



IMPACT ASSESSMENT OF THE INTEGRATED COASTAL RESOURCE MANAGEMENT ON THE LIVELIHOOD OF SMALL-SCALE FISHERS IN CUATRO ISLAS, LEYTE

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This study evaluates the impact of Coastal Resource Management (CRM) project implemented in Cuatro Islas Protected Landscape and Seascape (CIPLS). Aside from environmental goals, CRM aims to promote economic development through livelihood opportunities among households. Using cross-sectional data from 450 fishing households, we estimate the impact of CRM on fish catch, income and livelihood diversification. To do this, a quasi-experimental approach was used to estimate a comparable control group using propensity score matching technique. Descriptive statistics show that fishers are mostly men, married, and have at least elementary level of education. On average, fishers are 45 years old with four household members and have an average monthly income of PHP 4,581.73. The Mann-Whitney U test shows a significant difference in travel time, fishing hours, fishing revenue, fishing variable cost, and fishing gross income between the treated group (CIPLS) and comparison group (Pitogo fishers). Propensity Score Matching (PSM) reveals that CRM increases the fish catch of CIPLS fishers by 2.395kg a day, monthly income by PHP 1,595.50, and livelihood diversity by 0.275. This study recommends that CRM can be implemented in other

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island communities as a potential approach to improve socio-economic status of the fishers.

Keywords: coastal resource management, small-scale fishing, propensity score matching

1. INTRODUCTION

The agriculture and fishery sectors play an important role in poverty reduction and economic growth in the developing countries. However, the Philippine fisheries production has been on a declining trend indicating depletion of marine resources due to the combined impact of human overexploitation of marine resources, destructive fishing methods, pollution, climate change, and illegal and improper shoreline development (Espinosa et al., 2018; DENR 2013). Lower fish catch affects fishers' livelihood and income thereby contributing to worsening poverty incidence. This will have implications in terms of food security where food poverty is reportedly impacting close to 30% of the population in the Visayas region (Giles et al., 2019). According to Philippine Statistics Authority (PSA) (2023), fisherfolks are among the top with high poverty incidence. In Eastern Visayas, the reported poverty incidence of fisherfolks remains relatively high at 30.6% (PSA, 2023).

One of the emerging solutions to address food security, poverty and livelihood challenges in the coastal areas is the promotion of coastal resource management (CRM). This coastal management emphasizes on the integrated approach highlighting the role of local government and local communities in managing coastal resources and habitat management (Courtney & White, 2010). CRM advocates for multisectoral collaboration as a standard process in achieving the desired outcomes and promoting sustainability.

A CRM project was implemented in Cuatros Islas in Leyte province. Cuatro Islas refers to the four small islands that are rich in coastal and marine resources which is the major source of food and income of the residents; fishing is the major livelihood of the community. However, the study of Castillejos et al. (2018) revealed that Cuatro Islas is associated with the risks of environmental deterioration brought by pollution, improper waste disposal, and poor sanitation within the areas. Cuatro Islas has a diverse assemblage of seagrass species as determined by their community structure exposed to different levels of socio-economic activities. Further, changes in abundance, species composition, and structure of seagrass beds are due to the negative impact of human and socio-

economic activities. The researchers emphasized the necessity to take immediate measures for the rehabilitation and conservation of the coastal and marine resources of Cuatro Islas. Also, development projects like the establishment of industries, ports, tourism programs, and various sources of livelihood must be taken into consideration for the capacity of our natural resources, ensuring not to harm the environment (DENR 2013). Rehabilitation, conservation, and management of natural resources are the least human can do to save the environment (Ureta, 2016).

