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Understanding Local Perspectives on Climate Change and Its Impacts on Small-Scale Fishing Communities in Honda Bay, Palawan, Philippines

Lokalne perspektywy dotyczące zmian klimatycznych
i ich wpływu na małe społeczności rybackie w zatoce Honda na Palawanie na Filipinach

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Abstract: Climate change's adverse impacts are already evident, particularly in coastal areas. However, local perception that is essential in formulating policies for mitigating its impacts remains limited. Thus, this study evaluated the level of perception of small fishing communities on climate change and its impacts on livelihood and the environment. The data were obtained using a face-to-face survey with the aid of a structured questionnaire. They were interpreted and analyzed using the Likert point scale, descriptive statistics, and chi-square. A total of 308 male fisherfolks participated in the survey. Majority belong to age 51-60 years old (38%) and 61 years old and above (32%). Most of them (65%) finished elementary and generally (94%) rely on fishing for main source of living. As for income, 47% earned an estimated monthly income of Php 2,501-5,000 and 28% got Php 5,001-7,500. Most of the respondents are full-time fishers (89%) for more than 11 years (87%), and fishing within the municipal water (92%). Majority (90%) have an idea about climate change as reflected by their very high score in Likert Perception (24.3±2.3%). The climate change impacts perceived by the respondents include: increasing sea surface temperature (87%); fish are sensitive to changing climate (87%); and fossil fuel consumption contributes to climate change (84%). They said they got the information from TV/ Radio (99%) and social media (10%). The age (p-value < 0.0032) and source of information (p-value < 0.0348) are among the variables with significant relationship to the perception of respondents on climate change impacts. In total, it appears that majority of fishers are aware of the impacts of climates. It is suggested that effective management actions, such as emergency preparedness schemes and livelihood diversification should be explored to address the specific needs of fishing communities that are vulnerable to the impacts of climate change. Furthermore, an ecosystem-based approach that focuses on socio-economic dynamics and climate-induced changes in assessments and management is essential for the sustainable use of fisheries resources amidst the changing climate.

Keywords: coastal communities, environmental impacts, community resilience, adaptation strategies, vulnerability assessment

Streszczenie: Niekorzystne skutki zmian klimatycznych są obecnie powszechnie widoczne, ale w stopniu szczególnym uwidaczniają się na terenach przybrzeżnych. Wydaje się, że w ocenie tych zmian nadal brakuje perspektywy lokalnej, która jest konieczna dla wypracowania skutecznych działań mitygujących degradację środowiska. Niniejsze badanie przedstawia poziom postrzegania zmian klimatycznych przez małe społeczności rybackie, a także wpływ tych zmian na źródła utrzymania ludności oraz na środowisko naturalne. Dane uzyskano metodą bezpośredniego badania ankietowego przy pomocy ustrukturyzowanego kwestionariusza. Do interpretacji i analizy wykorzystano skalę punktową Likerta, statystykę opisową oraz chi-kwadrat Pearsona. W badaniu wzięło udział ogółem 308 mężczyzn. Największą grupę stanowiły osoby w wieku 51-60 lat (38%) oraz 61 lat i powyżej (32%). Większość z nich, tj. 65% ma wykształcenie podstawowe, a 94% podało rybołówstwo jako główne źródło utrzymania. 47% uzyskuje szacunkowo 2501–5000 Php dochodu miesięcznie, a 28% średnio między 5001, a 7500 Php. Przeważająca część respondentów to rybacy pracujący w pełnym wymiarze czasu pracy (89%) ze stażem powyżej 11 lat (87%), łowiący na wodach miejskich (92%). Większość (90%) wykazuje świadomość zmian klimatycznych, co znalazło odzwierciedlenie w wysokim wyniku w percepcji Likerta (24,3±2,3%). Skutki zmian klimatycznych dostrzegane przez respondentów to: rosnąca temperatura powierzchni morza (87%); wrażliwość ryb na zmianę klimatu (87%); przekonanie o wpływie korzystania z paliw kopalnych na zmianę klimatu (84%). Jako źródło informacji w tym zakresie, respondenci wskazali telewizję/radio (99%) oraz media społecznościowe (10%). Wiek (wartość $p < 0,0032$) i źródło informacji (wartość $p < 0,0348$) należą do zmiennych mających istotny związek z postrzeganiem przez respondentów skutków zmian klimatycznych. Ogólnie rzecz biorąc, większość rybaków jest świadoma konsekwencji zmian klimatycznych. Wydaje się konieczne przygotowanie planów zarządzania kryzysowego, takich jak programy gotowości na wypadek sytuacji kryzysowych oraz zmierzających ku dywersyfikacji źródeł dochodu mieszkańców, w celu zaspokojenia szczególnych potrzeb społeczności rybackich, które są narażone na skutki zmian klimatycznych. Ponadto, zasadnicze znaczenie dla zrównoważonego wykorzystania zasobów rybnych w warunkach zmieniającego się klimatu ma podejście ekosystemowe, które w ocenach i zarządzaniu koncentruje się na dynamice społeczno-gospodarczej oraz na zmianach wywołanych klimatem.

