand knowledge or information on how to advance the management of coastal resources, the proper handling and use of their gear, and to provide specific answers on the habitat use of species of importance to their survival (Berkstrom et al., 2019). Local Ecological Knowledge (LEK) is relevant to increase understanding about environmental information and the participation and involvement of the local communities in the management of resources. The fishers' LEK could be helpful in order to obtain information on how to manage coastal fishery resources (Berkstrom et al., 2019). In addition, LEK could help provide answers to questions related to the connectivity and identification of fish

habitat use and migrations for species and areas where such knowledge is scarce.

Local ecological knowledge plays a crucial role also in biodiversity conservation and ecosystem management. The local ecological knowledge, coastal ecosystem management, fisheries management, and biodiversity conservation are interrelated through various socially shared aspects, such as values and norms, spiritual beliefs and perceptions of ecosystem functions and benefits as well as operational conditions, including livelihood strategies and economic constraints (Joa et al., 2018). While many of the reviewed studies evaluate local knowledge as holding great promise for conservation of resources and biodiversity, conclusions regarding practical implications of this knowledge into conservation management are mixed and varied. However, LEK is very imperative in the integration of conservation schemes in the changing environmental conditions.

With the weather and climate being unpredictable and with the changes that happen in the coastal areas, the indigenous communities face tremendous cultural and even economic changes that possibly lead to the deterioration of their local knowledge base. In the face of profound and persistent changes in the climate and degradation of coastal areas, LEK, coastal resources and fishery resources management, and biodiversity conservation, and local resilience from these changes are likely to be seriously affected. The loss of local and indigenous information is likely to pose a critical threat to the successful protection of biodiversity, especially in community-based local conservation efforts (Aswani et al., 2018).

In this context, this study intended to carry out a perception study on the changes in coastal and fishery resources and the local ecological knowledge (LEK) about fishery resources and practices in selected municipalities in the province of Zambales.

METHODOLOGY

This study utilized quantitative and qualitative methods. The study areas are the four coastal municipalities in Zambales, such as Palauig, Masinloc, Candelaria, and Sta. Cruz. The municipal and barangay profiles of these coastal communities were gathered and assessed together with their historical background, socio-demographic, economic, and political conditions.

A survey was conducted to determine the perception of fisher folks regarding their observation of the changes that occurred in the coastal and fishery resources and the fish populations and other organisms.

The local ecological knowledge about fishing practices, coastal resources, and biodiversity conservation was documented. The implementation of LEK on the grassroots level was determined through Focus Group Discussion (FGD) to increase peoples' involvement.

Due to the intensive coverage of the study areas, the data-gathering procedures involved three phases. The first phase was conducting a survey using a questionnaire to determine the changes in coastal and fishery resources. The second phase was the semi-structured interview of randomly selected respondents to gather preliminary data about local ecological knowledge (LEK) of indigenous knowledge systems and practices (IKSP). The research covered thirteen (13) barangays from Palauig, ten (10) from Masinloc, eight (8) from Candelaria, and eleven (11) from Sta. Cruz. Fifteen percent (15%) of the total number of fisherfolks/households within each coastal community were chosen as respondents for the interview. The target respondents were the fisherfolks in the study sites, dependent on the coastal resources of the four coastal municipalities for their livelihood. Therefore, samples of the study were limited to the top three highest number of fishing households who reside along with the coastal areas of the four (4) study areas of Candelaria, Masinloc, Palauig, and Sta. Cruz. A total of 320 respondents were interviewed from the aforementioned municipalities.

Knowledgeable respondents such as community leaders, peoples' organizations, executives, and policy-makers (local executives or Municipal mayors and members of Sanggunian) from the LGUs were selected as potential key informants (KIs) for the second phase of data gathering.

The second sub-phase focused on using several qualitative methods like field immersions, direct observations, in-depth interviews (semi-structured) of the key informants, focus group discussions (FGD), and the *pakikipagkwentuhan* or story-telling. In this procedure, a descriptive reconstruction of the prevailing community belief system, livelihood, and the existence of a community support system was documented. The data gathered were systematically arranged to constitute the community profile part of the research. Data were tabulated using pre-designed tables and subsequently analyzed descriptively.

Summary tables with consolidated relevant data from phases 1 and 2 were constructed to trace the relationship between LEK /IKS practices and the prevailing livelihood and the existence of community support system such as cooperatives, people's organizations, and other civic groups, as well as other factors that have contributed to the evolution of such practices. Triangulation or cross-referencing was applied to ensure the reliability of the data. Data gaps were supplemented by techniques used for primary and secondary data collection in phases 1 and 2. Finally, results were presented to the community for validation.

RESULTS AND DISCUSSION

Table 1 shows the distribution of respondents by gender and age group. The majority were married (85.94%), male (90.94%), and in their post-adolescent to mid-life years, of which 75.94 % of them belong to the middle age group of 31 to 60 years old. Only a few belong to the senior citizen's group (13.75%), the 21-30 years age groups (7.19%), and below 20 years (1.25%). Across the four study areas, many of those engaged in fishing are in their prime years and considered the productive age population. Candelaria, Masincloc and Sta.Cruz had the most number of fishers who were interviewed, while Palauig had the least number.

Less than 50% of the respondents (48.75%) were high school graduates and drop-outs, while 38.13 percent were elementary graduates and drop-outs. Only a few (4.06%) were graduates from vocational courses, and even fewer of them (2.81% each) attained a college level of education. Candelaria and Masinloc had the highest number of elementary and high school graduates. Similarly, only Candelaria and Masinloc had the highest incidence of college graduates, and this may be attributed to the proximity of President Ramon Magsaysay State University or PRMSU to their community.

Among the four (4) municipalities, Candelaria, Masinloc and Sta. Cruz had over fifty percent (59.69%) of 1-5 members in the family, and less than half (34.06%) had 6-10 members in the family. Only Palauig had an equal proportion of 11% between 1-5 and 6-10 household sizes. This indicates that there is now a growing trend of Filipinos who prefer smaller families, as can be gleaned from Table 1.

In terms of ethnolinguistic identity, the Tagalog-speaking population (46.25%) was predominant in all four study areas. Masinloc is the only municipality that has no Zambal speaking group and is a predominantly Tagalog speaking community. A mixed group of Zambal-Tagalog-Ilocano speaking population is the second highest ethnolinguistic group present in all the four municipalities. Such mixed ethnolinguistic groups are more concentrated in areas of Candelaria, Sta. Cruz and Palauig. Furthermore, those who speak pure Zambal are found in areas of Candelaria, Palauig, and Sta. Cruz (Table 1).

Figure 1 shows the annual income of the families per study area. A little over 50% were those earning P60,001 to P80,000 and P40,001-P60,000 annually. Less than one-fourth (17.19%) earned over P100,000, and 16.56 % declared their income to about P80,001-P100,000. There were still families who earned below P40,000 (8.44%) and P20,000 and each year (5%). These income groups may be considered the poorest of the poor and the marginalized income earners. The group with over P100,000 income annually was high among the municipalities of Candelaria, Sta. Cruz and Masinloc, while the group with the lowest income of P20,000 and below, were also from the municipalities of Masinloc and Sta. Cruz. The highest income earned by the respondents was pegged at P100,000 annually or P8,333.33 a month, and the lowest income received by some respondents is P20,000.00 annually or P1,666.67 a month.

These data reflect that many of the fisher sectors from the study areas live below the poverty line. The Philippine Statistics Authority (PSA) currently pegs the poverty threshold at Php 10,481.00 a month for a family of five. Thus, many of the respondents are low-income earners who reflect the pervasiveness of poverty among the fisherfolk sectors.

Table 1

Socio-Demographic Data (Gender, Age, Civil Status, Educational Attainment, Household Size, and Languages Spoken) in Candelaria, Masinloc, Palauig, and Sta. Cruz, Zambales

SOCIO-DEMOGRAPHIC	Candelaria	Masinloc	Palauig	Sta.Cruz	Total	Percentage
Gender						
Female	3	11	-	8	22	6.88
Male	106	83	23	79	291	90.94
No Answer	-	2		5	7	2.188

Age						
Below 20 years		3		1	4	1.25
21-30 years	8	1	2	12	23	7.19
31-40 years	31	7	4	32	74	23.13
41-50 years	31	32	7	30	100	31.25
51-60 years	26	26	8	9	69	21.56
61 above	13	23	2	6	44	13.75
No answer		4		2	6	1.88
Civil Status						
Married	95	84	21	75	275	85.94
Single	12	7	1	10	30	9.38
Separated	2	-		2	4	1.25
Widowed		1	1	1	3	.94
No Answer		4		4	8	2.5
Educational Attainment						
Elem drop out	4	12	1	9	26	8.13
Elem graduate	40	32	2	22	96	30.00
HS drop out	11	14	3	12	40	12.5
HS grad	41	25	12	38	116	36.25
Vocational	6	2	1	4	13	4.06
College drop out	2	6	1		9	2.81
College graduate	5	1	1	2	9	2.81
No answer		4	2	5	11	3.44
Household size						
1-5	67	65	11	48	191	59.69
6-10	38	26	11	34	109	34.06
11-15	4			1	5	1.56
No answer		5	1	9	15	4.69
Languages Spoken						
Zambal	14		3	4	21	6.56
Tagalog	35	70	5	38	148	46.25
Ilokano	14	4	3	-	21	6.56
Zambal/Tagalog/atbp	46	15	10	41	112	35.00
No answer		7	2	9	18	5.63

