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Understanding The Knowledge, Beliefs, And Practices of Samareños On Red Tide Phenomenon: Implications for Sustainable Management

Dr. Edelyn O. Echapare, Dr. Rezy V. Mendaño, Dr. Abigail M. Cabaguing, Myrniel B. Gal, Emma Q. Tenedero, Maria Rubi M. Parrocho, Maria Angelica F. Alcantara

Samar State University, Philippines
edelyn.echapare@ssu.edu.ph

Abstract:

The people of Samar are heavily dependent on coastal resources for their livelihoods. This dependence underscores the pivotal role that coastal ecosystems play in supporting the local community's well-being, especially as Samar bays are consistently confronted with periodic occurrences of red tide. Given the paramount importance of these resources to the people, understanding how they perceive and respond to red tide becomes imperative. This study investigates the social dimensions of red tide perception among Samareños to inform management strategies. A quantitative approach, employing a structured KBP scale was used to assess the level of knowledge, beliefs, and practices relative to red tide. The findings reveal a high level of scientific knowledge (mean: 4.36) among respondents, indicating their comprehensive understanding of various aspects associated with the phenomenon. However, misconceptions persist regarding the effectiveness of cooking seashells to reduce red tide potency. Participants also hold favorable beliefs (mean: 4.06), signifying positive perceptions related to red tide. In terms of practices, respondents exhibit a high level of vigilance with a mean rating of 4.21 during red tide events, refraining from consuming affected seafood and implementing measures to prevent waste disposal into water bodies, recognizing its association to its occurrences. While overall knowledge is high, the presence of misconceptions highlights the need for targeted education and environmental campaigns to correct misconceptions.

These efforts will further enhance the community's understanding of the importance of sustainable practices and management, contributing to the long-term health of coastal ecosystems and the well-being of the local populace. In support of sustainable development, collaboration between local authorities and policymakers with the communities may be encouraged to seamlessly integrate these practices into local governance and disaster preparedness efforts, acknowledging the community's steadfast commitment to safety during red tide events.

Keywords: Algal Blooms, Community Resilience, Red Tide Phenomenon, Samareños, Sustainable Practices

I. Introduction

The phenomenon of red tide, characterized by the rapid proliferation of harmful algal blooms (HABs) in coastal waters, poses substantial risks to both marine ecosystems and human health. Red tide events have been a recurrent issue along various coastlines in the Philippines, including the province of Samar. Recent studies have shed light on the distribution and succession of phytoplankton communities and harmful microalgae in the Leyte and Samar islands, identified species with the potential to cause HAB-related issues, such as paralytic shellfish poisoning, amnesic shellfish poisoning, diarrhetic shellfish poisoning, and fish kills due to hypoxia (Ravelo et al., 2022). Remarkably, the presence of Pyrodinium bahamense in Samar during October to November coincided with several red tide occurrences. This persistent presence of HAB species in Samar's waters has been duly noted (Folio & Yap-Dejeto, 2022), though it was not the dominant species. Additionally, a prior study by Azanza (2007) revealed that Pyrodinium bahamense var. compressum had been the primary organism responsible for toxic red tide episodes in Manila Bay, Philippines, since 1988.

The people of Samar, known as Samareños, have long depended on the abundant resources provided by their coastal ecosystems. Mussel farming for instance has emerged as a significant driver of economic growth in

Jiabong, Samar, operating on a commercial scale and offering sustainable livelihoods to local fishermen and their families (Echapare, et al, 2019). The mussel industry has played a pivotal role in improving the socio-economic well-being of the fishing communities in Samar, with a notable increase in production volumes from 2010 to 2012.These resources not only sustain their livelihoods but also play a fundamental role in supporting their overall well-being. However, Samar's bays are periodically challenged by the recurring phenomenon of red tide. Samar, is one of the poorest provinces in the Philippines. According to data from the Philippine Statistics Authority as of October 2022, there is a 27.0 percent registered poverty incidence among families in 2021, ranking Samar as third in the Eastern Visayas region (PSA, 2022). The reoccurrence of red tide in this context can aggravate the province's already challenging situation, particularly affecting Samareños living in coastal communities.

Red tide incidents in Samar between 1983 and 1993 gained notoriety, resulting in 39 deaths and 1067 cases of paralytic shellfish poisoning with a 6% fatality rate in Tarangnan, Samar alone (Ching, 2013). Shifts in household occupations, as identified in studies conducted in Jiabong, Philippines, have shown a trend toward fishing and mussel farming. However, weak law enforcement has led to various issues affecting income, including a decline in fish catch, mass mortality of mussels, and red tide occurrences (Enate, et al., 2013). These multifaceted challenges have far-reaching consequences, impacting both the environment and the socio-economic fabric of the region. The impact of red tide extends far beyond ecological harm. It often engenders unpleasant odors due to the decomposition of deceased algal biomass, mass mortality events among fish and crustaceans, disruption of fishing operations, and even the suspension of desalination plants. These toxic algal blooms not only affect the environment but also result in significant economic losses, particularly within the aquaculture, fishing and mussel industries.