Słowa kluczowe: społeczności przybrzeżne, wpływ na środowisko, odporność społeczności, strategie adaptacyjne, ocena podatności

Introduction

Climate change is the permanent alteration on the local, regional or global temperature and weather pattern caused by greenhouse gases (Shivanna 2022). It poses a significant threat to the biophysical and socio-economic environments (Tiyo et al. 2015), impacting the environment and human populations (Salagrama 2012). Marine and coastal ecosystems are regarded as the most sensitive environment to climate change processes, including ocean warming and sea-level rise (McField 2017), which directly influence the lives and livelihoods of coastal fishers (Salagrama 2012; Kumar et al. 2021). Fisheries are generally reliant on the productivity of aquatic ecosystems. It supports the livelihoods and food security of over 500 million people

worldwide (Béné et al. 2016; Samieri et al. 2018). It plays an essential role in the food supply, nutrition, and revenue production at all levels (Mohammed and Uraguchi 2013; Cochrane et al. 2019), particularly within the small-scale fisheries (SSFs) that contribute to food security and poverty alleviation (Nthane 2015). In addition, SSFs support the livelihoods of vulnerable and marginalized coastal communities and help ensure food security by making fisheries resources available to low-income individuals (Wiebe et al. 2019). Most SSFs are in tropical developing countries like Africa and Asia and due to their remote location, SSFs heavily rely on fishing as their primary source of income and employment, as alternative livelihood is scarce in the area (Béné et al. 2007). However, aquatic ecosystems are sensitive to the impacts of climate change, and such could impair fisheries productivity, especially the SSFs, which are one of the most impacted sectors by climate change (FAO 2020).

The present engagement with climate change and its implications on fisheries and fishing communities has a significant disadvantage. The predominant focus on technical studies in fisheries management has led to an inadequate consideration of the perspectives and recommendations of fishing communities (Salagrama 2012). This lack of attention to the knowledge and expertise of fishing communities has restricted the development of comprehensive policies and strategies that consider the social and economic aspects of sustainable fisheries management. Consequently, there is a need to address this knowledge gap by incorporating the unique perspectives of fishing communities, which can contribute to a more holistic approach to fisheries management (Macusi et al. 2021).

Perceptions of small-scale fisheries on the impact of climate change have been documented on a global scale. However, such information is still limited in the Philippines (Macusi et al. 2020; 2021). In Palawan, the same is still needed although a study on risk perceptions of SSFs and other sectors on climate change impacts has been done in some coastal municipalities (Alcantara et al. 2023). Hence, to provide further understanding of the perception of SSFs on climate change impacts, this study was conducted in a fishing community in Puerto Princesa City, Philippines. Specifically, this study aims to determine the perception of small-scale fishers on the impacts of climate change. Their socio-demographic profile including fishing experiences and livelihood activities were also determined.

1. Materials and Methods

1.1. Study Sites

The study was conducted in Purok Honda Bay, Barangay (Brgy.) Sta. Lourdes and Purok Aplaya, Brgy. Tagburos, Puerto Princesa City, Philippines (Figure 1). These Barangays were located within Honda Bay, one of the most important fishing grounds in the area (Gonzales 2004). Honda Bay is connected to the nearshore ecological system of the larger Sulu Sea marine ecosystem (Sandalo 1994; Gonzales 2003). It has approximately 280 km^2 of potential fishing ground surrounded by coral reefs, seagrass beds, mangrove swamps, and algal flats about 100 km along the northeast section (Gonzales 2004). Most of the residents are into fishing activities such as capture fisheries, aquaculture (e.g. seaweed farming, lobster farming), and post-harvest (e.g. marinated butterfly Siganid fillet) (Gonzales 2003, 2004; Ramos et al. 2009). It is also a popular tourism destination that provides alternative livelihood among coastal residents within Honda Bay.