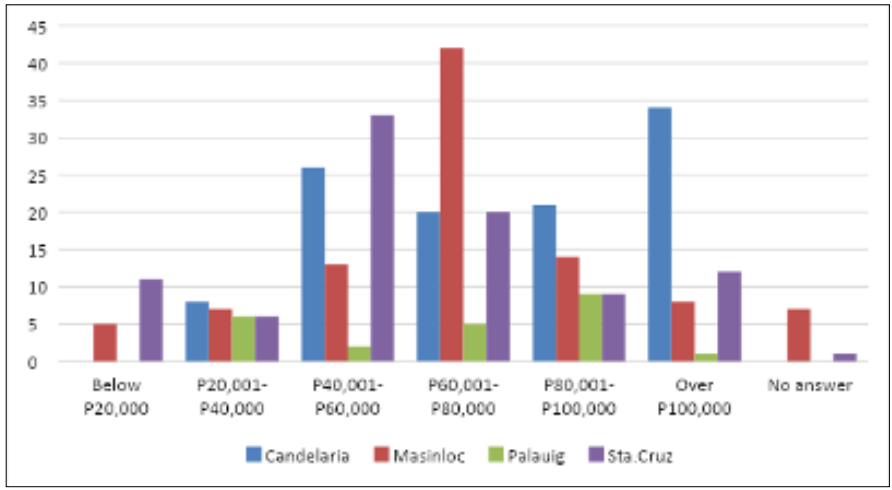


Figure 1. Annual income of the family per study area in Zambales, Philippines

Table 2 presents the supplementary monthly income of the households per study area. The majority (86.56%) of the families from the study areas had no supplementary income. This is not surprising because data show that very few families from the four municipalities have been engaged in livelihood activities such as livestock, raising, farming, and or those who sought employment in resorts, restaurants, and local tourism. Those who had an additional source of income are primarily from Candelaria and Palauig. Only about 10 % had a monthly income of P3,000.00 below, and 2.81 % make P3,001.00 to P9,000.00 a month. A little over half (63 %) had P12,000.00 additional monthly income.

Table 2

Supplementary Monthly Income Per Study Area

Supplementary income	Candelaria	Masinloc	Palauig	Sta.Cruz	Total	Percentage
(n=320)						
P3,000 and below	12	1	12	7	32	10
P3,001 – P9,000	3		2	4	9	2.81
P9,001 - P12,000	1			1	2	.63
No answer	93	22	82	80	277	86.56

During the lean months of the southwest monsoon, the season when fishing is dangerous and risky, only a few (3.75%) local fishers from Candelaria, Masinloc, and Sta. Cruz was engaged in livestock raising, and that generated only P6,000.00 and below as their additional income (Figure 1). Similar observations were seen on those engaged in farming. The majority (95.31%) of all those interviewed from the four municipalities did not engage in farming. Only 4.7% of the 320 respondents from Candelaria, Masinloc, and Palauig were engaged in farming; only a few of the respondents (3.13%) earned P3,000.00 and below, 0.9% earned P3,000.00-P12,000.00 and 0.63% respondents from Candelaria earned P30,000.00 monthly. These economic activities are the local fishers' adaptive ways to augment their income during the lean months of the year.

Respondents Perception on the Changes in Mangroves in the Four Municipalities

The fisher folks were asked about the locations where they usually visit to catch fish. The most frequently visited fishing locations by fishers from the four municipalities were the open sea or offshore, corals and mangroves. The majority of the respondents from Candelaria (81.7%), 52.2 % from Palauig, and 47.9 % from Masinloc caught fish offshore (Figure 2). The coral reef remained the second favorite fishing site among fishers from Sta. Cruz (25 %) and Candelaria (9.25%). Only a small number of fishers from Palauig (13%) went fishing in mangroves (Figure 2). Concerning this, a perception study was done to determine whether there are now changes that happened in the coastal and fishery resources of Sta. Cruz, Candelaria, Masinloc, and Palauig, where the fisher folks depend on their livelihood.

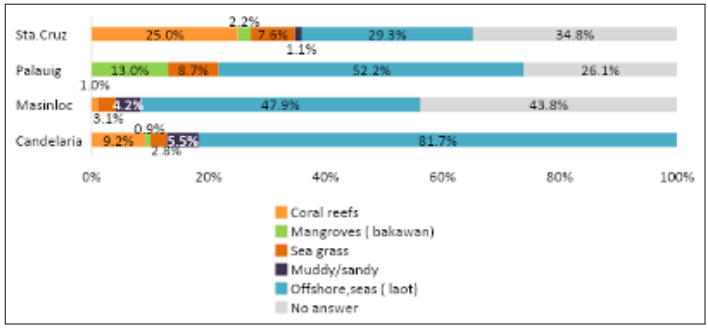


Figure 2. Locations where fishers commonly fish for each study area

Figure 3 shows that most fisher folks in the four coastal municipalities replied that there were no changes in the mangrove ecosystems in their area. Overall, the municipality of Palauig had the highest percentage of no changes that occurred with 94%, followed by Sta. Cruz and Masinloc with 89% and 88%, respectively, compared to Candelaria, which accounted for the lowest proportion (77%). Results revealed no significant changes in the destruction of mangrove ecosystems in the four coastal communities due to the local government units' action and policy to continuously promote the conservation and preservation of mangrove ecosystems. All the local government units require every resident in the barangays within each municipality to plant mangrove trees with different species along the river banks and coastal zones to prevent the impacts of strong typhoons and storm surge that might occur in their coastal areas.

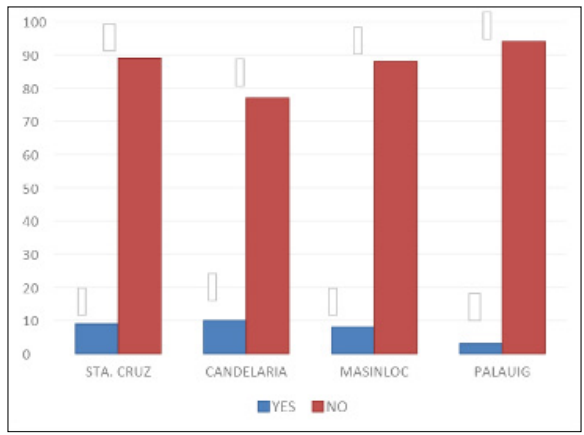


Figure 3. Respondent's perception of the occurrence of changes in mangroves in the four municipalities

Reasons of Changes in Mangrove Ecosystem

Figure 4 illustrates the reasons for the occurrence of changes in the mangrove ecosystem in the four coastal municipalities as perceived by the respondents. The mangrove ecosystem in the coastal areas was mainly affected by strong typhoons and waves, whereas storm surge was disregarded as a cause of change in the mangrove ecosystem. Therefore, residents of the area ignored the concept of storm surge because their area was not mainly affected by the

incident. Moreover, 50% of the respondents also considered human-made activities harmful to the ecosystem, such as cutting mangrove trees.

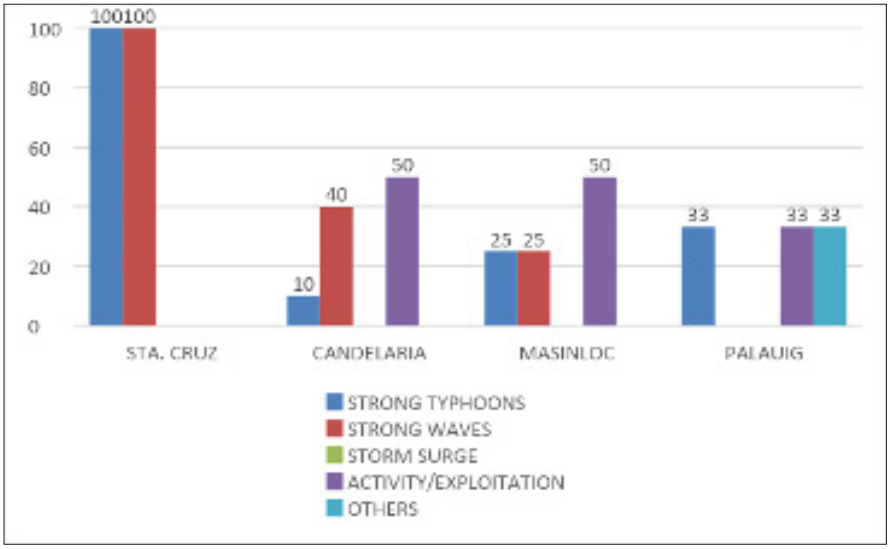


Figure 4. Reasons of changes that happened in mangrove ecosystems in the four municipalities as perceived by the respondents.

Respondents' Perception on the Seagrass Ecosystems Changes in the Four Municipalities

The majority of the respondents in the three coastal municipalities, such as Masinloc, Palauig, and Candelaria, alleged that there were no changes in the seagrass ecosystems in their areas (Figure 5). Conversely, 60% of the fisher folks from Sta. Cruz answered that the seagrass ecosystems in their area had changed a lot. Sta. Cruz residents observed that the seagrass population in their area is already declining, so they planted seagrasses. This was based on the observations of fishers who frequently see the presence of the various fish species for this ecosystem acts as a breeding ground for many marine organisms.