This study was conducted to assess how coastal resource management (CRM) impacted Cuatro Islas Protected Landscape and Seascape (CIPLS) by investigating the socio-economic indicators of fishers. The CRM project was jointly implemented by the Department of Biological Sciences (DBS) and the Institute of Tropical Ecology and Environmental Management (ITEEM) of the Visayas State University (VSU) from the year 2015 to 2017. The VSU CRM project was implemented with the support of the 5th district of Leyte local government units and other cooperating agencies. However, the rehabilitation of Cuatro Islas started in 1993 by implementing a community-based marine sanctuary and providing an alternative livelihood program to improve the living status of the coastal communities. The intervention conducted by the VSU CRM project focused on building local capacity and enriching knowledge and awareness through training and seminar, implement and improve sanctuary, promotes tourism, and provide alternative livelihoods. Aside from improving the coastal and marine resources, CRM aims to improve the livelihood and socio-economic status of the CIPLS fishers. Coastal resource management (CRM) is a holistic approach and widely accepted management framework to address coastal and marine environmental problems to achieve sustainable use of resources (Pollnac & Pomeroy, 2005). It uses the concept of community-based resource management that considers the interactions between and among resource systems and the coastal populace in the economically and ecologically sustainable management of resources. According to Munoz of the Department of Agriculture (DA), Philippines, the integrated CRM project improved the income of municipal fisherfolks by 30-40 % from increased catch and additional income from the alternative livelihood of the project. The research concluded that integrated CRM made a significant achievement in coastal resources in the Philippines to more efficient and responsible management.

Figure 1 shows that hypothesized impact of CRM on the fish catch, livelihood diversity, and income of CIPLS fishers based on the research of Munoz of DA. This framework was adapted from the study of Serriño et al. (2021) on the impact of super typhoon Haiyan (Yolanda) on the livelihood of coconut farmers

in Leyte, Philippines. This impact assessment study aims to evaluate the effect of capacity building activities whether it translated into the desired outcomes of improving livelihood. Figure 1 shows that if the project outcomes were adopted, it will be translated to improve outcomes influencing positively income of fishers, their fish catch and contribute to increasing livelihood opportunities.

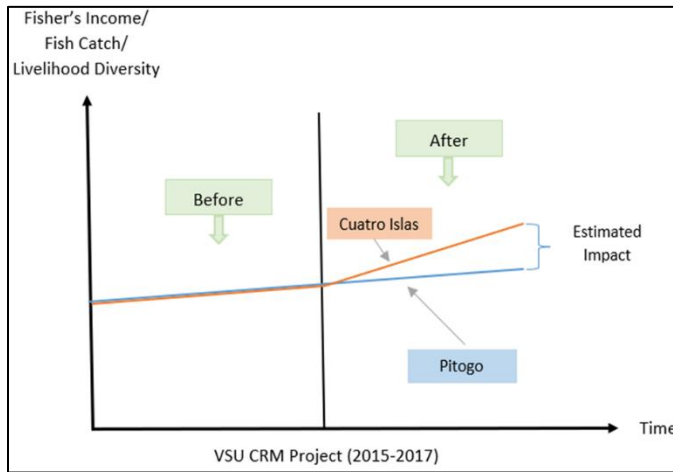


Figure 1. The theoretical framework of the impact of VSU CRM on the livelihood of small-scale fishers of Cuatro Islas (adapted from Serriño et al., 2021)

The main objective of this study is to assess the socio-economic impact of CRM on the livelihood of small-scale fishers in CIPLS. The specific objectives are: (a) describe the socio-demographic profile of respondents, (b) compare the fishing productivity between groups, with and without VSU CRM, and (c) estimate the impact of VSU CRM on fish catch, income, and livelihood diversity of small-scale fishers of Cuatro Islas.

The data of this study uses the fishing information of the last quarter of the year 2022 (October, November, and December). This impact analysis focuses on the socio-economic aspects only, environmental impact or the biodiversity data are not included in the study. The result of this study will be useful not only to the local fishers but will serve as a reference to the CRM project implementers like VSU, Department of Environment and Natural Resources (DENR), Bureau of Fisheries and Aquatic Resources (BFAR) and local government units.

2. METHODOLOGY

Following Pleños et al. (2020) and Nuñez et al. (2023), the quasi-experimental approach was used to evaluate two independent groups, VSU CRM's beneficiaries or CIPLS fishers (treatment group) and the control group or Pitogo fishers (Figure 2). The treatment group are fishers from Cuatro Islas. The Cuatro Islas is a collective term composed of four islands: Apid, Digyo, Mahaba (Inopacan), and Himokilan (Hindang) located in Western, Leyte of Eastern Visayas, Philippines. The Cuatro Islas are located in the municipalities of Inopacan and Hindang, Leyte in Eastern Visayas. Cuatro Islas is a famous ecotourism site in the Leyte Region as it has four magnificent and picturesque islands with white-sand beaches that are surrounded by crystalline water. Its beauty attracts more tourists to visit the islands that offer different activities such as island hopping, reef diving, swimming, snorkeling, and kayaking.