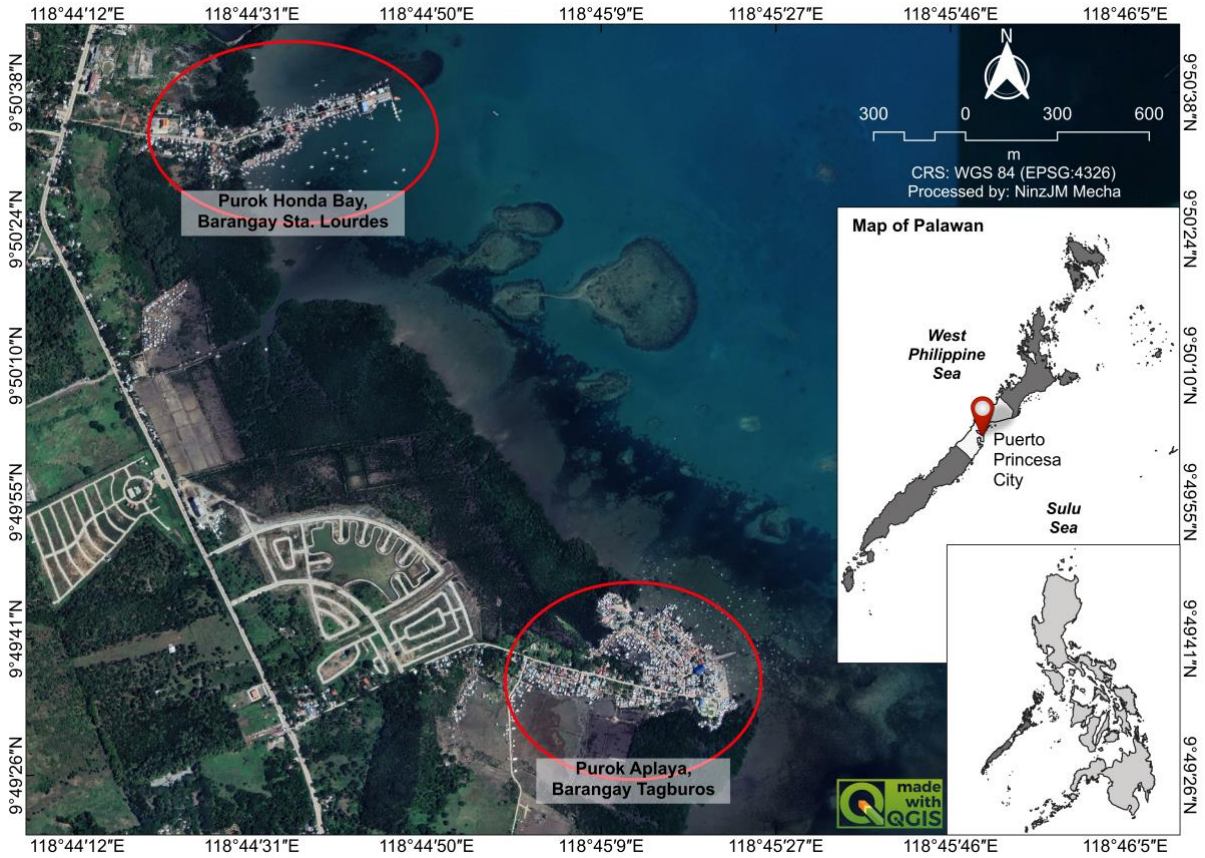

Figure 1. The two coastal barangays in Puerto Princesa City as the sampling sites of the study.

1.2. Respondents and Data Collection

The data were collected through assisted interviews using Google Forms on May 19-22, 2022. The questionnaire was tested and verified before the interview. The snowball method sampling technique was used to identify the target respondents and minimize direct contact with other respondents due to security measures during the COVID-19 pandemic. Based on the 2013 Census, there are 1,300 fishermen living in the coast of Honda Bay (Candelario et al. 2018). A total of 306 small-scale fishers were participated and selected as they are the ones who have first-hand experience with the changes in the coastal areas from the impact of climate change. The data collected include the respondents' socio-demographic profile as well as their educational attainment of household members, fishing experience, livelihood activities, and their perception of the impacts of climate change.