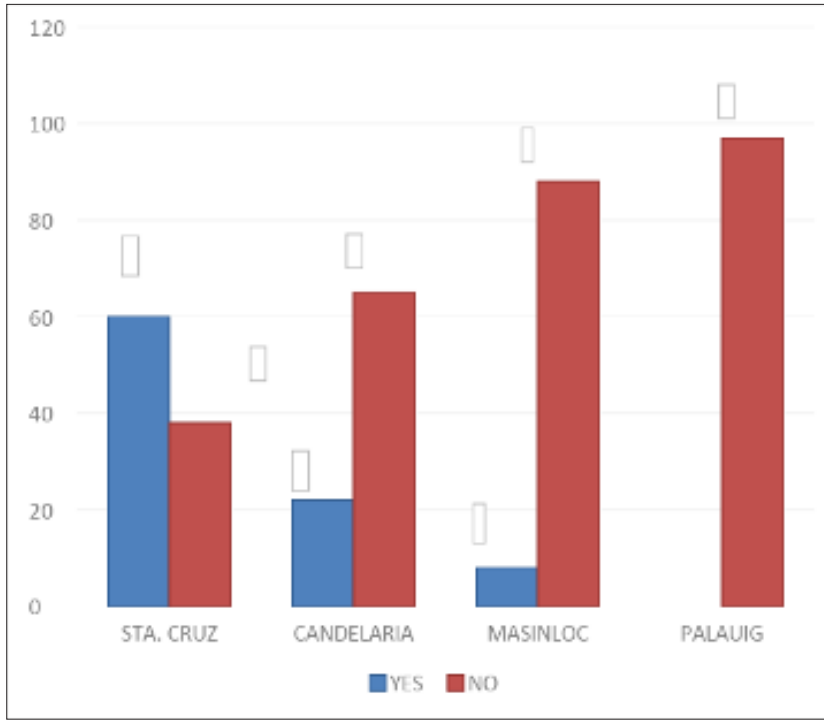


Figure 5. Respondent's perception on the occurrence of changes in seagrass ecosystems in the four municipalities

Reasons of Changes in Seagrass Ecosystem

Parallel to mangrove ecosystems, strong typhoons and waves were the major causes of destruction and changes in seagrass ecosystems as perceived by 100% of the respondents (Figure 6). But, according to the majority of the respondents from Sta. Cruz (77%) and Masinloc (75%) human activities such as dynamite fishing and mining destroy the seagrass ecosystems. These observations corroborate with the studies of Paz-Alberto et al. (2015), where results indicated that seagrasses in Candelaria and Masinloc had low diversity and the sediments were contaminated with lead and chromium, while the results of the study of Espiritu and Paz-Alberto (2018) showed that seagrass ecosystems in Sta. Cruz, mainly the seagrass sediments were contaminated with nickel. However, due to these problems, the local government released an ordinance prohibiting any resident from using and harvesting seagrass species.

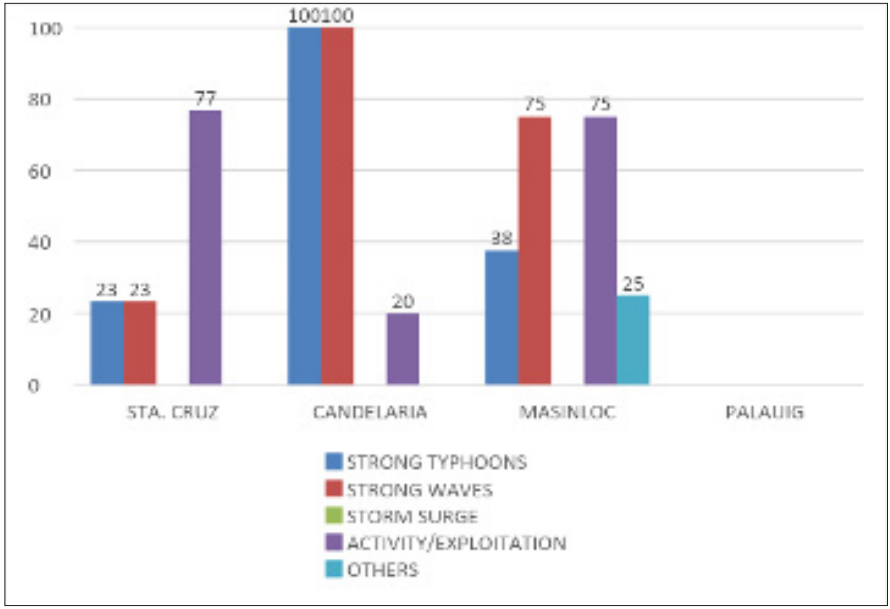


Figure 6. Reasons of changes that happened in seagrass ecosystems in the four municipalities as perceived by the respondents

Perception on Fish Population Changes in the Four Municipalities

Figure 7 shows the respondents' perception of the change of fish population in the four municipalities—the majority of the respondents of Sta. Cruz and Masinloc were well aware of the decrease of the fish population with 95% and 94%, respectively, whereas Palauig fisher folks were the least observant of the decrease in fish population in their coastal areas. Respondents (63%) from Candelaria also agreed that there was already a decline in the fish population. On the other hand, almost half (47%) of the Palauig's fisher folks were not aware of the decreasing fish population. The majority of the fisher folks replied that the main reason for this event in their coastal resources was human activities.

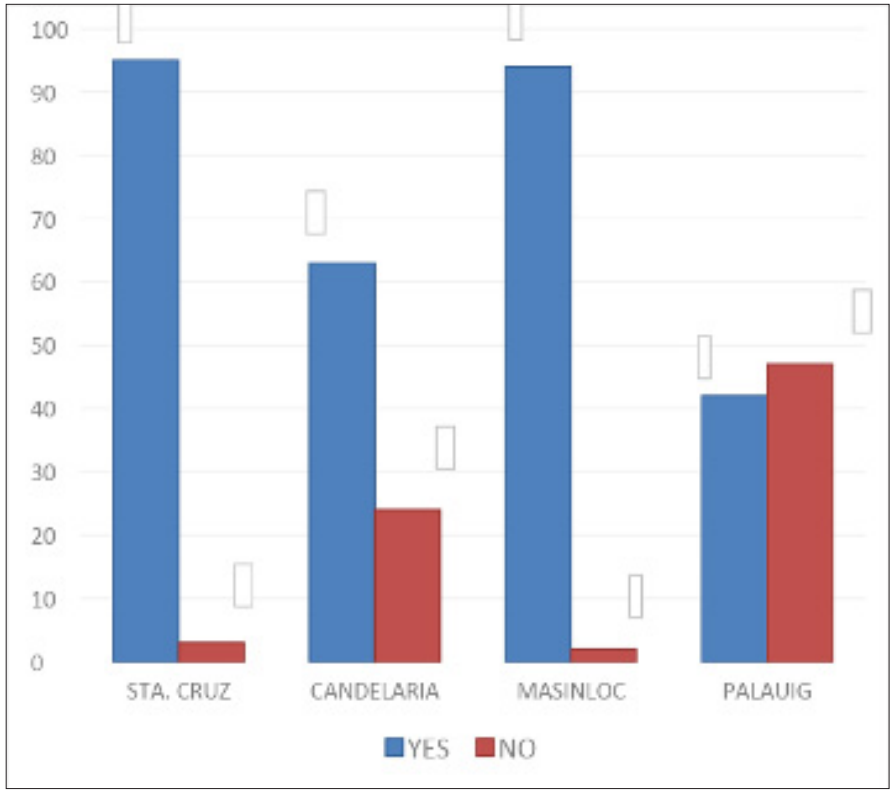


Figure 7. Respondent's perception on the occurrence of changes in fish population in the four municipalities

The fisherfolk's perceptions on the decreasing fish population are also supported by the report of NSAP-Zambales (2017) regarding the most common and top leading fish catches in the municipal and commercial waters of Zambales. Based on their report, combining the total catches of around 5,802.809 MT from municipal and commercial fisheries in Zambales in 2017, only a few types of fishes were being caught. The top ten (10) fishes that were being caught were skipjack tuna (37.57%), yellowfin tuna (29.63%), mackerel scad (10.39%), Philippine flying squid, *Nototodarus philippinensis* (5.20%), anchovy, *Encrasicholina punctifer* (1.82%), Buccaneer anchovy, *Acetes sibogae* (1.10%), rough triggerfish, *Canthidermis maculate* (1.07%), shortfin scad, *Decapterus macrosoma* (1.02%), houndfish, *Tylosurus crocodilus* (0.78%) and dark-banded fusilier, *Pterocaesio tile* (0.72%) (Table 3).

Table 3

Top 10 Leading Fish Catches in the Municipal and Commercial Water of Zambales in 2017 (NSAP-Zambales, 2017)

Fish Species	Catch (MT)
Skipjack tuna	2,180.26
Yellowfin tuna	1,719.63
Mackerel scad	602.87
Philippine flying squid	301.66
Anchovy	105.52
Buccaneer anchovy	63.80
Rough triggerfish	62.29
Shortfin scad	58.97
Houndfish	45.01
Dark-banded fusilier	42.01

Moreover, a study agreed that fish diversity and the population is decreasing in Northern Zambales. Results of this study revealed that the dominant catches covering the months of July to October 2018 and February 2019 were yellowfin tuna (*Thunnus albacares*), mackerel scad (*Decapterus macarellus*), skipjack tuna (*Katsuwonus pelamis*), Hawaiian flying squid (*Notodarus philippinensis*), and common dolphinfish (*Coryphaena hippurus*) in the municipal water. In addition, a recent study also confirmed the respondents' perception regarding the fish population decline in the four municipalities, which indicated a low population and diversity of fishes in the coral reef ecosystems of Sta. Cruz, Candelaria, and Palauig, while Masinloc had moderate diversity for the observed fishes in coral reef ecosystems (Paz-Alberto et al., 2021).

