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Assessing Community Willingness to Pay for Coral Reef Conservation: The Case of Palaui Island Protected Landscape and Seascape (PIPLS), San Vicente, Sta. Ana, Cagayan, Philippines

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Abstract:
Coral reefs are the most biologically diverse and economically valuable ecosystems on earth due to their ability to provide useful and vital ecosystem services for mankind. A study was carried out with 230 households on Palaui Island in San Vicente Sta. Ana Cagayan, Philippines to find out how much they would be willing to contribute towards conserving the coral reefs in the area. Various demographic and socio-economic factors of the respondents were analyzed using the Statistical Package for Social Sciences (SPSS) software. STATE 14.2 software was also used to examine how these factors influenced the households' willingness to pay (WTP) for coral reef conservation. Results revealed that several factors significantly impacted what people are willing to pay. This included their income, views on livelihood and survival, and their perceptions to coral reef conservation itself. On average, each household was willing to contribute about PHP 57.00 per month, which is roughly USD 1.01. If we could set up a system to collect these contributions, it would not only provide a much-needed source of funding but also ensure that there is a sustainable way to support coral reef conservation over time. If we consider all the households in the area, the total willingness to pay would be PHP 32,889.00 every month. Over five years, this could accumulate to nearly PHP 1,973,340.00 (or about USD 34,961.33). This potential funding could make a significant difference in how we manage and protect our coral reefs. It highlights the willingness of local communities to invest in the health of their environment and emphasizes the importance of community support in conservation efforts.

Keywords: coral reef; PIPLS; willingness to pay

1. Introduction

Coral reefs are the most productive, biologically diverse, and valuable in economic terms on our planet. These reefs offer a variety of essential services – provisioning, regulating, supporting, and cultural benefits- that are crucial for both nature and human communities. Unfortunately, they face numerous

challenges globally, including climate change, overfishing, habitat destruction, pollution, destructive fishing practices, and poor land management, which lead to sedimentation and reduced water quality.

In the Philippines, the geographical location also makes these reefs vulnerable to natural disasters like typhoons and floods, which can cause physical damage to coral communities. The coral reefs of Palaui Island are classified as fringing reefs, located on the eastern and southern portion sides of the island. The area between Palaui Island-specifically in places like Siwangag Cove, Aguab, and Cape Engaño- and the mainland Luzon is relatively flat, extending about a kilometer eastward into the Pacific Ocean. This reef covers roughly <10% of the area which is approximately 500,000 square meter (m^2) (DENR, 2001 cited by DENR-PAMB, 2010). Currently, the coral reef ecosystem in Palaui Island Protected Landscape and Seascape (PIPLS) is still in good shape, with about 70% health. It hosts 89 coral species across 27 genera, as identified by Villarao and Romero (2022) with 35 genera recorded in the study of Alinio et al., (2022). Out of the 488 coral species present in the Philippines (Nemenzo, 1981), 18% are known to exist in PIPLS (Villarao and Romero 2022) highlighting the rich biodiversity of this ecosystem. This variety not only supports an array of fish species but also vital for the livelihoods of local communities and the fishing industry.