1.3. Data Analysis

The data gathered were encoded and analyzed using different statistical tools in Microsoft Excel. Qualitative analysis and interpretation of the data were done using frequency distributions and percentage measurements. Likert Point Scaling was used to assess the qualitative knowledge of climate and ecosystem changes. Responses were assigned numerical values, and the weighted average score was calculated based on those values. The level of perception of climate and changes in the ecosystems of respondents was calculated based on the following range: 1-7.5 = Low, 7.6-15.0 = Moderate, 15.1-22.5 = High, and 22.6-30.0 = Very High. Pearson's chi-squared test was used to compare the relationship of the perception of respondents to the selected variables from climate change impacts at a significance level of 0.05.

2. Results and Discussion

2.1. Socio-Demographic Profile

All respondents were male (100%) with the majority belonging to ages between 51 to 60 years old (38%) and 61 years old and above (32%), of which many (65%) have completed elementary education (Figure 2). These findings are similar in Cote d'Ivoire, West Africa where males are also dominant respondent fishers under 30 to 59 years old (Amoutchi et al. 2021). That indicates that males between the ages of 30 to >60 years old are the main players in fisheries in the coastal area (Diouf et al. 2020; Alam and Mallick 2021). In addition, the dependence of most

respondents on fishing as a source of income was correlated with their low educational attainment, resulting in monthly income that belongs to the poor cluster under the low-income class (Divina 2024).

Most of the respondents have a monthly income ranging from PhP 2,501 to 5,000 (47%) and PhP 5,001 to 7,500 (28%), which they derived from fishing (94%) and a combination of fishing and tourism (5%) and fishing, tourism, and retirement benefits (5%; Figure 2). This further showed that the majority are living below poverty. The Philippine Statistics Authority (2022) reported that a family with five members living in Palawan should have Php 10,441 per month to meet the basic food and non-food needs. The same was observed in other fishing communities in Palawan, Philippines (Alcantara et al. 2023).