Reasons for the Fish Population Decline

Human-made exploitation such as dynamite fishing and improper fishing techniques were the primary reasons for the low diversity and the diminishing number of fish population in the coastal areas as perceived by the local fishers (Figure 8). Likewise, most of the respondents said that most of the fish thriving in their area tended to migrate and transfer to more distant areas, which hamper the fishing activities of the fishermen and make it

difficult for them to catch fish. Furthermore, the residents considered ocean acidification and increased temperature as the causes of the continuous decrease of the fish population—likewise, Sta. Cruz and Candelaria have mining operations that relatively affect fish growth and could lead to the decrease of the fish population.

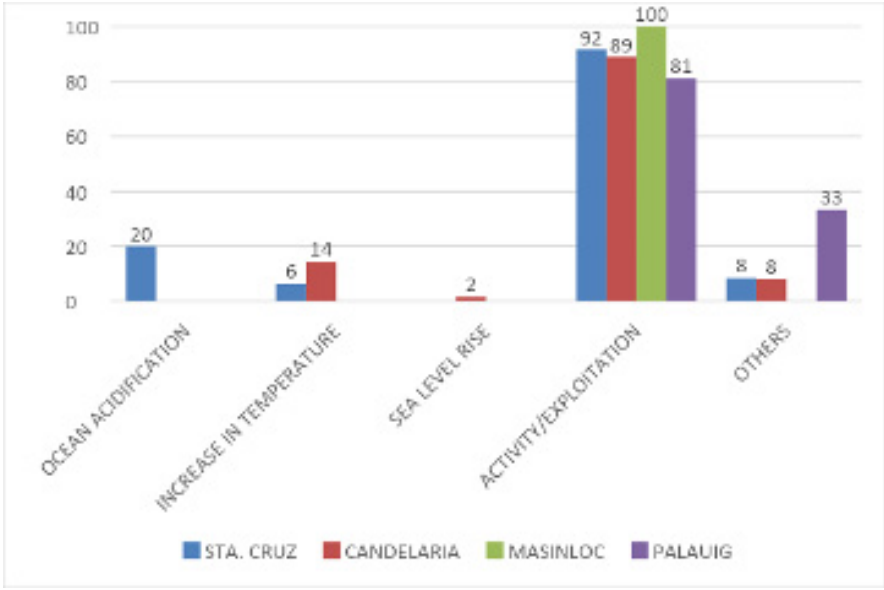


Figure 8. Reasons affecting the number of fish population in the study areas

The respondents' perceptions are supported by another study conducted by Paz-Alberto et al.(2021) about the sources of degradation of coastal resources in the four municipalities, affecting the population of fishes. Results showed that the significant sources of environmental degradation in Sta. Cruz, Zambales were mine drainage pollution and tourism or recreational development while mine tailings, sedimentation/siltation, solid wastes, and environmental, aesthetic degradation had moderate impacts. However, in Candelaria, Zambales the sources of degradation which posed major impacts on the coastal ecosystems are quarrying and dynamite fishing. This was followed by mine drainage pollution and mine tailings and soil erosion and environmental, aesthetic degradation, which had moderate impacts on the coastal ecosystem of Candelaria. Furthermore, eutrophication, dynamite fishing, oil spill, and mine drainage pollution only posed moderate impacts

on the coastal ecosystem of Masinloc, Zambales. While in Palauig, Zambales, eutrophication, dynamite fishing, oil spill, mine drainage pollution, and solid wastes significantly impacted the coastal ecosystems.

Perception on the Changes in Seashore Appearance in the Four Municipalities

Figure 9 shows the perception of residents in the four municipalities on the presence of changes in the seashore appearance. Results revealed that half of the respondents observed that there were no changes that occurred in the seashore. In contrast, less than half of the respondents replied that changes happened, particularly on the proliferation of houses near the seashore despite the local government's ordinance on the prohibition of settling near the area, which could lead to the destruction of the seashore.

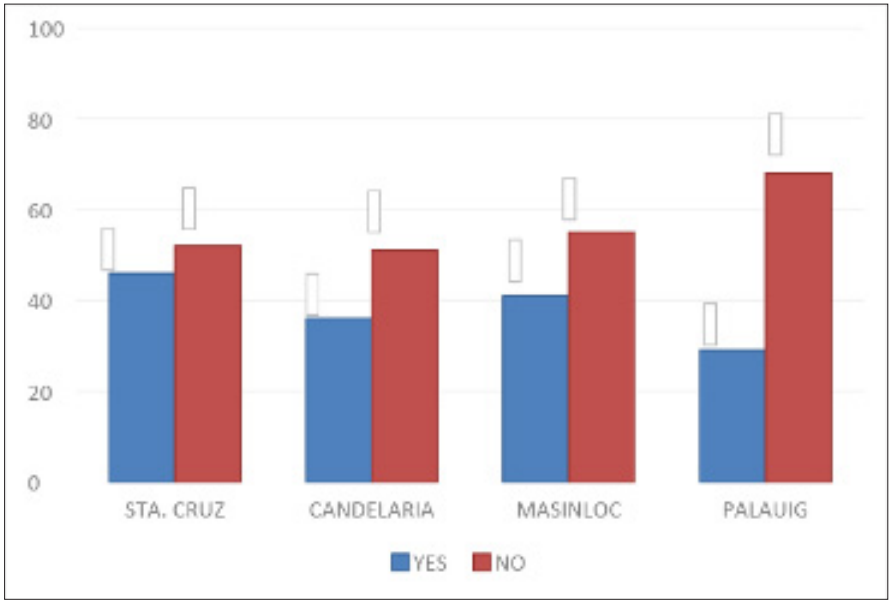


Figure 9. Respondent's perception of the occurrence of changes in the seashore appearance in the four municipalities

Causes of Changes in the Seashore Appearance

Figure 10 shows the factors affecting the aesthetic appearance of the seashore as perceived by the respondents. Results revealed that the impact of human activities and exploitation from the residents in the coastal area of the four municipalities (100%) are the main reasons for the destruction of the aesthetic appearance of the seashore. In addition, improper waste disposals and old and rotting logs from the mountains also contribute to seashore changes in the study sites. Moreover, strong waves in conjunction with strong typhoons also cause the destruction of the seashore in the area (Figure 10).

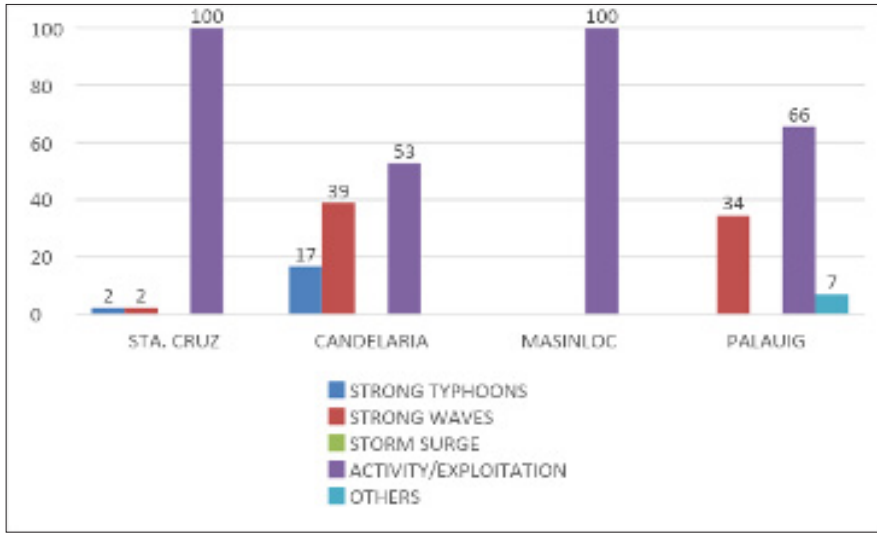


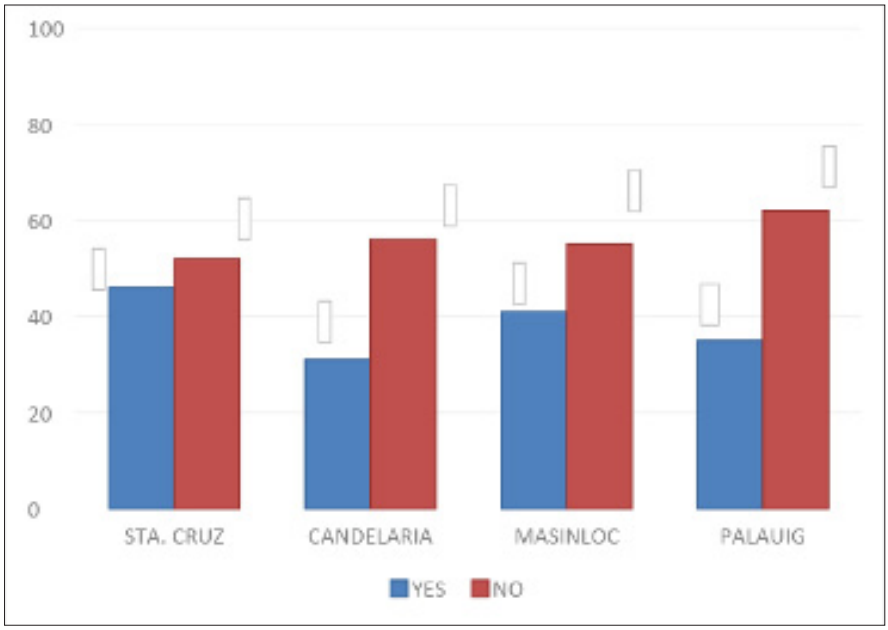
Figure 10. Causes of change in the appearance of seashore in the study areas

Perception on Coastline Changes of the Four Municipalities

An average of 38.25% of the residents of the four municipalities observed significant changes in the coastline's appearance, while around 56.25% did not see any variations (Figure 11). According to some of the respondents, major changes had happened in the aesthetic appearance of the coastline. For example, the coastlines are getting more polluted due to overpopulation and lack of discipline. Additionally, migrants from the islands of Visayas are

the most common occupants of the land along the sea of Sta. Cruz due to the increasing incidence of poverty in the Visayas.