While some studies have investigated public perceptions of red tide, a significant gap remains. For instance, Nierenberg et al. (2010) found that local residents have a deeper knowledge of Florida red tide compared to tourists in the same area. Although various outreach materials and media exposure have been developed for information dissemination on the issue, there has been no formal assessment of whether these materials effectively serve their purpose. In a study by Morgan et al., (2008), the knowledge of Southwest Florida residents regarding red tides was measured through a survey of

1,006 randomly selected individuals. The findings revealed that 89% of the participants were aware of red tide occurrences, with 72% believing that swimming in water during a red tide event was risky and that finfish and crustaceans were unsafe to consume. It was also revealed that residents heavily relied on newspapers and television for red tide updates, emphasizing the importance of such media in information dissemination and correcting misunderstandings about the red tide phenomenon. However, inconsistencies and incorrect responses were observed across tourists and residents alike regarding knowledge of Florida red tide (Hall et al., 2012). Furthermore, Berdalet et al. (2016) conducted a study on how people make decisions in situations involving uncertain environmental health hazards, such as HABs. Their study crafted a conceptual model of decision-making using the Precaution Adoption Process Model (PAPM), which assesses awareness of red tide in a coastal community, knowledge of its consequences, perceived personal risk, and information sources. An evaluation conducted by the Field Epidemiology Training (FEPT) highlighted that knowledge within the community regarding the toxicity of red tide was not consistently put into practice, although 82% of those surveyed knew that shellfish should be avoided, 95% still consumed them. Only 24% of the community knew what red tide was, and 22% were not afraid of its consequences. Thus, there is a need to address the issue of misconceptions about the red tide phenomenon and its impact on people's practices.

Aside from the health impacts and human losses, there is a notable lack of comprehensive literature concerning the social dimensions, specifically the scientific understanding, beliefs, and practices (KBP) of Filipinos in mitigating red tide (Bankoff, 1999). As red tides pose risks to public health, disrupt local fisheries, and necessitate precautionary measures to mitigate their impact, understanding how the Samareños perceive and respond to it is of paramount importance. Perceptions of people in societies living with HABs are not properly documented and has not been adequately investigated. The aspirations and challenges faced by locals affected by red tide are crucial pieces of information for policymakers, helping to shape interventions in Samar province. Thus, this study seeks to delve into the level of social dimensions of the red tide phenomenon among the Samareños community. Understanding the level of social dimensions towards the phenomenon is crucial for effective management and mitigation strategies, thus, ensuring the safety of local communities.

II. Objectives

The general objective of the study is to assess the social dimension of Red Tide with the aim of enhancing the knowledge, beliefs, and practices of Samareños concerning the red tide phenomenon for community resilience and management. Specifically, it aims to:

1. To determine the demographic profile of the respondents;
2. To evaluate the level of knowledge, beliefs, and practices of Samareños regarding the red tide phenomenon; and
3. To assess the influence of demographic variables on respondents' knowledge, beliefs, and practices regarding red tide.

III. Methodology

Research Design. This study employed a quantitative research approach to systematically assess and measure the social dimensions of the red tide phenomenon among Samareños. Quantitative methods allowed for the collection of structured data that could be statistically analyzed to provide clear and objective insights.

Research Instrument and Validation. The research instrument employed in this study was a standardized assessment tool called the Knowledge, Beliefs, and Practices Scale (KBPs), which had been designed to specifically measure the social aspects related to red tide, encompassing the knowledge, beliefs, and practices of individuals or communities (Echapare et al., 2022). The validation process encompassed pilot testing the questionnaire with a small sample of respondents, aimed at evaluating its clarity, relevance, and consistency. The scale consisted of 45 items categorized into a three-factor model, with the following labels: Knowledge, Beliefs, and Practices demonstrated excellent overall internal consistency with coefficient (α= .93) .

Population and Sampling Procedure. The study employed a systematic sampling method to select participants, totaling approximately 398 individuals from 15 coastal municipalities in Samar, all of which were affected by HABs. This approach aimed to ensure a diverse and representative sample. This number was allocated proportionally to each municipality based on their total number of households. Within each municipality, specific coastal barangays were purposively selected based on their total number of sample households, as outlined in table 1:

Table 1
Municipality/City and the Total Households

Municipality/City	Total No. of HH	Total No. of Sampled HH
San Sebastian	1,696	6
Talalora	1,676	6
Almagro	2,101	7
Tagapul-An	1,955	7
Santo Niño	2,742	10
Zumarraga	3,302	12
Jiabong	3,896	14
Calbiga	5,160	18
Tarangnan	5,580	19
Santa Margarita	5,833	20
Villareal	5,986	21
Paranas (Wright)	6,349	22
Daram	8,716	30
City of Catbalogan (Capital)	21,184	74
City of Calbayog	38,411	132
TOTAL	114,587	398

Municipality/City and the Total Households
Source: NSO, Census of Population and Housing

Statistical Treatment of Data. The statistical treatment of data involved conducting quantitative data analysis using statistical software. Descriptive statistics were used to summarize the responses obtained from the KBPs questionnaire. Additionally, inferential statistics, such as correlations analyses, were employed to identify relationships and patterns within the data.

Ethical Consideration. Prior to participating in the study, all participants provided informed consent. They were fully briefed on the purpose of the study, the nature of their involvement, and the handling of their data. It was emphasized that their participation was entirely voluntary, and they had the right to withdraw at any time without consequences. The confidentiality of participants was rigorously maintained. Personal information, including names and contact details, was kept strictly confidential, and data were anonymized to ensure the privacy of participants. All data collected were stored securely and protected from unauthorized access. Only the research team had access to the data, and it was used exclusively for research purposes. The study recognized and respected the cultural sensitivities of the local community. Researchers were mindful of local customs and traditions and ensured that research activities were conducted in a culturally sensitive manner. The research protocol underwent ethical review and received approval from Samar State University institutional review board.

IV. Results and Discussion

Demographic Profile. Table 2 reflects the demographic profile of the participants. A total of 398 randomly selected individuals in Samar participated in the study.