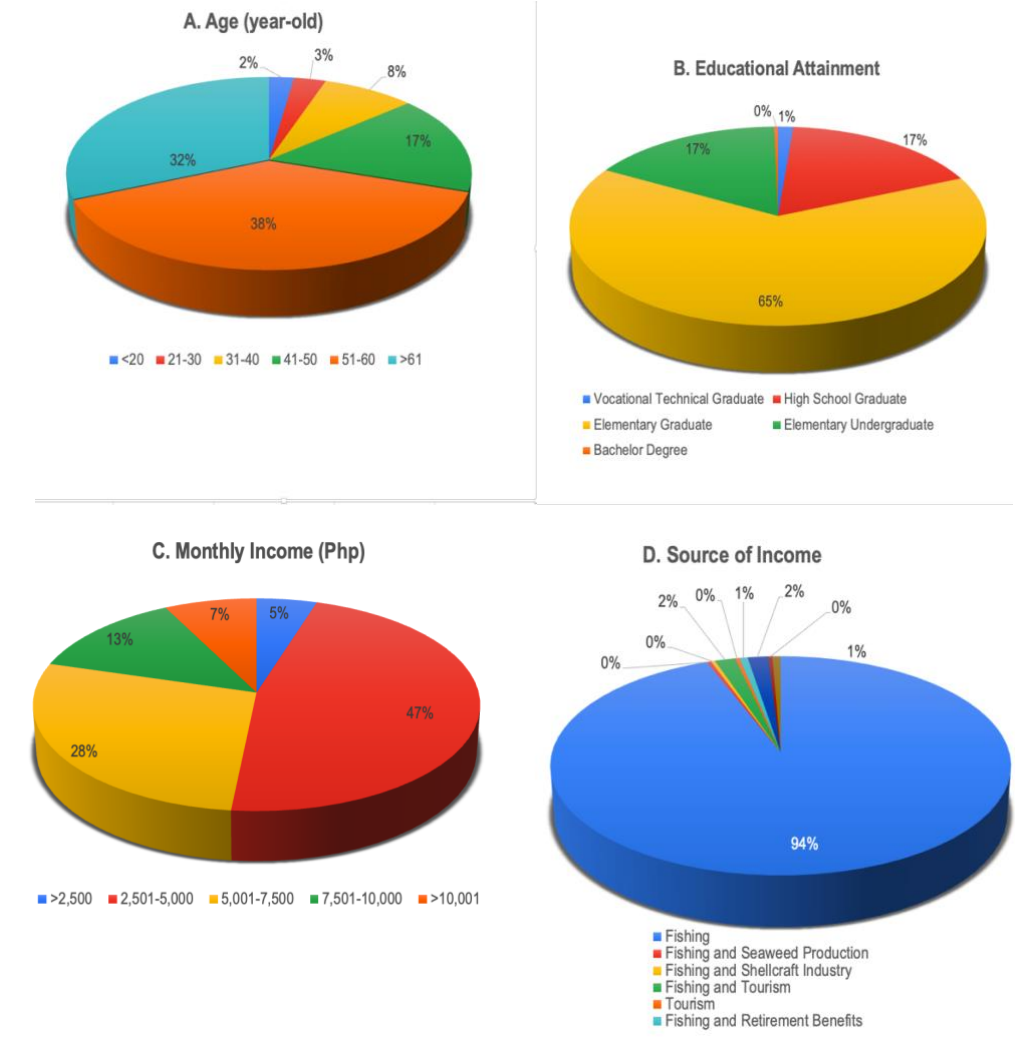

Figure 2. The socio-demographic profile of 308 respondents who participated in the survey. Note: Philippine peso (Php) to United States dollar: 1 = 0.018 as of 2024.

2.2. Fishing Data

The majority are full-time fishers (89%), while the others are just part-time fishers (11%). Most of the respondents have been fishing for more than 11 years (87%), while few have spent 6-10 years as fishers under municipal fisheries (92%; Figure 3). Municipal fishing operates 15 kilometers from the coastline heading seaward without using any vessel or less than 3 gross tons (FAO 2005).

The period of fishing (in years) and the time spent fishing within the municipal water provide additional evidence that the fishers belonging to SSFs are highly dependent on fishing activities as their primary source of income (Figures 2 and 3). This can be attributed to their low educational attainment, which hinders them from landing a higher-earning job. In fact, fishers in the Philippines were regarded as the poorest of the poor. Unlike other sectors in the economy, they have the least, if not lacking, capital to invest or land a well-paying job. They do not even own land which is why they resorted to the coastal area for settlement and livelihood since the resources are free for everybody. Given such dependence of small-scale fishers on the bounty of the sea, it explains their importance as the primary key players in detecting changes within municipal waters. Such could be used as an essential step towards developing and implementing adaptation and mitigation strategies to deal with the effects of climate change (Amoutchi et al. 2021).

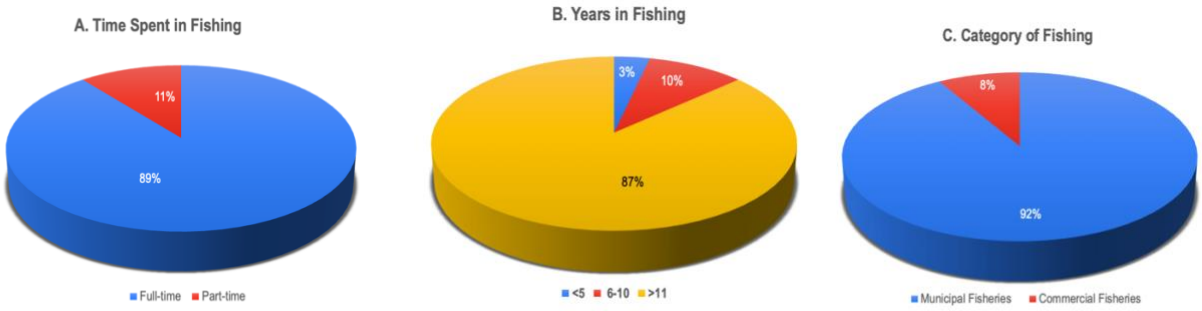

Figure 3. Fishing data from 308 respondents participating in the survey.