Figure 11. Respondents' perception of the occurrence of changes in the the



coastline of the four municipalities

Causes of the Changes in Coastline Appearance

One hundred percent (100%) of the respondents regarded human activity as the leading cause and source of the problem of the changes that affect the coastline of the four coastal municipalities. Construction of houses and illegal settlements along the coastline without proper permission from the local governments is destroying the coastline's aesthetic appearance (Figure 12).

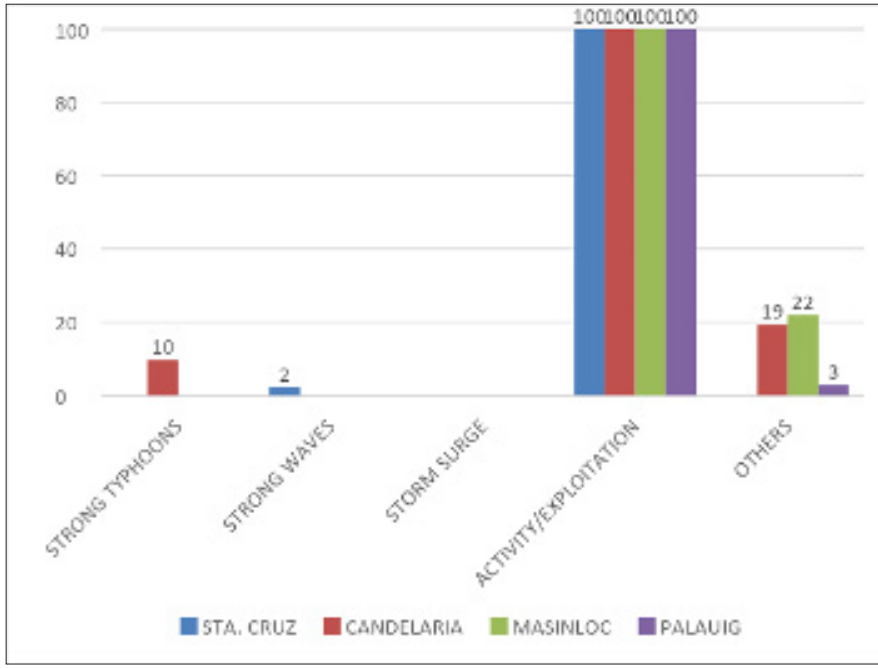


Figure 12. Causes of change in the coastline appearance of the study areas

Diminishing Coastal Resources as Perceived by Respondents

Figure 13 shows that respondents from all four municipalities perceived a dwindling number of fish populations, which confirms their perception of the change in the fish population in the four coastal municipalities, as shown in Figure 7—many fisher folks from Masinloc (79%), Candelaria (68%), Sta. Cruz (66%) and Palauig (57%) noted the decrease in the status of fishes in their areas. They observed that their catch is diminishing and may be attributed to the widespread collection and selling of *Aragan* or brown algae known to be the fish's food, deforestation of mangroves, depleted conditions of corals, illegal use of fishing gears and net techniques, and dynamite fishing. There is a divided view of the respondents from the four study areas concerning the abundance of seagrasses (Figure 14). There is an almost equal proportion of two views between those who observed the decrease of seagrass and those who did not observe the decrease of seagrasses within their areas, which corroborates their perception of the changes that occurred in seagrass ecosystems, as shown in Figure 5. However, a considerable number of unsure

or no answers were noticed, especially for Sta. Cruz (23%) and Palauig (17%) to mitigate the problem, the coastal communities of Palauig had replanted seagrasses in eight (8) hectares of land near the MPA area.

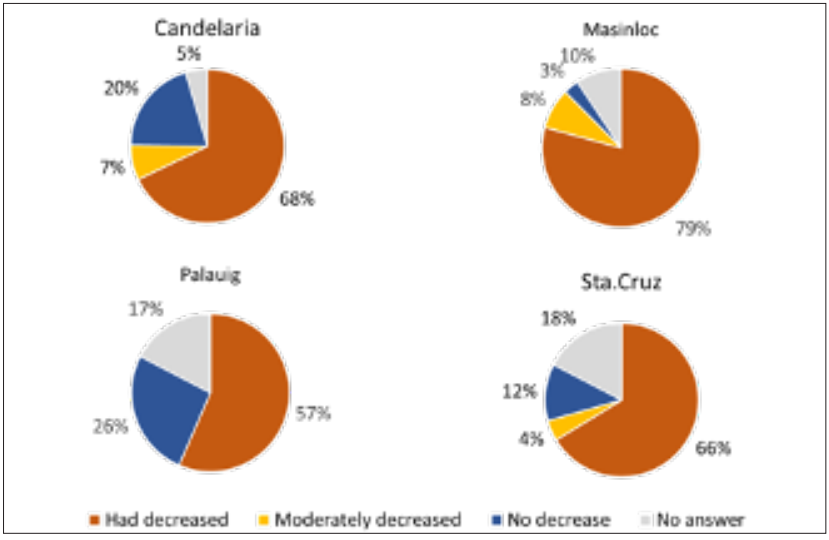


Figure 13. Perception on decreasing fish population per study area

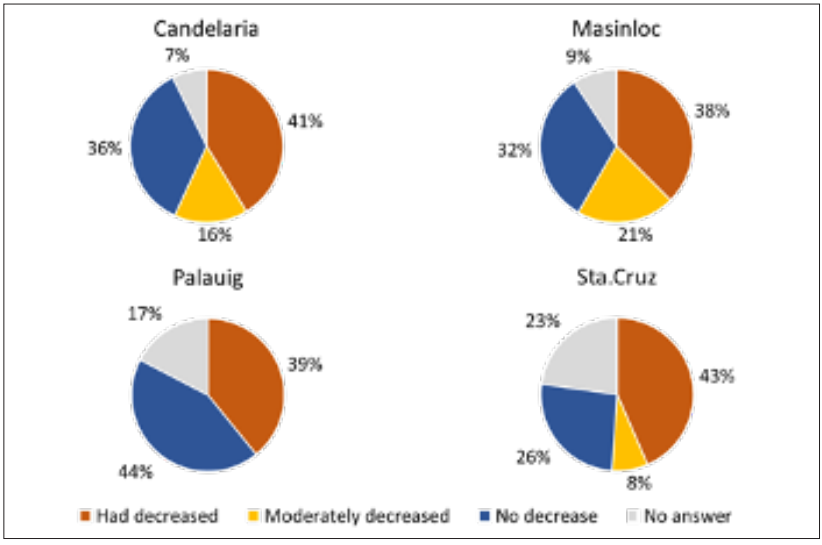


Figure 14. Perception on decreasing seagrasses per study area

Concerning mangroves, respondents from three out of four study areas observed a decrease in the abundance of mangroves within their coastal areas. Figure 15 shows that half of those interviewed (57%) in Candelaria and lower than 50% in Palauig declared no decrease in the abundance of mangroves which also corresponds to their perception of the changes in mangrove ecosystems, as shown in Figure 3. In contrast, respondents from three of the four municipalities, namely Sta. Cruz (43%), Palauig (39%), and Masinloc (38%) perceived a decrease in the abundance of mangroves within their areas. Similar observations were noticed in the condition of their corals, as shown in Figure 16. Thus, the status of the corals within these four municipalities had decreased considerably. Among the four municipalities, depleting conditions of coral reefs were observed by the respondents from Candelaria (51%), Sta. Cruz (46%), Masinloc (43%), and Palauig (35%) while moderately decreasing stages of coral reefs were seen in Palauig (43%), Candelaria (33%), Masinloc (26%), and Sta. Cruz (22%) (Figure 16).