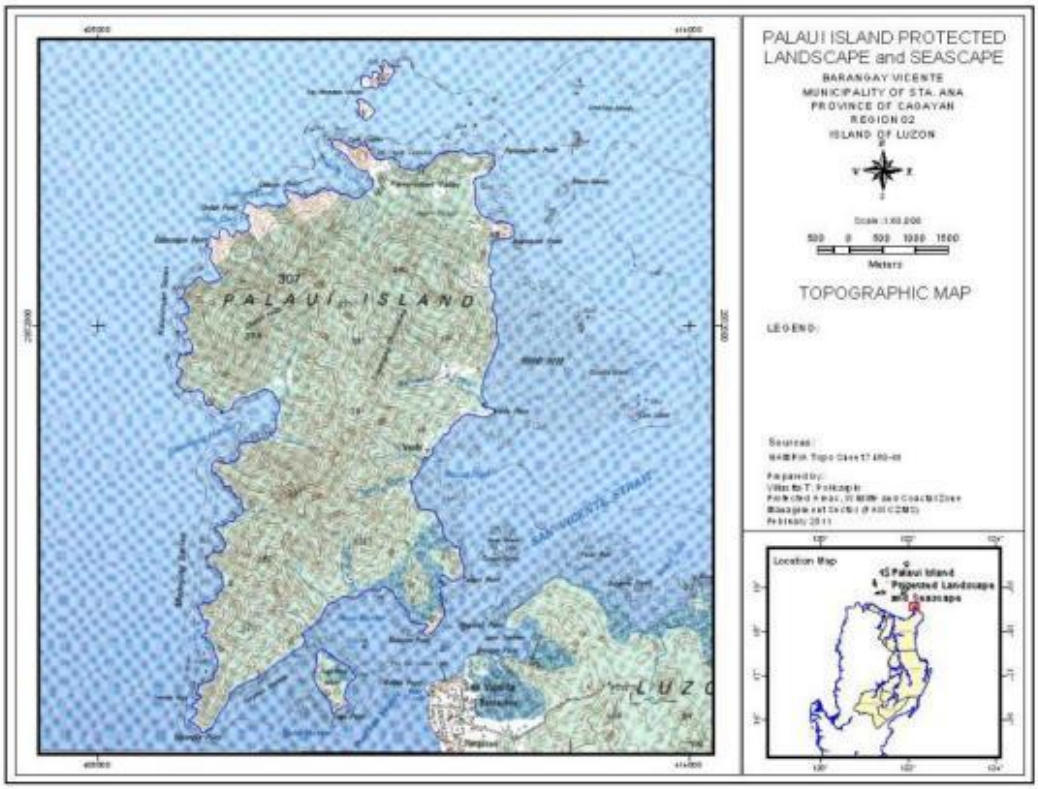
Given the importance of these reefs, the study was conducted to explore the coastal community in San Vicente, Sta. Ana, Cagayan, could engage in local protection and management efforts for the reefs. The outcomes of this research could provide valuable information for resource managers and policy makers, helping them create more effective conservation policies. Additionally, the findings could be used to assess damage in the wake of disasters like typhoons, which threaten these ecosystems. Ultimately, this information could lay a groundwork for implementing for Payment for Environmental Services (PES) in communities, ensuring the sustainable conservation of coral reefs.

2. Materials and Methods

2.1 Study Site

The study was conducted in Palaui Island Protected Landscape and Seascape in San Vicente Sta. Ana, Cagayan from May 2018 to June 2018. The island is situated within Barangay San Vicente of the Municipality of Sta. Ana, Cagayan, Palaui Island Protected Landscape and Seascape (PIPLS) spans between 18° 30’ to 18° 35’ North latitude and 122° 05’ to 122° 10’ East longitude. It is surrounded by Pacific Ocean on the east, The West Philippine Sea to the north and west, and the San Vicente Strait to the south, encompassing an area of 7,415.8 hectares of land and water (Figure 1). Barangay San Vicente is composed of seven (7) sitios namely Sitio Pacac, Sitio Alpha, Sitio Palaui, Sitio Pasiguit, Sitio Uma, Sitio Nangaramoan, and Sitio Dalupang. Each sitio contributes to the unique charm and character of the island, making it a special place for both locals and visitors alike.

Figure 1: Map of Palaui Island Protected Landscape and Seascape San Vicente Sta. Ana, Cagayan where the study was conducted



2.2.Data Collection

Prior to the conduct of the study, researchers seek first for the approval of the Protected Area Management Board (PAMB) of PIPLS. Data were collected primarily through household-based interviews conducted by trained enumerators. Secondary data from reports, master lists, profiles, and online sources were also gathered. Before the study, a survey questionnaire was pre-tested, and permission and assistance were obtained from the Barangay Captain's office in Barangay San Vicente.