2.3. Perception of Climate-Related Phenomena

Majority (90%) of the respondents have knowledge about climate change. The Likert Scaling Scores on their perception of climate-related phenomena scored between 12 - 29 points

with the total mean computed as 24.3 ± 2.3 points, indicating a "Very High" rating. Except for the respondents under 21-30 years old with a monthly income of Php 2,500 and a "High" rating, the other socio-demographic variables have a "Very High" rating (Table 1). This shows that despite the low educational attainment, the respondents still have a very high perception of climate change and other climate-related phenomena (Figure 4).

Table 1. Perception of fisherfolks (% respondents) on climate change.

Demographic Variable	**Perception on Climate Change**				
	n	Range	Mean Score	St Dev	Equivalent Rating
Age					
20 years old and below	7	22-26	23.6	1.7	Very High
21 – 30	9	20-27	23.4	2.2	High
31 – 40	26	12-28	23.8	3.0	Very High
41 – 50	51	16-28	24.0	2.3	Very High
51 – 60	118	18-29	23.9	2.4	Very High
61 years old and above	97	19-28	25.2	1.9	Very High
Sex					
Male	308	12-29	24.3	2.3	Very High
Female	0	-	-	-	-
Educational Attainment					
Elementary Undergraduate	51	21-28	24.2	2.1	Very High
Elementary Graduate	199	12-29	25.4	2.5	Very High
High School Graduate	53	20-28	23.8	2.1	Very High
Vocational Technical Graduate	4	22-25	23.8	1.5	Very High
Bachelor's degree	1	26	26.0	-	Very High
Income					
0 – 2,500	15	16-27	23.0	3.0	High
2,501 – 5,000	144	12-29	24.7	2.4	Very High
5,001 – 7,500	86	20-29	23.8	2.1	Very High
7,501 – 10,000	40	20-28	24.2	2.3	Very High
10,001 and above	23	21-27	24.7	1.7	Very High
Total	308	12-29	24.3	2.3	Very High

Additionally, more than 50% of the respondents perceive the following as impacts of climate change: a) increasing sea surface temperature; b) more frequent and intense typhoons; c) fish sensitivity to changing climate; d) fish catch, abundance, and diversity as adversely affected;

and e) fish kills (Figure 4). Respondents further believed that high fossil fuel consumption is a major contributory factor (84%), and there are substantial scientific studies to support it (70%). Similar findings were reported in Bangladesh, with temperature, frequency of tropical cyclones, and sea level rise as the perceived impacts of climate change on fishers (Alam and Mallick 2021).

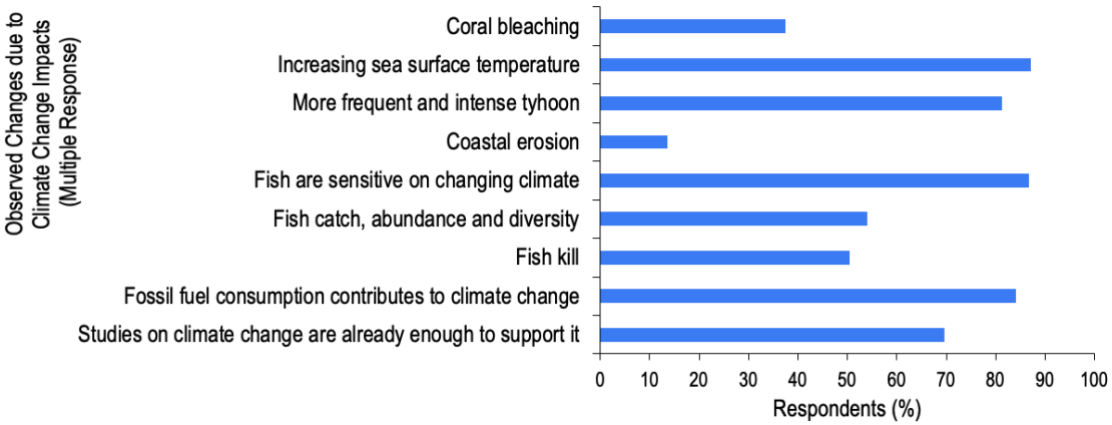

Figure 4. Percentage of respondents with knowledge of climate-associated phenomena.