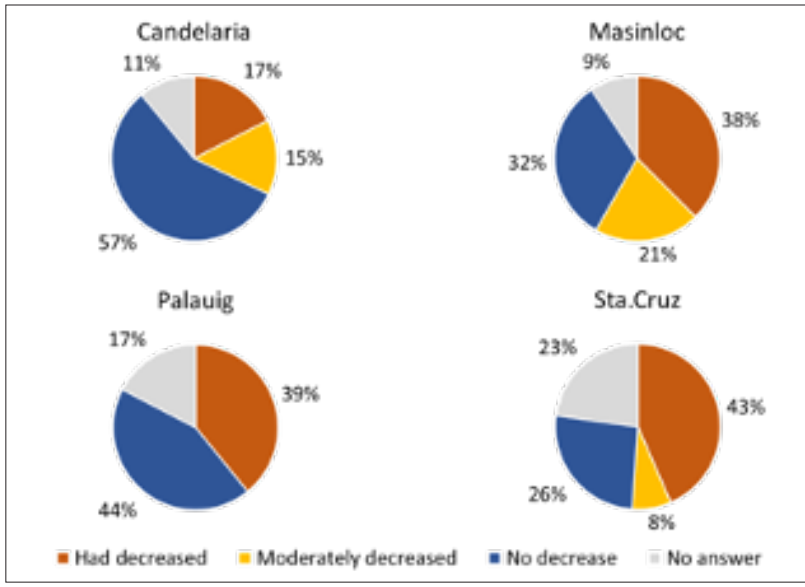


Figure 15. Perception on decreasing mangroves per study area

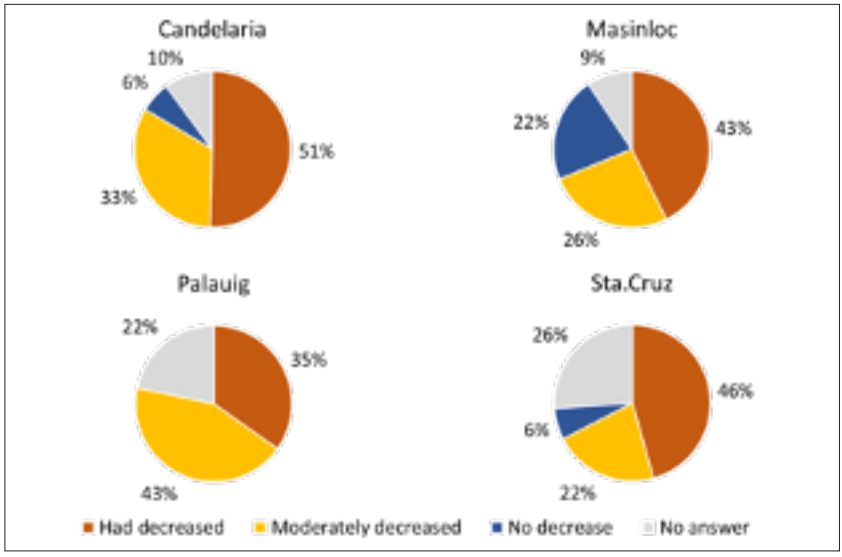


Figure 16. Perception on decreasing corals per study area

Traditional and Local Ecological Knowledge (LEK)

The study areas' traditional and local fishing practices are no longer strictly followed and adhered to by the fishers in the coastal areas in Zambales. For example, figure 17 shows that only half of those interviewed from Palauig (57%), Candelaria (55%), and Masinloc (55%), and only a few from Sta. Cruz (28%) followed and observed their old ways of fishing while some in modified ways.

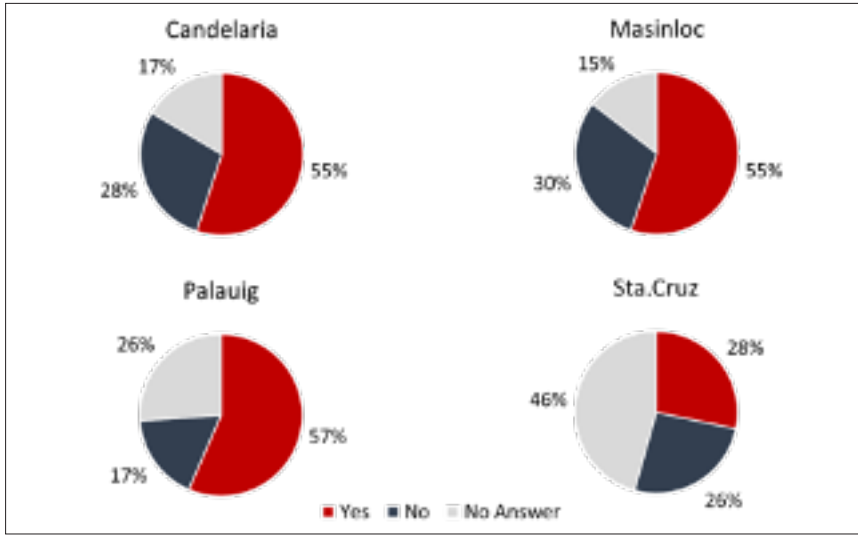


Figure 17. Adherence to the traditional fishing practice (LEK) per study area

According to Wagey et al. (2016), local fishers' indigenous ecological knowledge on the utilization of marine and coastal resources had contributed to sustainable fishing and gleaning practices. Local and indigenous ecological knowledge has been successfully passed on to several generations of fishers until recently, when fishing, as an occupation, becomes obsolete and most gears have been modified.

LEK on Fishing Practices

LEK on fishing practices was documented in the four coastal municipalities, as shown in Table 4. There were six (6) traditional fishing practices that the fisher folks in the four municipalities of Zambales are still following. Due to their long years of experience in fishing, the fishers have developed an extraordinary and uncanny way of knowing specific fish species behaviors.

LEK is essential and valuable in the fishing industry in the Philippines (Macusi et al., 2017). However, studies on fish behavior using Local Ecological Knowledge (LEK) are good complements where data is limited.

Table 4

LEK on Fishing Practices in the Four Coastal Municipalities in Zambales

Hila-hila and Kawil	• Used by some skilled fishers can determine without spotting what fish species is caught by the bait by simply determining the direction of the pull. • If the catch pulls the gear (*hila-hila*) downwards, and the pulling is strong, this is usually done by a tuna. • *Talakitok* pulls the bait (*hila*) up and down, left and right. Then, a *dorado* pulls the *hila* farther from the fishers.
Bingwit and Kawil	• Old fishers only used these baits made from specifically selected refined chicken's feather that resembles a small fish once it was submerged into the seawaters. • Old fishers poach fishes along the shoreline without using a fishing vessel. If boats are used, fishers paddle along the seashores and do not sail too far simply because fishes near the shorelines are abundant before. When motorized boats came into fashion, fishing went farther from the shoreline.
Kurong (Swing-like with cover)	• This is used when there is no ice box available. To keep the freshness of the catch, they will be tied to the side of the boat. When weighing scales were not popular, the fishes were placed in skewers based on size and shape.
Palubog	• It refers to an old technique of fishing where branches of leaves with the fine mesh of fishnets are placed below the river to catch a large number of small fishes.
Lambaklad	• It is a specific type of *"lambat"* or fishnet with a playground and bag that targets small fishes used in the open sea. They are usually set up during summer and are harvested in rainy seasons.
Singgapong	• This is a fishing gear used during February with the sporadic appearance of *"dilis"* and *"tirong"* for anchovies. This type of species thrives for 3-4 days only. Beyond this week, one has to wait for the next month to catch dilis using *singgapong*.
Other Fishing Practices	
Using lamps	• When out on a fishing expedition using a motorized boat at night, Coleman lamps used for lighting are not allowed to avoid being hit by the pointed snout of a swordfish called *"Batalay."* Once the body of a swordfish has been touched or stroked gently, it will weaken and tame.
Aragan (Brown Algae)	• It is food for fishes and is made into organic fertilizer. • However, they are also viewed as hindrances to fishing because they get stuck in the fishnets. Extraction of brown seaweeds or aragan is prohibited because they serve as refuge and hatchery for the eggs of the fishes.
Butete- fish similar to yabut-yabutan	• If its gallbladder erupts, it becomes poisonous when eaten. • These fish species are considered partners when caught: *Buto-bayog* and *Sarhento, Dumalariwan* and *Sabsabado, Taklaw* and *Padas* - small fishes caught in *"kawan"* or school of fishes.

Catching seaweeds, crabs, and squids	• Before, to catch seaweed, crabs and squids which hide inside stone holes of corals, stone beaches, and corals are crushed to get the prized species. Now, their stone habitats are no longer destroyed. Instead, collectors just use improvised sticks to pick on them.

Table 5 shows various fishing tools currently utilized by the respondents from the four municipalities of Candelaria, Masinloc, Palauig, and Sta. Cruz. Fishnets (*lambat*), fish hooks (*kawil*), lift net (*basing*) are commonly used among the respondents from the four municipalities. However, spear (*pana*) and fishing lure, bait, or jig (*bubo*) are still utilized by fishers from the municipalities of Candelaria, Masinloc, and Sta. Cruz.

Table 5

Fishing Tools Utilized Per Study Area in Zambales

Fishing tools utilized	Candelaria	Masinloc	Palauig	Sta.Cruz
Fish Net *(lambat)*	64	50	16	55
Fish hook *(kawil)*	24	19	4	7
Lift net *(basing)*	7	6	2	2
Spear *(pana)*	3	4		10
Fishing lure, bait, jig *(bubo)*	5	10		6
Others	6			3
No answer		7	1	9

Presently, the fishing practices being undertaken by the fisher folks are far more different from the traditional fishing practices. The commonly used gears for catching fishes were hook and line, squid jigger, and gillnet. However, based on the inventory of fishing gears used by the fishers in Northern Zambales in 2002, the following were the commonly utilized gears in the area: gillnet (53.91%), squid jigger (9.40%), longline (8.20%), spear gun (6.61%) and handline (5.90%) (Rueca et al., 2002). In 2017, the first five gears used in municipal water in terms of landed catch were multiple handline (29.80%), scoop net (17.87%), bagnet (16.47%), handline (12.69%), and hook and line (5.67%) (Table 6) (Yutuc et al., 2017). The municipal fishermen were spending 8-10 hours in the water to have an average catch of 49.51 kg.