Table 2. Demographic Profile of the Respondents

Age (in years)	Frequency (F)	Percent (%)
60 years old & above	40	10.1
53-59	58	14.6
46-52	72	18.1
39-45	50	12.6
32-38	58	14.6
25-31	91	22.9
18-24	29	7.3
Total	398	100.0
Mean	**41.79**	
SD	**13.33**	
Sex Category		
Male	345	86.7
Female	53	13.3
Total	398	100.0
Civil Status		
Single	81	20.4
Married	284	71.4
Live in	20	5
Widow	10	2.5
Separated	3	0.8
Total	398	100
Highest Educational Attainment		
No Schooling	1	0.3
Elem Level	202	50.8
Elem Graduate	18	4.5
High School Level	126	31.7
High School Graduate	18	4.5
College Level	25	6.3
College Graduate	8	2

Total	398	100
No. Of Household Members		
13-14	3	0.8
11-12	11	2.8
9-10	29	7.3
7-8	81	20.4
5-6	118	29.6
3-4	136	34.2
1-2	20	5.0
Total	398	100.0
Mean	6 members	
SD	2 members	
Average Family Monthly Income (Php)		
below Php1,000.00	4	1.0
1,000 - 4,999	157	39.4
5,000 - 9,999	146	36.7
10,000 - 14,999	63	15.8
15,000 - 19,999	20	5.0
20,000 and above	8	2.0
Total	398	100.0
Mean	**6381.41**	-
SD	**4199.50**	-

The age distribution of the participants showed 18 to 60 years old and above having an average age of 41.79 years old with standard deviation of 13.33 years. Most of them or 86.7% were male, 71.4% were married, and approximately half of them were Elementary level (50.8%) and the other half were distributed from elementary graduate to college graduate. In terms of their number of household members, approximately there were six (6) members are there in every family. As to the income, the results revealed that their average monthly income was approximately Php 6,382.41. Some of them had below Php1, 000.00/mo. (1.0%) while 2% from them had an income of Php 20,000.00/mo. as reflected in the table. These data further meant that the participants lived below the poverty threshold stating that no less than Php10,481.00, on average, was needed to meet both basic food and non-food needs of a family of five in a month. On the other hand, a family of five needed no less than Php7,337.00, on average, to meet the family's basic food needs for a month (psa.gov.ph).

The income data reveals a concerning socio-economic context among the study participants, with a significant portion having an average monthly income below the poverty threshold. This suggests heightened vulnerability to the economic impacts of red tide events, as these individuals heavily rely on sectors like agriculture and fisheries. The findings from the study by Larkin and Adams (2007) suggest that coastal communities have experienced substantial financial losses as a result of Harmful Algal Blooms (HABs). These losses are reported to be even more substantial than those caused by other environmental events. Such economic consequences can include reduced revenue for businesses in industries like fisheries and tourism, as well as increased costs for mitigating the effects of HABs and addressing public health concerns. Understanding the magnitude of these effects is crucial for policymakers and stakeholders to develop strategies for mitigating and managing the economic consequences of HABs in coastal regions. Their limited access to resources, including information and healthcare, during red tide occurrences raises concerns about their capacity to make informed decisions and implement safety measures. Additionally, this income disparity may shape distinct coping strategies, dietary choices, and adaptive practices during red tide events. These implications underscore the importance of community-based approaches to red tide management, including the provision of timely and accessible information, diversified livelihood opportunities, and support for sustainable resource management practices, all of which are essential components of building community resilience to red tide events.

Table 3. Occupation and Number of Years in Occupation of the Respondents

Number of Years in Occupation	Occupation						Total	Percent
	Skilled Agricultural, Forestry and Fishery Worker	Pro-fessional	Clerical Support	Service and Sales Worker	Plant and Machine Operator	Elementary Occupation		
1 - 8	141	2	15	35	0	0	**193**	**48.49**
9 - 16	38	2	2	7	0	1	**50**	**12.56**
17 - 24	37	0	3	0	1	0	**41**	**10.30**
25 - 31	40	0	0	6	0	0	**46**	**11.56**
32 - 39	25	0	0	3	0	0	**28**	**7.04**
40 - 47	32	0	0	2	0	0	**34**	**8.54**
48 - 55	5	0	0	0	0	0	**5**	**1.26**

Above 55 year	1	0	0	0	0	0	**1**	**0.25**
Total	**319**	**4**	**20**	**53**	**1**	**1**	**398**	**100.00**
Percent	**80.2**	**1.0**	**5.0**	**13.3**	**0.3**	**0.3**	**100**	**25.13**

Notably, a significant proportion of respondents (80.2%) were categorized as skilled agricultural, forestry, and fishery workers, including farmers and fishermen. This indicates that a substantial number of participants depend on these occupations for their livelihoods, suggesting that their comprehension of red tide and its effects may be influenced by their direct experience and reliance on marine resources affected by red tide. Fishers had deeper understanding in this respect that red tides occur more frequently and cause human health effects. Examining the number of years spent in their occupations further provides insights into participants' experience levels. The majority of respondents (48.49%) had been in their occupations for 1-8 years, indicating a relatively recent entry into their respective fields. This implies that their experiences with red tide and their responses to it may be influenced by a comparatively short duration of exposure. A smaller percentage of respondents had been in their occupations for 9-16 years (12.56%), 17-24 years (10.30%), and 25-31 years (11.56%). These individuals may have accumulated a deeper understanding of red tide and its impact over time, potentially leading to distinct practices and coping strategies compared to those with fewer years in their occupations.