Almost all (99%) said that they obtained such information from television or radio programs (Figure 5). However, these observations may not be precise, and they may be influenced by mass media. People in the non-indigenous and non-rural populations, such as our study sites, have better access to information thus their perception of climate change is highly influenced by scientific discourses that are presented in mass media (Fernández-Llamazares et al. 2015; Marin et al. 2013). Interpretation and evaluation of the perceived changes in the environment are mainly influenced by mass media (Nerlich et al. 2010), local traditions (Byg and Salick 2009), and the intensity effect on a locality (Cinner et al. 2018). These claims are indicative but still must be supported by science-based data.

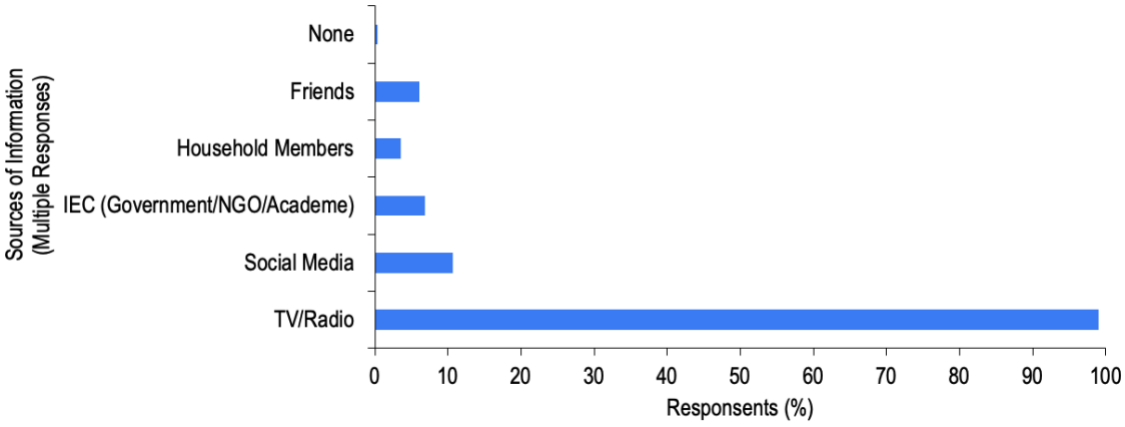

Figure 5. Sources of information regarding changing climate and ecosystem.

The Chi^2 test performed between selected variables and the knowledge of the respondents on climate change revealed that age and source of information have significant relationship with the knowledge of climate change, with the *p*-values 0.0032 and 0.0348, respectively (Table 2). These results showed that the older the respondents are, the higher their understanding of the climate phenomena and knowledge of media sources.

Climate change and climate variability have been present throughout history, and natural systems have been able to adapt accordingly (Brander 2010). However, the adaptive capacity of many coastal fishers particularly the SSFs is being compromised due to the more rapid rate of change and the concurrent pressures affecting the resilience of species and systems (Planque et al. 2010). Recent studies have shown that approximately 25-30% of the world's coral reefs are already severely degraded, and the surface of the world's oceans has warmed by 0.7°C, with sea-level rising by 18 cm (McField 2017). Previous studies have identified changes in primary production (Brander 2010; Richardson and Schoeman 2004), fish recruitment (Lehodey 2001; Lehodey et al. 2003; Loukos et al. 2003), distribution and phenology of organisms (Beaugrand 2004; Möllmann et al. 2003; Renz et al. 2006), and population processes (Brander 2007; Morgan et al. 2001; Mueter et al. 2002).

The adaptive capacity of local communities such as the SSFs to climate change is affected by a complex interplay of social, political, economic, technological, and institutional factors operating at multiple scales (Dolan and Walker 2023). Resilience is largely dependent on available assets and infrastructure and access to information (Cinner et al. 2018). Government and non-government organizations can initiate strategies and play an important role in facilitating climate strategies. These factors are intricately linked, and their interrelationships play a vital role in shaping the adaptive capacity of the system. As such, a thorough understanding of the relationships between these factors is essential for effective decision-making and successful adaptation strategies.

Table 2. Statistics of some selected variables and level of knowledge of respondents on climate change.