Upon achieving the required sample size of 230 household respondents and adhering to the established methodologies and stipulations from the PAMB, Local Government unit (LGU) of Sta. Ana, and the Barangay Captain's Office, data collection commenced immediately. The household respondents were sources from Barangay San Vicente and its affiliated sitios via a ramdom sampling technique. Data collection employed an open-ended referendum approach, facilitating direct inquiries regarding the respondents' WTP for coral conservation, utilizing straightforward statistical methodologies outlines by Anderson (2007) and Togridou et al. (2006). This approach simplifies the calculation of mean and median WTP values, promoting relaxed environment for respondents, thereby mitigating the potential biases associated with starting points hypothetical scenarios (Haneman, 1984).

An initial interview schedule was implemented to elucidate the survey instrument's questions and provide necessary clarifications. This included formatting targeted inquiries aimed at gauging respondents' WTP for coral conservation initiatives. Subsequently, a focus group discussion (FGD) was conducted to extract pertinent data regarding coral reef ecosystems' current status. Insights gathered from the discussion informed the development and refinement of the questionnaire.

The finalized questionnaire consisted of four (4) distinct sections. Section A captures the Socio-economic

and demographic profiles of the respondents. Sec B pertains to the respondents' awareness of the importance and threats facing coral reef ecosystem. Section C pertains to the perception regarding livelihoods, survival, conservation efforts, and government roles. Section D pertains to the respondents' WTP for coral reef conservation programs, categorized as binary response (YES/NO). Following this, a subsequent question solicited the specific monetary contribution the respondent was willing to make toward various conservation initiatives, encompassing coral reef monitoring, fish and water quality assessments, information, education, and communication (IEC) efforts, and enforcement activities.

2.3.Data Analysis

Descriptive statistics and percentages were employed in describing the information obtained from the respondents. A binary logistic regression analysis was then utilized to provide empirical evidence through the software STATA version 14.2. Identified factors affecting willingness to pay in coral reef conservation program were analyzed using the discrete "willing to pay" or "not willing to pay" was employed in logistic regression model with the formula below. The WTP model was specified following the work of Haneman (1984):

$$V\ (M - P, Q^{l}, S) > V\ (M - 0, Q^{\circ}, S)$$

Where M is the income, P is the price, Q^1 if the respondents answered yes and Q^0 if the respondents answered no and S is the socio-economic characteristic of the respondent. The equation shows that the respondents answered yes when the utility he/she derived from the program (Q^1) and paying the price (P) was higher than not having a program (Q^0) and paying the price (P=0).

If V (P, M, Q, S) is the observable component of the utility, the probability of the respondents saying yes was expressed as:

$$\text{Prob(Yes)} = \text{Prob}[V(M, P, Q^{l}, S) + \ (i > V(M, P, Q^{\circ}, S) + \ (0)]$$

where (i s are observable components of the utility. Assuming that the random variable (i followed a logistic probability distribution this can be written as:

$$\text{Prob (Yes)} \ = \frac{1}{1 + e - \Delta}$$

Where $-\Delta = \ V(M - \ P, Q1, S) \ \ > \ \ V(M - \ P, Q0, S)$

Thus, the non-use value benefit of the hypothetical market (to conserve the coral reef ecosystem of PIPLS) was defined as:

$[V(M) - WTP, Q^{l}, S) > V\ (M - P, Q^{\circ},S)]$

Haneman (1984) showed that with a linearly specified indirect utility function V (M - P, Q, S), then:

$$\text{Log}\ [\ \frac{1\text{Prob(Yes)}}{1 - \text{Prob(Yes)}} = (_{\circ} + (^{1}\ P + (^{2}\ Q + ((iSi)]$$

Parameters ($_0$ and (i were estimated parametrically using the logistic regression technique which was done using the Binary Logit Model in STATA. But before the model was applied to analyze the effect of explanatory variables on WTP, variance inflation factor (VIF) was applied first to test the collinearity between various explanatory variables. It was computed as:

$$\text{VIF (Xi)} = 1/1 - \text{VIF (Xi)}$$

where R^2 is the coefficient of determination in the regression of one explanatory variable (X) on the other explanatory variables (X_i). If there was no collinearity between regressors, the value of VIF is 1. A VIF value of a variable exceeds 10, which happens when Ri^2 exceeds 0.90, the variable was said to be highly collinear (Gujarati 2004). Contingency coefficients were also estimated to see the degree of association between the dummy explanatory variables. A value of 0.75 or more indicates a stronger relationship between the variables (Healy 1984). The contingency coefficients (C) were computed as CC.