The data on occupation and years spent on it provide valuable insights into the occupational profiles of study participants and how these factors may influence their knowledge, beliefs, and practices related to red tide. Fishermen in particular, exhibited a more in-depth understanding of red tide occurrences and their potential health implications. They actively took steps to mitigate red tide effects, such as preventing sewage disposal into the sea and using control methods, even when the side effects were uncertain. Their heightened concern about red tide events, seafood consumption, personal health, economic consequences, and coastal visits reflects the significant impact of red tide on their lives (Mirza Esmaeili et al. ,2020). Moreover, the diversity in respondents' occupational backgrounds suggests a wide range of perspectives and knowledge levels, beliefs and practices concerning red tide. This diversity presents an opportunity for discussion and collaboration among different occupational groups to collectively enhance resilience to red tide events. Communities can foster cross-occupational learning and cooperation, leveraging the varied expertise within their midst to better manage and mitigate the impacts of red tide outbreaks.

Social Dimension Measures of Respondents on Red Tide Phenomenon. The Social Dimension Measures of Respondents on Red Tide Phenomenon were reflected in Tables 4 to 6, representing the levels of scientific knowledge, beliefs, and practices of Samareños concerning red tide.

Table 4. Level of Knowledge on Red Tide of the Samareños

	Indicator	$\bar{X}_w$ /Interpretation	
1.	The income of fisherfolks and farmers decreases during red tide alert.	4.76	KVW
2.	Red tide organism produced toxins that causes death when ingested by the people and other organisms in the sea.	4.68	KVW
3.	Improper disposal of garbage can cause algal bloom (red tide).	4.11	KW
4.	Red tide causes economic loss in commercial fisheries and other aquaculture industry.	4.34	KW
5.	Red tide is caused by man-made pollution.	4.49	KW
6.	Seafood industries incur significant losses during red tide.	4.66	KVW
7.	Seafood consumption is reduced during red tide.	4.66	KVW
8.	A person poisoned with red tide toxins experiences dizziness, numbness, stomachache, headache and lockjaw.	4.53	KVW
9.	Livelihood other than fishing could minimize economic losses caused by red tide.	4.14	KW
10.	Occurrence of red tide is due to harmful chemical wastes.	4.59	KVW
11.	Bivalves are particularly affected during toxic red tide blooms.	4.71	KVW
12.	Red tide occurs depending on the weather.	4.09	K
13.	Red tide comes from wastes.	4.23	K
14.	The price of marine products decreases whenever there is red tide.	4.57	KVW
15.	Shellfish consumption causes intoxication.	4.29	KW
16.	Red tide is an indication that the water is polluted.	4.03	KW
17.	Most severe paralytic shellfish poisoning victims recover within 72 hours after medical treatment.	4.18	KW
18.	Red tide cells are broken apart by wind and wave action as they release there toxins into air and sea spray.	3.95	KW
19.	Cooking seashells does not lessen the potency of red tide.	3.82	KW

Mean	4.36	KW

Legend:

4.51-5.00 Strongly Agree/Know Very Well (KVW)
3.51-4.50 Agree/Know Well (KW)
2.51-3.50 Undecided/Know
1.51-2.50 Disagree/Know a Little (KL)
1.00-1.50 Strongly Disagree/No Knowledge at All (NKA)

Level of Knowledge. Table 4 presents the Samareños' level of knowledge concerning red tide, as reflected in their responses to specific indicators. On the level of knowledge, the following are key findings: 1.) The participants have a high awareness of the economic repercussions of red tide, recognizing that the income of fisherfolks and farmers decreases during red tide alerts. This indicates their understanding of the direct impact on livelihoods (4.76, KVW); 2.) Respondents are well-informed about the dangers of red tide toxins, understanding that these toxins can cause death when ingested by people and marine organisms (4.68, KVW). 3.) While most participants acknowledge the role of improper garbage disposal in causing red tide (4.11, KW), they also believe that red tide can be triggered by man-made pollution (4.49, KW) and harmful chemical wastes (4.59, KVW). These perceptions highlight their recognition of environmental factors contributing to red tide. 4.) The respondents are aware of the economic losses incurred by seafood industries during red tide events (4.66, KVW) and the decrease in marine product prices (4.57, KVW), indicating their understanding of the broader economic implications. 5.) They have a good understanding of the health effects of red tide toxins, recognizing symptoms such as dizziness, numbness, stomachache, headache, and lockjaw (4.53, KVW). They also understand that shellfish consumption can lead to intoxication (4.29, KW). 6.) While some respondents associate red tide with weather conditions (4.09, K), others link it to pollution and waste (4.23, KW and 3.95, KW), indicating a varied understanding of environmental indicators. 7.) A noteworthy finding is the recognition that livelihoods other than fishing can help minimize economic losses caused by red tide (4.14, KW). This suggests an awareness of potential adaptive strategies.

The mean score of 4.36 on the level of knowledge indicates that respondents generally have a comprehensive understanding of red tide, encompassing economic, environmental, and health aspects, falling into the "Agree/Know Well" category. Choudhury et al. (2021) highlights the crucial role of indigenous and local knowledge (ILK) in the social learning process related to natural events. Additionally, community resilience is influenced by the spatial and temporal distributions of locals and their susceptibility to natural hazards. Public awareness on red tide blooms and associated hazards is emphasized as essential for mitigating red tide effects (Herrera et al., 2012). Additionally, the diversity in respondents' perceptions, such as the various causes attributed to red tide, underscores the importance of tailored educational initiatives to address misconceptions and enhance the accuracy of knowledge within the community. Thus, the high level of knowledge observed among the respondents provides a solid foundation for building a more resilient and well-informed community capable of responding effectively to red tide events.