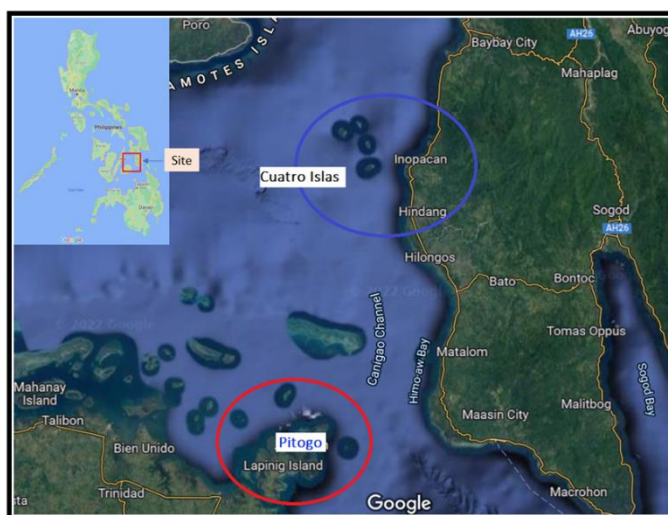


Figure 2. Map of the study's location (source: Google maps, 2022)

To assess the outcomes of the VSU CRM project, we identified a comparison group. The comparison group was composed of small-scale fishers from the islands of Gaus, Butan, and Bantigue Islands of Pitogo. Pitogo is also known as President Carlos Garcia under the jurisdiction of the province of Bohol, Central Visayas, Philippines. Both sites are composed of small, isolated islands. The socio-economic status of the two groups is similar, Inopacan as 4th class and Hindang as 5th class municipality while Pitogo is 4th class municipality. Cuatro

Islas is a marine protected area (MPA) while the Gaus, Butan, and Bantigue islands of Pitogo have locally managed sanctuaries and VSU CRM project was not implemented in Pitogo areas.

Cross-sectional data were gathered through face-to-face interviews of small-scale fishers using the KOBOLCollect Application. Four hundred fifty respondents participated in the survey (treatment=200, control=250). The data collection was conducted during the 1st quarter of 2023. KOBOLCollect is an open-source Android app for collecting data instead of printed questionnaires to save money and time and to have organized data. KOBOLCollect can be easily installed on the enumerator's phone. It contains a form composed of a series of questions that need to be filled in by the enumerator during conducting the interview. Some questions and variables were changed and improved after the conduct of the pre-test of the survey instrument. Moreover, the researcher conducted a courtesy call before the on-site interview and/or gave letters to the barangay captains providing information about the study. The respondent's consent was asked before the interview and ensured the privacy, confidentiality, and anonymity of the respondents.

The primary data collected was analyzed using STATA (an integrated statistical software package) including descriptive analysis, Mann-Whitney U test, and propensity score matching (PSM). Descriptive Analysis was used to analyze the socio-demographic characteristics of fishers and fishing characteristics that include averages, percentages, counts, and ranges that were presented in tables. For the comparison of fishing productivity, the Mann-Whitney U test, a non-parametric test was used to check significant differences between groups without any assumptions of the parameters. As CRM beneficiaries were not randomly selected and no available baseline data, propensity score matching (PSM) was used to evaluate the impact of CRM on the socio-economic status of fishers by comparing the treatment group (CIPLS fishers) and control group (Pitogo fishers). Through PSM, potential sample selection bias will be reduced (Seriño et al., 2021; Gertler et al., 2011). Comparison of outcome variables was evaluated using matched respondents from the treatment and control group with similar socio-demographic characteristics. The three algorithms (nearest neighbor, radius, and kernel matching) were employed to check the robustness of the result. The variables age, sex, civil status, education, household size, spouse working status, boat ownership, and type of boat were used as indicators in matching the respondents. These variables were considered indicators as they were recognized to have important relationships and assumed as significant factors in the outcome variables based on the related studies (Cavatassi et al., 2019; Keppeler et al., 2020;