$$CC = \sqrt{\frac{x^2}{N + x^2}}$$

Where CC is the coefficient of contingency, x^2 is the chi-square and N is the total sample size. The Pseudo R^2 and the chi-square were used to measure the goodness of fit of the model and the significance of the model used. The mean maximum WTP for the coral reef conservation in PIPLS was calculated using the formula:

$$\text{Mean WTP} = \frac{1}{\beta 1} = [\ln\ (1 + e\ + (^1\alpha 0 + \ \beta 2\ Q + \ \Sigma Bi\ Si)]$$

3. Results and Discussion

3.1. Socio-demographic Profile of the Respondents

Table 1 presents a summary of statistical data for the variables utilized in the logistic regression model. The demographic respondents indicate a predominance of males (63.4%), with ages ranging from 29 to 79 years, and an average of 45 years, The age distribution aligns with the economically active population bracket defined in the Philippines which is 15-64 years old (PSA, 2023) and in Japan which is 20-69 years old (Ishibashi, 1998). Mwamunyange (2008) underscores that age is a critical factor in individual maturity and the prosperity to make informed decisions, suggesting that the adult demographic surveyed is capable of rational decision-making regarding the WTP for coral reef conservation initiatives.

Table 1: Summary of Statistics for Model Variables used in the Logistic Model.

Variables	Description	Mean	Std. Dev.
Gender	1 if male, 0 if otherwise	1	0.47
Age	In years	45.48	10.56
Education	In years	7.54	3.38
Household size	in numbers	5.27	2
Income	Annual income in PhP	81,383.71	69,494.43
Residency	In years	39.15	13.89
Membership to Environmental Organization	1 if member, 0 if otherwise	0.27	0.44
Awareness	1-SDA, 2- D, 3-NS, 4- A and 5 – SA	4.41	0.7

Perception towards livelihood and survival	1-SDA, 2- D, 3-NS, 4- A and 5 – SA	4.51	0.75
Perception towards coral reef biodiversity conservation	1-SDA, 2- D, 3-NS, 4- A and 5 – SA	4.29	0.83
Perception towards government	1-SDA, 2- D, 3-NS, 4- A and 5 – SA	4.41	0.9

Educational attainment among respondents revealed that significant proportion did not complete high school, with an average schooling of only six (6) years, which corresponds to elementary education. Nevertheless, this level of education appears sufficient for respondents to comprehend the significance of coral reef conservation.

In terms of household composition, the average household consisted of five (5) members, three of whom were children. The primary source of livelihood for these households was predominantly fishing-related activities, including fish processing and fish vending. On the contrary, the recorded average monthly income of PHP 6,781.00 falls below the national poverty threshold. In 2021, the Philippine Statistics Authority (PSA) reported that a monthly income of PHP 12,030.00 was necessary to remain above the poverty line, while PHP 8,379.00 was required to satisfy basic needs (PSA, 2021).

With respect to community engagements, a substantial portion of respondents were affiliated with non-environmental groups, although only 25.7% were linked to environmental groups such as the Palaui Environmental Protectors Association (PEPA) and the San Vicente Environmental Protectors Association (SVCEPA). The average duration of residency among respondents was 39 years, with the longest duration being 78 years, represented by the oldest participant in the study.

3.2.Factors Affecting Willingness to Pay

The variance inflation factor (VIF) was used to examine whether there were any collinearity issues among dependent and independent variables. Results indicated that there is no sign of collinearity, aligning with the guidelines established by Gujarati (2004). Additionally, pairwise correlation analysis supported the findings of the study by demonstrating that there is no collinearity exist. According to Mitchell and Carson (1989), a contingent valuation study can be considered acceptable if it has an r^2 greater than 0.15 with a limited number of key variables. In our study, the r^2 value was found to be 0.19 suggesting that there are ternal factors influencing the WTP of the respondents.