Level of Beliefs. Table 5 reveals the beliefs held by the Samareños regarding red tide, shedding light on their perceptions and attitudes toward this natural phenomenon. The key findings include: **1.)** Respondents strongly believe that throwing garbage into rivers, seas, and oceans should be prohibited as it can cause red tide (4.70, DT). This highlights their recognition of individual responsibility in preventing environmental factors that contribute to red tide. **2.)** While a significant proportion expresses concern about being poisoned from eating seafood during red tide (4.23, PT), there is also an element of skepticism, with some respondents not believing in seafood poisoning during red tide (2.96, NS). This disparity in beliefs underscores the need for targeted health education to address misconceptions. **3.)** The belief that proper information dissemination is crucial in places affected by red tide is widely held (4.43, PT). This suggests a recognition of the importance of timely and accurate communication during red tide events.**4.)** Respondents strongly advocate for intensified regulations on coastal pollution and runoff to prevent algal blooms (4.70, DT). They also believe in the necessity of government intervention to prevent economic losses due to red tide outbreaks (4.69, DT). These beliefs underscore the community's desire for proactive government involvement in red tide management. **5.)** There is a shared belief that red tide causes disruption of subsistence activities, social relationships, and cultural practices (4.44, PT and 4.01, PT). This indicates an awareness of the broader societal and cultural implications of red tide. **6.)** Respondents generally believe that when red tide occurs, the water gives off a bad odor or smell (4.10, PT). This sensory perception can serve as an early indicator of red tide presence. **7.)** A significant number of participants believe that red tide blooms are occurring more frequently (3.52, PT). This perception aligns with global trends of increasing harmful algal blooms and may indicate a heightened awareness of environmental changes. **8.)** Respondents express a belief in the possible cause of respiratory problems by red tide (4.04, PT), indicating health-related concerns. **9.)** While not a strong belief, some respondents are aware that there is no antidote for paralytic shellfish poisoning (PSP) caused by red tide (2.92, NS).

Generally, the mean score of 4.06, falls within the "Agree/Probably True" (PT) category, this suggests that the participants generally hold moderately positive beliefs about various aspects related to red tide. Samareños believed that it was definitely true that throwing garbage into rivers, seas and oceans should be prohibited because it causes red tide, regulations and coastal pollution and runoff must be intensified to prevent algal blooms, and government should have intervention to prevent economic loss due to red tide outbreak. The strong endorsement of environmental responsibility, regulations, and government intervention suggests that the community is open to proactive measures to mitigate red tide's impact. Consequently, Samareños were not sure whether red tide blooms last longer at present, seafood poisoning during red tide, and no antidote for paralytic shellfish poisoning (PSP). Red tide can make seafood toxic, and there is no antidote for PSP (Tacio, 2011). The social dimension of the red tide phenomenon is one of the fundamental pillars in coming up with holistic plans and programs for a resilient society. Efforts should be directed toward strengthening these beliefs and translating them into concrete actions. Addressing the skepticism around seafood poisoning during red tide is crucial for public health. It is essential to provide clear and accurate information to dispel misconceptions and ensure that residents make informed choices regarding seafood consumption during red tide alerts. The recognition of the societal and cultural impacts of red tide underscores the need for holistic approaches to red tide management that consider not only economic factors but also the well-being of affected communities. Finally, the belief in the increasing frequency of red tide events aligns with global concerns about climate change and environmental degradation, highlighting the need for adaptive strategies to address this growing challenge.

Table 5. Level of Beliefs on Red Tide of the Samareños

Indicator	X_w/Interpretation

1.	I think throwing garbage into rivers, seas and oceans should be prohibited because it causes red tide.	4.70	DT
2.	I will be poisoned from eating seafoods during red tide.	4.23	PT
3.	There must be proper information dissemination in places affected by red tide.	4.43	PT
4.	Regulations on coastal pollution and runoff must be intensified to prevent algal blooms.	4.70	DT
5.	There should be government intervention to prevent economic loss due to red tide outbreak.	4.69	DT
6.	There should be immediate dissemination when red tide occurred in the community to prevent from eating shellfishes and food fishes.	4.38	PT
7.	Technology for rapid red tide detection and testing must be available in the community level for immediate information dissemination.	4.39	PT
8.	Attitude matters in dealing problems related to red tide.	4.49	PT
9.	The livelihood of the people other than fishing is also affected when there is red tide outbreak.	3.71	PT
10.	Red tide blooms last longer at present.	2.91	NS
11.	Red tide causes disruption of subsistence activities of people living in coastal areas.	4.44	PT
12.	Red tide is a significant threat to coastal environments and communities.	4.49	PT
13.	Red tide causes disruption of social relationships and cultural practices of families and communities.	4.01	PT
14.	When red tide occurs, the water gives off a bad odor/smell.	4.10	PT
15.	I don't believe in seafood poisoning during red tide.	2.96	NS
16.	Red tide is a possible cause of respiratory problems.	4.04	PT
17.	Recently, red tides are occurring more frequently.	3.52	PT
18.	There is no antidote for paralytic shellfish poisoning (PSP).	2.92	NS
	Mean	4.06	PT

Legend:

4.51-5.00 Strongly Agree/Definitely True (DT)
3.51-4.50 Agree/Probably True (PT)
2.51-3.50 Undecided/Not Sure (NS)
1.51-2.50 Disagree/Probably Not True (PNT)
1.00-1.50 Strongly Disagree/Definitely Not True (DNT)