Table 6

Type of Gear and Computed Catch Per Unit Effort (CPUE) of Gears Commonly Used in the Municipal Water of Zambales (NSAP-Zambales, 2017)

Gear	Landed Catch (kg)	No. of Days	CPUE (kg/day)
Multiple handline	142,869	5,318	26.87
Scoop net	85,671	3,182	26.92
Bagnet	78,961	1,493	52.89
Handline	60,832	3,709	16.40
Hook and Line	27,165	1,846	37.67
Push net	21,066	954	22.08
Jigger	14,847	515	28.83
Fish corral	14,096	56	251.71
Gillnet	9,942	389	25.56
Speargun	9,915	322	30.79
Drift gillnet	7,030	83	84.70
Multiple hook and line	5,277	426	12.39
Bottom gillnet	1,505	573	2.63
Trammel gillnet	173	4	43.25
Bottom set long line	65	5	13.00
Single handline	48	16	2.99
Long line	16	2	8.13
Fishpot	6	1	5.80

LEK on Fish Identification

Based on LEK, the fishers could identify and identify the fishes they caught in the coastal areas. (Table 7). Grounded on their long experience, the fishers stated that more fishes are caught in the aftermath of a storm because sea waters are murky or unclear. During March, the *Talakitok* and *Lapu-Lapu* are the fishes seldom caught in Zambales coastal areas.

Payao from a functionalist perspective is a traditional practice by fishermen, which promotes diversity as long as illegal dynamite fishing is not applied. This is helpful to fishers because various fishes are being caught in this practice. However, diminishing catch (50%) was observed by most

fishers due to overfishing and illegal fishing methods. Likewise, commercial fishers in Zambales stayed for an average of 36 hours in the water to have an average catch of 2,850 kg. Fishing was done using a combination of *payao* and purse seine. *Payao* is a fish aggregating device that serves as an attractant and home to pelagic fishes like tuna and tuna-like species. The aggregate of fish in the *payao* is being surrounded by purse seine to effect a catch. Results of the study were supported by Macusi et al. (2017) where they mentioned that using LEK, such as the anchored fish aggregating devices (FADs or *payao*), transformed the Philippine tuna fisheries into a million-dollar industry.

Table 7

LEK on Fish Identification

Burador and Bugihan	• *Bugihan* is female *borador* which are fatter than the male borador.
Samaral or Pitung	• Expensive type of fish species.
Tuna	• A deep-sea fish. During the day, it swims 60 feet down under
Tanigue, Dorado, Blue Marlin (Susay) and Talakitok	• Caught at daytime. • The fishing gear used to catch these species is *putong-putong* or *hila-hila* with an artificial squid as bait. • At night, they only float 20 feet below because their source of food which is the shrimp, also abound in the sea area. The fishing gear used to catch shrimps was an improvised waterproof light, hook & line gear called balikwasan dipped 20 feet below the sea surface.
Tanigue and Tuna	• Most fishers anticipate the "ber" months (October to December) because these are the months when the schools of large fishes are sighted and caught. However, the months of April and May are the months for coral fishes where fishers catch diverse fish species.
Yellow Fin Tuna or Baralyete	• Fishing or *"nagtitimbog"* is ideal for catching a yellow fin or *baralyete* if waves are large and high.
Stingray or Manta Ray (Pagi)	• When sighted jumping in the sea, large waves are expected to arrive. They served as a barometer or a warning sign for fishers not to proceed in their fishing expedition in the far seas.
Butete	• It is a type of fish which has no bones or *"tinik"* and is considered poisonous.
Talakitok and Lapu-lapu.	• They are rarely caught during March.

The local ecological knowledge is rich and varied among different communities considering their cultural, practices, and topography differences. Unfortunately, as expected, the fishers' knowledge, experiences, and traditional practices accumulated and passed on from one generation to another are infrequently considered by fishery scientists and coastal resource managers.

LEK on School of Fish

A school of fish is detected by seagulls or birds that sometimes dive in the seawater. Another way to identify a school of fish is a darkened area of the sea that looked like a cloud shadow. The occurrence of undercurrent is an additional way to find the school of fish. LEK was utilized to identify the behavior of marine organisms such as fish which was found to be important in fishing activities, particularly about attraction, retention, and departure behavior of fishes (Macusi et al., 2017).

LEK on Topography and Fishing

There are also traditional knowledge and practices documented about topography and fishing in Zambales (Table 8). Results of the study showed that the fishers were still practicing and following these traditions for their fishery resources management. In addition, typhoons, strength, and duration of the southwest monsoon (*habagat*) cloud features were also determined by the locals using LEK, which could be very helpful in their fishing activities (Wagey et al., 2016).

LEK on Predicting/Forecasting Weather Conditions Concerning Fishing Practices

Part of the local ecological knowledge is the uncanny and strange ability of the local fishers to detect bad weather by way of reading changes in wind direction, sounds, and height of waves (Table 9). The local fishers must preserve this traditional knowledge about the prediction of weather conditions for this information are very useful in the present-day situation,

especially that the Philippines is a vulnerable country to natural disasters and climate change impacts. Another scientist corroborates these findings in his study that in the Visayas region, local fishers, especially those accustomed to using the traditional gears, have developed skills to catch fish in the coastal resources amidst hardships brought about by the effects of extreme weather conditions (Wagey et al., 2016.)

Table 8

LEK on the Condition of the River and Ocean as Signs of the Presence of Fish in the Coastal Areas

Mouth of the River	
From December to January, the mouth of the river is silted with sand from the ocean.	• The mouth of the river, covered with sand, is brought about by the waves. As a result, an instant lake is formed. • This is the time when fishes and shrimps become abundant because they thrive in warm water. • The more the water within the river's mouth gets hotter due to the downflow of water from the mountains, the more shrimps tend to pool into the shallow area.
Low Tide Season	• Desiltation and the dredging of the water canal are scheduled during the low tide season to facilitate the release of warm water from the river's mouth. • Desiltation of the mouth of the river is done to reduce the water temperature, thereby reducing fishkill. • To catch shrimps, the fishers consider the low tide season as the best time. They go with the flow of the water where the traps with "housing" are strategically located.
Water Current	
If the water current from the north meets south	• This is believed to affect fish behavior. They tend to migrate to some other areas. Thus, fish catch is low because water becomes murky.

Table 9

LEK on Predicting/Forecasting the Weather Conditions to Fishery Resources and Fishing Practices in the Coastal Municipalities in Zambales

• If the force and sound of the waves are strong • If the sea turns foamy • If the wind from the north turns strong and if clouds move fast and turn dark	• A storm is expected to come. • Warning signs for not going out fishing
• If seagrasses stand erected • If seagrasses lie down flat on the sea bed	• On-set of the southwest monsoon (Habagat) in May • The weather is good for fishing
• If the sound known as "Balkak" can be heard from the mouth of the river	• Indication of bad weather condition
• The sighting of a smooth white fish called "Taburdik" in the sea	• It forewarns fishers of bad weather condition

LEK on Lunar Forecasting Concerning Fishing Practices

Table 10 shows the Local Ecological Knowledge (LEK) of fishers in the four selected coastal municipalities of Zambales on lunar forecasting with fishing practices and fishery resources in Zambales. Once again, the skills and talents in recognizing the moon's appearance, stages, and shapes are quite extraordinary. That is why this knowledge and information must be well-preserved and passed on to the younger generation.

Table 10

LEK on Lunar Forecasting about Fishery Resources in the Four Coastal Municipalities of Zambales

Moon and Squids	
Full Moon and New Moon	• Fishers don't fish squids; the best period to catch squids is when the moon is hidden for 9 to 10 days or two weeks.
Kiw-kiw or Pasiwasiw	• This is a fishing gear used to catch squids.
Jetplane Squids	• It is the most expensive and large type of squid due to its soft and juicy meat. This type of squid is usually collected at night when the moon is hiding. It is the hardest to catch squid species to catch because it is susceptible to sound and noise. Therefore, one has to exercise extreme caution when catching them.

Quarter Moon and Full Moon	
Quarter Moon and Full Moon	• Fishing offshore is avoided because storms or bad weather are expected to occur. • Huge waves appear due to the strong winds from the North. • Very few fishes are caught during the quarter and full moon because fishes hide or hibernate during this period.
New Moon Phase	• The following fish species are caught: *matang baka, bulan bulan* (*buwan buwan*), *dilis at tirong* (anchovies), tuna or *barilyete, sapsap, tanigue, alumahan.* • Red squids and *borador* (flying fish) are used as bait to catch deep sea fishes/big fishes like tuna and *tanigue.* • Blue Marlin (*Susay*), *Dorado* and *Batalay* (Sword fish) known as floating fishes are also caught during this season wherein fishes tend to swim along the shoreline. • Once the moon clears or gets brighter and is approaching the quarter moon, the following fish species are caught: tuna, rainbow-colored tail salmon, *talakitok*, white squids noted as one of the most expensive species that require the use of artificial bait called *"hulang-hulang"* to catch this species). • Fishers do not fish for *Singgapong* (anchovies or dilis) when on a full moon. Instead, they go out fishing for *singgapong* when the moon hides; the school of *singgapong* goes out and plays.
Moon and Its Ring	
Kubkob-Ring around the moon	• If the ring around the moon is dark, rains are expected to come. • If the ring around the moon has a smoke-like appearance, strong winds are expected to come. • If the ring shows a bluish effect, the extreme dry season is in the offing.

In the same study conducted by Wagey et al. (2016), local fishers in the Visayas region also practiced and used LEK in weather and lunar forecasting to determine disturbances in their fishing activities.

LEK on Rare and Diminishing Catch

Fish species that are seldom sighted and caught nowadays include *Tamban*, rainbow-tailed salmon, and *Bonitilyo* (a small type of bonito). Between the 1970s to 1980s, large crustaceans or *alimasag* were no longer caught offshore but along the shorelines only. *Banak* and *tabios* are known for their delicious type of fish but are rare to catch nowadays because they are sighted only from September to December. The *"bia/palya"* and *bunog* are believed to be the parent stocks of *banak* and *tabios*. The river currents draw their eggs into the sea where they are hatched. Once the fishes can swim, they go back to the river.