The log-likelihood ratio for the chi-square distribution among household respondents was calculated to be -77.42, with a chi-square probability of 0.0004, which is less than the 5% significance level (Table 2). Out of 11 explanatory variables included in the study, only four (4) showed significant effects on WTP at 5% and 10% levels. However, the discussion will focus solely on those variables that were statistically significant at the 5% level. When it comes to economic factors, the study found that the estimated coefficient for income was both positive and statistically significant at the 5% level. This indicates that as gross income increases, so does the WTP.

Table 2: Results of Binary Logit Model for the Variables

Variables	Coefficient	Odd Ratio	p-value
Income	1.33	3.80	0.001*
Education	0.44	1.56	0.25
Household size	-0.09	0.91	0.41

Age	0.04	1.04	0.10**
Gender	-0.54	0.57	0.25
Residency	-1.10	0.33	0.22
Member	0.18	1.20	0.72
Awareness of the importance and threats to coral reefs	0.22	1.25	0.46
Perception towards Survival	1.01	0.36	0.01*
Perception Towards Coral Reef Biodiversity	0.74	2.1	0.01*
Perception towards the Government	0.10	1.10	0.69
Constant	-11.72	8.12E-06	0.02

*Note: *significant at α=0.01., ** significant at α=0.10.*

Notably, the odds ratio for income was 3.80, suggesting that households in higher income brackets are over three (3) times more likely to express willingness to pay compared to those in lower income brackets, all else being equal. Specifically, WTP increase by 0.11, consistent with the economic theory that posits that individuals with higher incomes are more able to purchase goods and services and therefore more likely to pay. This trend was supported by other studies, indicating that higher income respondents are more inclined to invest in environmental conservation efforts. They tend to value environmental protection more that respondents with lower incomes, who often see their limited financial resources as a barrier to valuing natural resources and environmental services (Seenprachawong, 2001). Kamri (2013) also noted that both income and education are crucial variables in research samples, asserting that higher income corresponds with greater WTP.

On the contrary, the education variable in this study did not show a significant impact on WTP, supporting the findings of Bradecina et al., (2011). Perception of livelihood and survival was found to have a positive correlation with respondents' WTP. An odds ratio estimated 0.36 indicating that households with lower perception on the importance of conservation for their livelihoods are less likely to pay than those with higher perceptions, assuming other factors are constant. This suggests that lack of understanding about significance of coral reef ecosystem conservation may diminish WTP. Many respondents rely on fishing for their income, and they may view conservation efforts as potential threats to their livelihoods due to restrictions and regulations that could limit their fishing activities.

Additionally, respondents who have a higher and more positive perception of coral reef conservation were twice as likely to express WTP for conservation initiatives compared to those with negative or low perception. This aligns with previous study of Zarrintaj (2011), showing that a person's educational background can significantly impact their awareness and perceptions of environmental issues. Despite many respondents having only elementary education they still demonstrated a strong understanding and awareness regarding resource management and conservation practices.

Table 3 presents the distribution of WTP responses for coral reef conservation program. The majority of responses, 72.87%, ranged from PHP 10.00 to PHP 100.00. The lowest reported WTP was PHP 30.00, while the highest reached PHP 800.00. On average, households expressed a WTP of PHP 57.00, which is higher than the median WTP of PHP 50.00. The standard deviation for these values was 76.88, indicating a wide variety of responses. Notably, 68.7% of households indicated a WTP, compared to 31.3% who did not.

Table 3: Distribution of Willingness to Pay Responses of the Respondents.

Ranges of WTP Amount	FREQUENCY (N)	PERCENTAGE (%)
PhP 10.00 -100.00	137	72.87
PhP 101.00 - 200.00	17	9.04
PhP 201.00 - 300.00	2	1.06
PhP 301.00 - 400.00	0	0
PhP 401.00 - 500.00	1	0.53
PhP >501.00	1	0.53
STATISTICS	Mean WTP - PhP 57.00 Median WTP - PhP 50.00 Min WTP= 30, Max WTP= 800	
	Std. Dev. 76.88	