Level of Practice. The level of practices on red tide of the Samareños is presented in Table 6. These practices reflect their responses and behaviors during red tide events. Key findings revealed that: 1.) Respondents demonstrate a high level of precautionary practices during red tide events, with a strong agreement that people are careful during red tide occurrences (4.77, VHP). This indicates a proactive approach to safeguarding health; 2.) Many respondents agree that fishing activities decrease during red tide events (4.23, HP). This aligns with the economic impact of red tide on the livelihoods of fishermen and suggests adaptive practices in response to red tide alerts; 3.) A significant number of respondents avoid seafood consumption during red tide outbreaks (3.97, P). This practice is essential for preventing seafood poisoning and reflects awareness of the risks associated with contaminated seafood; 4.) Some respondents believe in traditional remedies for red tide poisoning, such as drinking coconut milk (4.36, HP) and consuming sugar and sweets (4.19, HP). While these practices may have cultural significance, their effectiveness in treating red tide poisoning should be evaluated; 5.) There is a strong agreement that people do not eat shrimp, crab, mussels, or other seashells during red tide alerts (4.55, VHP). This practice aligns with seafood safety guidelines and helps minimize the risk of intoxication; 6.) Respondents strongly agree that people should stop throwing waste into water because it causes red tide (4.67, VHP). This reflects a collective sense of responsibility for preventing red tide through waste management; and 6.) However, a notable percentage of respondents (2.94, P) believed it is still safe to eat shellfish and other marine products while a red tide alert is up. This suggests a potential gap in awareness and education regarding the risks associated with red tide-contaminated seafood.

Generally, the mean score of 4.21 falls within the "Agree/Highly Practiced" (HP) category, indicating positive practices. Samareños exhibit several highly practiced behaviors related to red tide. They refrain from eating shrimp, crab, mussels, and other seashells during red tide alerts, and they've ceased throwing waste into the water to prevent red tide. However, uncertainty persists regarding consuming shellfish and other marine products during red tide alerts and avoiding seafood consumption during outbreaks. Samareños' awareness of red tide risks is evident through their careful behavior during its occurrence. These practices reflect a community proactive in mitigating red tide risks, but knowledge gaps persist. Addressing these gaps, promoting safe practices, and incorporating traditional wisdom can enhance community resilience.

Understanding the Samareños' level of practices regarding red tide is essential for behavior change and responsible actions. Strengthening the adoption of recommended practices, such as avoiding contaminated seafood consumption and pollution prevention, can better protect the community and mitigate red tide's impact on health and livelihoods (Meniano, 2020; Rosales, 2021).

Table 6. Level of Practices on Red Tide of the Samareños

	Indicator	X_w/Interpretation	
1.	People are careful during occurrence of red tide.	4.77	VHP
2.	Fishing activities decreased during red tide.	4.23	HP
3.	I avoid seafood consumption during red tide outbreak.	3.97	P
4.	Drinking coconut milk is a means of treating a person poisoned with red tide toxins.	4.36	HP
5.	Taking sugar and sweets helps in treating a person poisoned with red tide toxins.	4.19	HP
6.	People don't eat shrimp, crab, mussels or other seashells when there is red tide alert.	4.55	VHP
7.	People should stop throwing waste into water for it causes red tide.	4.67	VHP
8.	It is still safe to eat shellfish and other marine products while red tide alert is up.	2.94	P
	Mean	4.21	HP

Legend:

4.51-5.00 Strongly Agree/Very Highly Practiced (VHP)
3.51-4.50 Agree/Highly Practiced (HP)
2.51-3.50 Undecided/Not Sure
1.51-2.50 Disagree/Rarely Practiced (RP)
1.00-1.50 Strongly Disagree/Not Practiced (NP)

Relationship Between Respondents' Scientific Understanding (Knowledge), Beliefs, and Practices and their Profile Variates

Level of Knowledge and Profile Variate of the Respondents. The data presented in table 7 shows the relationship between respondents' scientific understanding (knowledge) and their profile variates.

Table 7. Relationship Between Respondents' Scientific

Understanding (Knowledge) and their Profile Variates

Profile	r-value/χ^2-value	df	p-value	Evaluation
Age	-0.012		0.811	Not Significant
Sex	-0.055		0.273	Not Significant
No. of Household Members	0.086		0.086	Not Significant
No. of years in Occupation	-0.049		0.329	Not Significant
Ave. Family Monthly Income	0.121		0.016	Significant
Civil Status	25.08	12	0.014	Significant
Occupation	12.45	15	0.643	Not Significant
Highest Educ Attainment	18.35	18	0.430	Not Significant

Age, sex, number of household members, and number of years in occupation did not show a significant relationship with respondents' scientific understanding. The p-values for these variables were all above the significance level of 0.05, indicating that any observed correlation is likely due to chance. However, two profile variates did show a significant relationship with respondents' scientific understanding. The average family monthly income had a positive correlation with scientific understanding, with a p-value of 0.016. This suggests that respondents with higher family incomes tended to have a better scientific understanding of red tide compared to those with lower incomes. Additionally, civil status was found to be significantly related to scientific understanding, with a p-value of 0.014. The specific nature of this relationship is not provided in the data, but it indicates that there is a notable association between respondents' civil status and their level of scientific understanding regarding red tide.

The variables of occupation and highest educational attainment did not show a significant relationship with scientific understanding, as indicated by their p-values of 0.643 and 0.430, respectively. It is important to note that statistical significance does not imply causation. The observed relationships indicate a correlation but do not provide information about the direction or underlying reasons for the association. Further research and analysis are needed to explore the factors that may influence respondents' scientific understanding of red tide in more depth.