Variable	df	x^2 value	*p*-value
Age	15	34.18	0.0032*
Educational Attainment	12	11.46	0.4895
Income	12	15.76	0.2024
Time Spent on Fishing	15	17.13	0.3112
Years of Fishing	15	9.37	0.8575
Category of Fishing	15	19.65	0.1858
Source of Information	15	26.32	0.0348*

Coastal communities in Honda Bay, Puerto Princesa City, like other coastal areas in Palawan are the first areas to experience the effects of climate change (Alcantara et al. 2023; Madarcos et al. 2021). These areas are experiencing more pressure due to higher poverty incidence and the scarcity of opportunities. As coastal communities, they are the most susceptible to adverse impacts of climate change, particularly to sea level rise and intense typhoons. Therefore, it is crucial to plan strategies to adapt and mitigate the future impacts of climate change. One possible solution is to implement an ecosystem-based approach to management, which can help slow down the effects. This approach involves fishing mortality reduction, water quality improvement, and marine biodiversity restoration (Macusi et al. 2020; 2021). It is also essential to understand the socio-economic dynamics of the area. Another possible solution is the diversification of income as the source of livelihood in these two coastal areas. The majority (94%) of the population rely only on fishing as their source of income. Thus, having an alternative source of income can reduce the pressure on the marine environment and make them more resilient to adverse impacts since they have other sources. Involving the locals in combating climate change is another adaptive strategy sought in developing countries like the Philippines (Macusi et al. 2021). The limited capacity of the government to respond according to the needs of the people urges them to initiate steps at a community level. Javan (1999) noted that community empowerment is crucial for achieving sustainability within the coastal area. Several successful community-based initiatives are already well documented in the Philippines, such as the Apo Island Marine Sanctuary (Russ and Alcala 1999).

It is also advantageous to incorporate local perception in policy-making and adaptation strategies for climate change. According to Rokicka (1998), accounting for the local perspective is a prerequisite for solving regional economic and ecological problems. Visualizing the future allows communities to mitigate, adapt, or prepare for impacts (Bannan et al. 2022). Since changes in the socioecological system are affected by different factors, spatially and temporally (Holling 2001; Berkes 2002), local knowledge provides valuable information for suitable and acceptable interventions. Considering the local concerns and the real-life impacts of climate change on individuals is crucial for their safety and survival (Danielsen et al. 2005; Laidler 2006). These studies emphasize the significance of examining climate change from a people-centric perspective, which is essential for developing effective mitigation and adaptation strategies. By incorporating insights from these sources, policymakers and researchers can gain

an in-depth understanding of climate change and its implications for local communities. Scientific studies and climate models sometimes overlook local conditions, making it even more crucial to consider the importance of local knowledge (Kloprogge and Van der Sluijs 2006; van Aalst et al. 2008).

Understanding environmental issues can promote environmentalism, encourage local support, and ease mobilization and action. To devise effective plans and programs aimed at enhancing environmental awareness and promoting positive public behavior towards the environment, it is imperative to first conduct a comprehensive assessment of the level of environmental awareness prevalent within the community (Wahba and Al-Murad 1999). The results of this assessment can help stakeholders gain valuable insights into the level of knowledge, attitudes, and practices of the community, and use this information to develop targeted interventions tailored to meet the needs of the population. Ultimately, this approach can help foster a culture of environmental stewardship and promote sustainable practices that benefit both the community and the wider ecosystem (Wahba and Al-Murad 1999).

Conclusion

Based on the results, it can be said that the impacts of climate change on the marine ecosystems are already apparent as perceived by the small-scale fishers in Honda Bay. Despite their low educational attainment, fishers displayed a high perception that can be attributed to their direct observation as primary users of marine resources. However, it was also apparent that media have influenced their perception. Altogether, such perception can be used as a vital input in crafting appropriate management actions for climate change mitigation and adaptation, including emergency preparedness schemes for coastal villages that are prone to the impacts of sea level rise and typhoons.

Climate change significantly influences the marine ecosystems structure. The tiniest change in the base of the food chain will have a rippled effect on the top. Thus, humans, as end users will also be affected. In the case of these two fishing communities of Honda Bay, they are more prone to risk in the changing climate as the majority are highly dependent on the marine ecosystems' productivity for livelihood. Thus, strategies for adaptation and mitigation of future impacts are essential. Aside from reducing fishing mortality, improving water quality, and increasing marine biodiversity, socio-economic aspects must be investigated to include income

diversification. More importantly, an ecosystem-based approach that includes climate-induced changes in assessments and management is essential and must be put in place.

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