By extrapolating the average WTP of PHP 57.00 (or about 1.01 USD at an exchange rate of PHP 56.44 to 1 USD as per BSP 2024) from the 68.7% of the local household population, which consist of 841 households, the total expected WTP for the coral reef conservation initiative amounts to PHP 32,889.00 per month (or 582.69 USD). Over five (5) years, this could generate approximately PHP 1,973,340.00 (around 34,961.33 USD). This figure represents the total contributions anticipated from households in San Vicente Sta. Ana Cagayan and its surrounding areas for the five-year duration of the program. If the collection of these funds is formalized alongside the WTP, it could create a sustainable financial resource for the local government. While the minimum amount that the household can contribute is PHP 30.00, some households may struggle to make monetary contributions. However, they are still willing to support the program in non- monetary ways, such as offering their boats for patrols or assisting with awareness campaigns. To reflect the value of this in-kind support, the cost of hiring a boat for a full day, which is PHP 800.00 was considered. This only suggests that the local community is highly aware and holds a positive attitude toward conservation, which positively influences their WTP.

Generally, even though the mean WTP figures are relatively low, this is common in developing countries like Philippines where immediate survival often takes precedence over environmental issues.

3.3.Awareness of the Importance and Threats to the Coral Reef Ecosystem

Table 4 illustrates that a significant proportion of the respondents exhibited a high level of awareness on coral conservation, despite many having only elementary education. Specifically, 54% of the respondents agreed on the importance of various conservation and management strategies for coral reefs, achieving a mean score of 4.4. These strategies include the establishment of Marine Protected Areas (MPAs), creation of protected landscape and seascapes, regular monitoring and assessment of reef health. Development of comprehensive coastal land use plans, and the implementation of information and education campaigns along with training initiatives.

Table 4: Awareness of the Importance, Threats, and Conservation and Management Measures of Coral Reef Ecosystem

Statement	Mean	Std. Dev.	Description (Likert scale)
Establishment of a Protected Area, coral reef monitoring and assessment, establishment of Landscape and seascape, Creation	4.43 (54%)	0.83	Agree

of Coastal Land Creation of Coastal Land Use Plan, and conduct of IEC and training are some of the conservation and management measures for coral reef conservation.			
The coral reef ecosystem serves as a breeding ground and nursery ground for different forms of marine life.	4.4 (60%)	0.81	Agree
Threats to the coral reef ecosystem and its biodiversity come from a wide variety of aspects like increasing population, habitat loss, degradation, sedimentation, and unsustainable use of resources.	4.5 (63%)	0.74	Strongly Agree

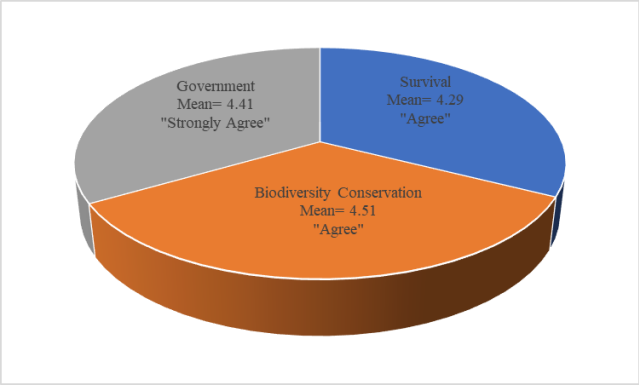
On the other hand, the same percentage of respondents (54%) acknowledged that coral reef ecosystems serve as critical breeding grounds for diverse marine life, again reflecting a mean score of 4.4. Respondents noted the prevalence of juvenile fish and other organisms within coral reef habitats, which provide essential resources for feeding, shelter, and breeding.

Furthermore, a substantial 63% (mean score = 4.5) of household respondents expressed strong agreement concerning the myriad threats faced by coral reef ecosystems. These threats stem from various factors, including population growth, habitat loss, environmental degradation, sedimentation, and unsustainable resource exploitation.

3.4.Perception towards Livelihood and Survival, Biodiversity Conservation, and Government

Respondents' perceptions can influence the decision-making process and behavior of each individual. Perception represents the formation of an individual state of mental awareness that is affected by internal and external environmental stimuli such as economic, social, and cultural influences (Radam et al., 2010).