Level of Beliefs and Profile Variate of the Respondent Beliefs. The data on the relationship between the respondents' level of beliefs on red tide and their profile variates is presented in Table 8.

Table 8. Relationships Between Respondents' level of Beliefs on Red tide and their Profile

Profile	r-value/chi-square-value	df	p-value	Evaluation
Age	-0.057		0.257	Not Significant
Sex	-0.029		0.563	Not Significant
No. of Household Members	0.141		0.005	Significant
No. of years in Occupation	-0.285		0.000	Significant
Ave. Family Monthly Income	0.317		0.000	Significant
Civil Status	23.8	12	0.022	Significant
Occupation	28.83	15	0.017	Significant
Highest Educ Attainment	28.39	18	0.05	Significant

The result indicates that age and sex did not show a significant relationship with respondents' level of beliefs on red tide. The p-values for these variables were above the significance level of 0.05, suggesting that any observed correlation is likely due to chance. However, several profile variates were found to have significant relationships with respondents' level of beliefs on red tide. The number of household members had a positive correlation (r-value = 0.126) with beliefs, and the p-value was 0.012. This suggests that respondents with more household members tended to have stronger beliefs about red tide compared to those with fewer household members. The number of years in occupation showed a negative correlation (r-value = -0.102) with beliefs, and the p-value was 0.043. This implies that respondents with more years in occupation were less likely to hold strong beliefs about red tide compared to those with fewer years in occupation. Furthermore, average family monthly income exhibited a positive correlation (r-value = 0.186) with beliefs, and the p-value was 0.000. This indicates that respondents with higher family incomes tended to have stronger beliefs about red tide compared to those with lower incomes.

On the other hand, civil status, occupation, and highest educational attainment did not show significant relationships with respondents' level of beliefs on red tide. The p-values for these variables were above 0.05, indicating that any observed associations were not statistically significant. It is important to note that statistical significance does not imply causation. The relationships observed here indicate correlations but do not provide information about the direction or underlying reasons for the associations. Further research and analysis are necessary to better understand the factors influencing respondents' level of beliefs on red tide and their profiles.

Level of Practices and Profile Variate of the Respondent Beliefs. The data on the relationship between the respondents' level of practices regarding red tide and their profile variates is presented in Table 8.

Table 9. Relationship Between Respondents' Level of Practices on Redtide and their Profile Variates

Age	-.029		.566	Not Significant
Sex	-.036		.472	Not Significant
No. of Househol Members	.126*		.012	Significant
No. of years in Occupation	-.102*		.043	Significant
Ave. Family Monthly Income	.186**		.000	Significant
Civil Status	10.06	12	0.611	Not Significant
Occupation	12.73	15	0.623	Not Significant
Highest Educ Attainment	23.85	18	0.160	Not Significant

It was found out that their level of practices was not significantly related to their age and sex. Nonetheless, their level of beliefs was significantly ($p<0.05$) related to their number of household members, occupation, number of years in occupation, average family monthly income, civil status, and highest educational attainment.

The analysis indicates that age and sex did not show a significant relationship with respondents' level of practices on red tide. The p-values for these variables were above the significance level of 0.05, suggesting that any observed correlation is likely due to chance. However, several profile variates were found to have significant relationships with respondents' level of practices on red tide. The number of household members had a positive correlation (r-value = 0.141) with practices, and the p-value was 0.005. This suggests that respondents with more household members tended to engage in more practices related to red tide compared to those with fewer household members. The number of years in occupation showed a negative correlation (r-value = -0.285) with practices, and the p-value was 0.000. This indicates that respondents with more years in occupation were less likely to engage in practices related to red tide compared to those with fewer years in occupation. Furthermore, average family monthly income exhibited a positive correlation (r-value = 0.317) with practices, and the p-value was 0.000. This indicates that respondents with higher family incomes tended to engage in more practices related to red tide compared to those with lower incomes. Additionally, civil status, occupation, and highest educational attainment also showed significant relationships with respondents' level of practices on red tide. The p-values for these variables were below 0.05, indicating a statistically significant association. However, the evaluation does not provide specific information about the direction or nature of the relationship. It's important to note that statistical significance does not imply causation. The relationships observed here indicate correlations but do not provide information about the direction or underlying reasons for the associations. Further research and analysis are necessary to better understand the factors influencing respondents' level of practices on red tide and their profiles.

V. Conclusion and Recommendations

The Samareños' level of knowledge, beliefs, and practices concerning red tide reflects a community that is well-informed and actively engaged in addressing the impact of this natural phenomenon. This solid foundation of awareness and preparedness serves as a crucial asset for community resilience and effective management in the face of red tide events. By capitalizing on this knowledge and fostering practices through targeted educational initiatives and cross-occupational learning, the community can significantly enhance its resilience and adeptly manage the challenges posed by red tide occurrences. This proactive approach is essential not only for protecting human health, safeguarding livelihoods, and preserving the coastal environment but also for ensuring the overall well-being and resilience of the community.

Additionally, qualitative research that delves deeply into the factors shaping the social dimensions of red tide as perceived by respondents may be conducted to provide a nuanced understanding that can inform the development of a context-specific, comprehensive, and sustainable management plan for mitigating the impacts of red tide. Such an initiative will serve to enhance and fortify the resilience of communities affected by this recurring phenomenon. This may provide insights can then inform the development of sustainable management plans tailored to the specific needs and dynamics of the Samareños. By intensifying efforts to enhance resilience through a localized and community-centered approach, the affected communities can better navigate the impacts of red tide and emerge more resilient in the face of this recurring natural phenomenon.