In various studies conducted on the relationship of LEK to fish catch, only the temporal and spatial patterns of fishery resource distribution are common. Furthermore, results showed that the integration of conventional fishing approaches with experiences accrued by fishers revealed a significant influence of seasonal and spatial dynamics of marine environmental factors, which caused higher fishing pressure in shallow and usually more deficient waters. Results also indicated the importance of having direct on-board observation not only to produce more realistic and detailed data but also as a way to confirm the factors that hamper fishing operations. Once established, the accuracy of LEK may be used to gather a set of reliable information for fisheries management through well-structured interviews capable of quickly revealing ecological patterns of target species. Therefore, translating LEK into an accessible language to scientists is also an important step to achieve its integration into management and provide a more holistic and more realistic understanding of fishing. Specifically, the fishing patterns observed in areas less exploited due to environmental limitations are essential in fishing zone selection for the management of fishing bottom set gillnet and prevent the emergence of ghost nets caused by the loss of nets seabed that continue killing marine organisms indefinitely. These patterns need to be further investigated by joining fishers and landing observations over large spatial and temporal scales. Besides, additional research should use LEK to identify other environmental limiting factors on fishing effort and production used as stepping stones to management. The results also confirmed that fishers detain an essential body of knowledge that could support faster and more affordable management initiatives. Moreover, fishers could certainly contribute with additional information where there are no official statistics. As science advances, it becomes clearer that fishers can enhance our understanding of marine ecosystem dynamics and of fisheries in general, which is not easily or cheaply achieved solely by conventional approaches (Pinheiro et al., 2017).

LEK on Mangrove Resources

Table 11 shows the LEK about the presence and abundance of organisms in mangrove ecosystems. Mangrove ecosystem also provides important ecological and economic services in the fishery resources and management in the coastal ecosystems of Zambales.

Table 11

LEK on the Presence and Abundance of Organisms in Mangrove Ecosystems

Invertebrates (Crustaceans, gastropods, Univalves, and Bivalves)	• Diverse fish or aquatic species are collected from mangrove forests such as shrimps, *alimunga, laguy-laguy, bagsang, giwoy, kopoy-kopoy* (white clam shells), *tubing-tubing, lokan* (white clam shells bigger than *kopoy-kopoy*).
Crabs	• Usually found in between the holes of the mangroves. Fishers have this special skill of determining whether there are crabs inside the holes by listening to the sounds emitted from the holes. • The crab trap or tapangan, which is made out of bamboo, is used to catch crabs. The right timing to catch is during high tide. Crabs get out of their hiding place in these holes, searching for food when the weather cools down. • *Dulag* is one type of mangrove eaten by crabs.
Lukaw	• Collecting shells (*Lukaw*) – a small clam or kabibe. Local folks have the skill of picking on them if the lips are slightly opened, and bubbles are sighted out of the clam's lips.
Teyaila	• *Teyaila* is likewise collected from mangroves along with the land area. *Teyaila* hides in holes covered with a mound of earthworms' waste. *Teyaila* resembles a shrimp with an oversized head and pincers (claws).

LEK on Biodiversity Conservation

Results revealed some local ecological knowledge about biodiversity conservation practiced by the fishers in the coastal areas of Candelaria, Masinloc, Paluig, and Sta. Cruz (Table 12) but assessing these documented practices being done by the local fishers, most of these are current practices that need to be implemented by them for these are included in the fishery and environmental laws and policies.

Table 12

LEK on Biodiversity Conservation in Coastal Resources

Fishing Practices	• Small fishes are released back to the sea if caught. • Prohibit dynamite fishing or *buli-buli* • Avoid using fine-meshed nets • Inhibit oneself from doing illegal fishing practices • Heighten vigilance against illegal fishing • Prohibit fishing inside the sanctuary

Biodiversity Conservation Efforts	• Get involved in any organization or *Bantay Dagat* with advocacy on marine life conservation. • Assist in the construction of *rama* or artificial reefs • Forbid throwing of garbage or wastes into the sea and river. • Participate in the clean-up activities of the rivers and coastlines • Prohibits bio-prospecting, live fish collection, brown seaweeds or *aragan* extraction, and other sediments and pebble materials for aquarium near the Sanctuary area.

Findings of this study indicated that the local ecological knowledge (LEK) in fishing practices and coastal and fishery resources in the coastal municipalities of Zambales are now very scarce, and only a few fishermen are familiar and well informed of this traditional knowledge. Furthermore, it seems that these practices are already being modified, revised, and converted by the younger generation of fishers. However, these knowledge systems and practices are at an escalating rate of deterioration due to consistent assimilation and integration of various information that resulted from the continuing loss of interest in these practices from young fisher folks. In addition, many communities face tremendous cultural, economic, and environmental changes, contributing to the decline and eventual loss of their local knowledge base. In the face of profound and ongoing environmental changes, cultural and biological diversity and the coastal and fishery resources are likely to be severely impacted, and local resilience capacities from this loss of traditional and local ecological knowledge.

LEK is very imperative in the fishing practices of fisher folks, for fishing serves as their main livelihood and important for coastal and fishery resources management. LEK presents many options to governments, scientists, practitioners, and local communities to approach different management practices in coastal and fishery resources. Traditional knowledge is essential and crucial in planning for community development, indicating that traditional knowledge can be used as a planning tool by local communities (Mutasa, 2015). LEK provides information, awareness, and discernment that match science and environmental observations, which can also give a complete understanding of the interrelationships of the various components of the ecosystem/ environment, natural resources, and culture, including the human interaction among these constituents (Galloway-McLean, 2010; Nakashima et al., 2012; Tauli-Corpuz et al., 2009; Cook et al., 2014). Likewise, LEK is important for the information that can be transmitted to other

communities with related sites and conditions (Shaw et al., 2008). It involves community participation and empowers local communities. Also, it provides valuable information and knowledge about the local situations; its non-formal means of dissemination and broadcasting can serve as a model for learning about coastal and fishery management, which is crucial in Zambales coastal resources.

Moreover, the local knowledge and information developed through local community experiences over centuries passed orally from generation to generation were an important catalyst to sustainable development due to their direct connection to resource management and conservation (Donato-Kinomis, 2016). Thus, empirical evidence to showcase the importance of environmental protection and cultural preservation is encouraged. Likewise, studies connecting these indigenous knowledge and practices to the academic curriculum are highly regarded as influential in their preservation. Hence, if LEK is an information source of species, ecosystems, and practices held by ancestral cultures that interact with ecosystems for their benefit and livelihood daily, over long periods (Berkes et al., 2000), then LEK can potentially be a tool for coastal resources and fishery resources management and biodiversity conservation. This can also inform scientific approaches to management, either as a source of baseline data to fill information gaps that cannot otherwise be addressed or to provide alternative management approaches from which scientists and managers might learn (Schafer & Reis, 2008; Rist et al., 2010).

Moreover, fishers with intimate ecological knowledge of local conditions can appreciate the problems associated with overexploitation and are likely to feel that the resource should be managed for sustained harvest rather than for short-term gain (Ostrom, 2009). Accordingly, LEK could be a potential holistic management tool and approach in dealing with coastal resources and fishery resources management (Berkes et al., 2000, 2001). Therefore, LEK involvement and influence on coastal and fishery resources management must be observed more keenly and profoundly and with founded focus and attentiveness.

CONCLUSION

There was already a decrease in fish population in the coastal and fishery resources as perceived by most fishers in the coastal areas of Zambales. There

were no changes in the mangrove and seagrass ecosystems, but less than half of them observed that the seashore and coastline aesthetic appearances had been destroyed. Most of them alleged that the main reasons for these problems are human activities and overexploitation.

The local ecological knowledge (LEK) is still rich and varied among the different coastal communities considering their differences in culture, practices, and topography. The coastal fisheries considered LEK as very essential in their fishing practices. Thus, most of the documented LEK and information were focused on fishing practices and ways to look, find and catch fish and other marine organisms in coastal and fishery resources for fishing serve as their main livelihood and vital for their fishery resource management. Local Ecological Knowledge (LEK) in fishing practices and coastal and fishery resources in the four municipalities in Zambales are scarce, and only a few fishermen are familiar and well informed of this traditional knowledge. It seems that these practices are now being modified, revised, and converted by the younger generation of fishers. These traditional knowledge, systems, and practices are at intensifying rates of decline due to the continuing loss of interest of the young fisher folks.

In the face of profound and ongoing environmental changes, cultural and biological diversity and the coastal and fishery resources are likely to be severely impacted as well as local resilience capacities from this loss of traditional and local ecological knowledge. Hence, if LEK will continue to be harnessed, adapted, and practiced by the local fishers in the coastal areas, this could be a potential holistic management tool in conserving fishery and coastal resources in the changing environmental conditions.

RECOMMENDATIONS

The following are the recommendations deduced from the results: a) promote and utilize LEK related to coastal and fishery resources conservation and for marine protected area (MPA) management; b) strengthen inter-agencies joint efforts for coastal resource management; c) establish community-based coastal marshals along with coastal communities as an auxiliary force to reinforce the Bantay Dagat against illegal fishing; d) work for the regeneration of disturbed coastal ecosystems; e) conduct massive IEC campaign drive with Marine Biodiversity Conservation and preservation of

LEK about coastal and fishery resources management; f) increase capacity building of the MPA team on MPA management and provide continuous incentives to the MPA team; g) strict enforcement of "No fishing zone," "No Take Zone" and "For Your Eyes Only" inside the MPA.

It is further recommended that fishery scientists and conservationists consider local ecological knowledge (LEK) in coastal resource management, local conservation efforts, and policy formulation.

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