Figure 2: Perception of Household Towards Coral Reef Ecosystem Conservation



Notably, 34% of the household respondents have a high perception that coral reefs biodiversity needs conservation (Figure 2). A healthy ecosystem harbor a diverse fish species and other marine organisms harvested by the fishermen, thus local community should also help in the active campaign for its conservation in order to sustainably provide the services needed by the local community. The positive perception of the local community could be attributed to the nature of their livelihood (e.g. fishing, fish vending, and fish processing) wherein most of the respondents are mainly fishers that are very much dependent on the fisheries resources for livelihood. Thus, a high and positive perception was also noted when it comes to perception of local community towards livelihood and survival. According to Wesseler (1999), fish is the major source of animal protein for most Filipinos even though meat consumption

exhibited steady growth rates, daily consumption was only one-third that of fish. Thus, most of the respondents are very much aware that fish in the coral reef ecosystem serve as food for the respondents. Meanwhile, 33% has a high perception towards the government, and agreed that conservation programs in PIPLS must be financed by the government. They believed that programs like this have its own budget from the national agencies and other institutions. The government has still the biggest responsibility when it comes to financing conservation programs in the area. However, they are still willing to contribute at a minimal amount because of their limited income since according to the respondents they are also benefited on then services that the coral reef ecosystem provides. The high level of awareness and perception of the community could be due to various training and public educations on resource conservation and management conducted since the start of CEP in PIPLS (Calicdan et al., 2016) The declaration of Palaui Island and its surrounding waters as Marine Reserve in August 1994 under the category of Protected Landscape and Seascape based on R.A. 7586 (National Integrated Protected Area System Law). Since the time of its declaration, an intensive IEC campaign and participation of all stakeholders and other People's Organizations (POs) were encouraged to participate from the decision-making to the implementation stage. The local community was represented by the members of POs of the area (e.g. PASAMOBA, PEPA, SAMOBA, SVCEPA, Barangay Council, SK, and RIC) which are also one of the 14 stakeholders of PIPLS. Intensive IEC campaigns, dialogues, seminars, and training had been conducted by different Civil Society Organizations (CSO's), and the Local Government Unit (LGU's) and national agencies like Bureau of Fisheries and Aquatic Resources, Department of Environment and Natural Resources, Philippine Coast Guard, and Philippine Navy that boosted the awareness of the local community (Calicdan et al., 2016). The knowledge of some respondents was gained through mass media (e.g. radio and television), some casually heard from their neighbors and some acquired based on their fishing experience. As observed, respondents who have little knowledge and low awareness of coral reef conservation were those who are not connected to any environmental groups and are not environmentally aware with regards to the coral reef ecosystem.

4. Conclusion and Recommendations

The residents recognize that the good condition of the coral reef ecosystem in the area could increase their catch. Therefore, residents are more willing to pay for its conservation. Consistent with rational choice behavior, the majority of the respondents expressed a positive attitude which served as a good indicator of the role that the respondents can play in the purpose of coral reef conservation of PIPLS. If the resource could be conserved it could continually provide the services and benefits, particularly on fisheries for the welfare of the people living near the ecosystem. WTP should also be conducted to resort owners and tourists and this should be conducted to the whole ecosystem services of PIPLS to give a total picture of the WTP of the whole community and the resources of the island. Residents should also be empowered with the knowledge particularly those residents who have very low awareness and perception towards conservation. Their activities could negatively or positively impact the conservation, hence empowering them could improve the status of the conservation program. Further studies should be conducted on motivating factors that contribute to willingness to pay for coral reef conservation, incentives that encourage residents to promote conservation, and the compensation of residents coupled with education programs that can increase the level of awareness and perception of the respondents who have negative views on the conservation program. If such a program is implemented, all proceeds will be given to PAMB to manage which serves as a trust fund for conservation. It is important to remember that the task and

responsibility of conserving the coral reef ecosystem and its biodiversity are not solely appointed by the government and legal authority involved, it is a matter of cooperation among the particular authority and the public.

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