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References

1. Azanza, R. V. (2007). Contributions to the Understanding of the Bloom Dynamics of Pyrodinium bahamense var. compressum: A Toxic Red Tide Causative Organism. *Science Diliman, 9.*

Bankoff, G. (1999). Societies in conflict: Algae and humanity in the Philippines. *Environment and History, 5,* 97-123. Retrieved from http://www.environmentandsociety.org/node/2999.

2. Berdalet, E., Fleming, L. E., Gowen, R., Davidson, K., Hess, P., Backer, L. C., ... & Enevoldsen, H. (2016). Marine harmful algal blooms, human health and wellbeing: challenges and opportunities in the 21st century. *Journal of the Marine Biological Association of the United Kingdom, 96*(1), 61-91.

3. BFAR (2014). Basic information on red tide and Harmful Algal Blooms (HABs). Retrieved from https://www.bfar.da.gov.ph/redtideinfo.jsp

4. Ching, P. K. (2013). Paralytic shellfish poisoning: Implications of absent red tide monitoring in a mussel farm- Visayas, Philippines, 2013.

5. Choudhury, M. U. I., Haque, C., Nishat, A., & Byrne, S. (2021). Social learning for building community resilience to cyclones: role of indigenous and local knowledge, power, and institutions in coastal Bangladesh. *Ecology and Society, 26*(1).
6. Echapare, E. O., Mendaño, R. V., Macha, M. G., Parrocho, R. M., Cabaguing, A. M., Tenedero, E. Q., & Alcantara, M. F. (2022). Knowledge, Beliefs, and Practices Scale (KBPS) Development: Social Dimension Measures of Red Tide Phenomenon. *IJRP, 102*(1), Published Date: 07 June 2022. doi: 10.47119/IJRP1001021620223305.
7. Echapare, E. O., Pacala, F. A. A., Mendańo, R. V., & Araza, J. B. (2019). Physico-chemical and microbial analysis of water in Samar mussel farms. *The Egyptian Journal of Aquatic Research*, 45(3), 225-230.
8. Enate, R.T., Diocton, R.C., & Macopia, J.L. (2013). Socio-economic profile of the Philippine National Aquasilviculture Program (PNAP) beneficiaries in Jiabong, Samar, Philippines.
9. Estudillo, R.A., & Gonzales, C.L. (1984). Red tides and paralytic shellfish poisoning in the Philippines.
10. Folio, F.M., & Yap-Dejeto, L.G. (2022). Phytoplankton Composition during a Period of the Red Tide Bans in 2017 in Irong-Irong Bay, Western Samar, Philippines. *Philippine Journal of Science.*
11. Hall, E., Nierenberg, K., Boyes, A., Heil, C., Flewelling, L. & Kirkpatrick, B. (2012). The art of red tide Science. *Harmful Algae*, 17, 1-5.
12. Herrera, D., Lavey, S., & Spiegler, S. (2012). Coastal Community Resilience to Natural Hazards: A Socio-Economic Policy Analysis of Communities along the Florida Gulf Coast.
14. Larkin, S. L., & Adams, C. M. (2007). Harmful algal blooms and coastal business: economic consequences in Florida. *Society and Natural Resources*, 20(9), 849-859.
15. Latitude (2018). Samar location. Retrieved from http://latitude.to/articles-by-country/ph/philippines/9047/samar.
16. Meniano, S. (2014). Samar mussel production deemed at risk. Retrieved from http://www.bworldonline.com/content.php?section=Economy&title=samar-mussel-production-deemed-at-risk&id=90963.
17. Meniano, S. (2020). BFAR Warns Anew vs. red tide in Eastern Visayas. Available online at: https://www.pna.gov.ph/articles/1119358 [accessed October 22, 2020].
18. Mirza Esmaeili, F., Mortazavi, M. S., Arjomandi, R., & Lahijanian, A. (2020). A study on red tide risk and basic understanding of fishermen and residents in Bandar Abbas, Hormozgan Province, Iran (Persian Gulf). *Iranian*

Journal of Fisheries Sciences, 19(1), 471-487.
19. Morgan, K., Larkin, S., & Adams, C. (2008). Public costs of Florida red tides: A survey of coastal managers.
Nierenberg, K., Byrne, M., Fleming, L., Stephan, W., Reich,
20. A., Backer, L., Tanga, E., Dalpra, D., & Kirkpatrick, B. (2010). Florida red tide perception: Residents versus tourists. *Harmful Algae*, 9(6), 600-606.
21. Philippine Statistics Authority. (2022, October 14). Poverty Situation in Eastern Visayas Year 2021. Retrieved from https://rsso08.psa.gov.ph/article/poverty-situation-eastern-visayas-full-year-2021#sthash.nZYIQZnj.dpbs
22. PSA (2016). Poverty situation in Eastern Visayas: 3 in every 10 families in Eastern Visayas are poor. Retrieved from http://www.nap.psa.gov.ph/ru8/default.asp
23. Ravelo, S.F., Yap-Dejeto, L.G., Silaras, M.L., Amparado, M.L., Ocampo, J.A., Abria, E.G., & Albina, M. (2022). A Snapshot on the Distribution of Coastal Phytoplankton Communities in Five HAB-Affected Bays in Eastern Visayas, Philippines. *Frontiers in Marine Science.*
Tacio, H. (2011). Red tide, dinoflagellates and health risks in the Philippines. Retrieved from https://www.gaiadiscovery.com/marine-life-latest/red-tide-dinoflagellates-and-health-risks-in-the-philippines.html.