Pleños et al., 2020; Tikadar et al., 2022; Yang et al., 2022). The propensity score is the probability of a fisher being a beneficiary of the CRM project, given a similar pre-condition of socio-economic characteristics. Propensity scores were estimated through the probit model as follows:

$$P_i = E(T_i = 1 | X) = \beta_0 + \beta_1 \text{age}_i + \beta_2 \text{married}_i + \beta_3 \text{educ}_i + \beta_4 \text{male}_i + \beta_5 \text{hsize}_i + \beta_6 \text{wspouse}_i + \beta_7 \text{bown}_i + \beta_8 \text{bmotor}_i + u_i \quad (1)$$

where:

- P_i = probability of the fisher being a VSU CRM beneficiary
- E = the expected value of being part of the VSU CRM beneficiaries given the socio-demographic indicators
- T = 1 if the fisher is a VSU CRM beneficiary and 0 for non-beneficiary
- X = is a set of explanatory variables
- β_0 = is the intercept
- β_i = the regression coefficients

The explanatory variables/ indicators include the following:

- age = respondent's age in years
- married = fisher's marital status (1 for married and 0 otherwise)
- educ = years of education of fisher-respondent
- male = male respondent (1 for male and 0 for female)
- hsize = household size
- wspouse = dummy variable for spouse's employment status (0=spouse is not working, 1=spouse is working)
- bown = fishing boat ownership (1 for owned and 0 otherwise)
- bmotor = dummy variable for boat type being used (0= none/non-motorized boat, 1= motorized boat)
- u_i = remaining error term
- i = refers to the individual fisher

On the other hand, the matched treatment and control respondents were used to estimate the average treatment effect on the treated (ATT). ATT is the difference of means between the two groups after matching. It is the average difference in outcomes (fish catch, livelihood diversity, and monthly income) among matched groups of fishers from two groups. ATT measures the economic

impact of the VSU CRM project for those fishers that benefited from the project or the CIPLS fishers who received the VSU CRM project not for the entire population of fishers unlike ATE (average treatment effect), it measures the impact or the average effect across all fisher's population (Seriño et al., 2021). This is the estimated impact of CRM which is expressed in ATT form:

$$ATT = E(Y^1_i - Y^0_i | T_i = 1) \quad (2)$$

$$ATT = E(Y^1_i | T = 1) - E(Y^0_i | T = 1) \quad (3)$$

Then, the impact estimates of matched treated and control respondents were compared using a T-test. The T-test will determine if the difference in outcomes between the two groups is significant. If there is no significant difference or close to zero, it means that the CRM project is not effective in terms of the outcome variables; it has no impact on the variable of interest.

3. RESULTS AND DISCUSSION

Socio-demographic profile of Fishers

Respondents were classified into two groups, treatment group and comparison group. The treatment group or the small-scale fishers of Cuatro Islas Protected Landscape and Seascape (CIPLS) where the CRM of VSU has been implemented and the control group or the small-scale fishers of Pitogo (no CRM of VSU implemented). Table 1 shows the demographic characteristics of fishers in both locations. In most cases, fishers are mostly male while female is very rare which is true in Cuatro Islas. However, there is a different scenario in Pitogo where 19.2% of the fishers are female. Female residents in Pitogo usually the wives, are participating in the fishing activity of their husbands because there is no other livelihood that will help them earn income to support the needs of their families. Unlike Cuatro Islas, women are doing other activities aside from fishing like mat weaving and other Romblon products which help them earn extra income to sustain their family needs.

The majority of the fishers are married and with an average age of 45 years old for both groups. In terms of education, the average number of years is 6.3 in Cuatro Islas and 6.9 in Pitogo. On average, fishers are mostly elementary graduates.

In terms of household structure in Cuatro Islas, 4 is the average household size, 1 member working, 3 dependents, and 1 dependent in school. While in Pitogo, 5 is the average household size with 2 working members and 3 dependents where 2 dependent members are in school. On average, fishers-respondents are residents of Cuatro Islas for 35 years and Pitogo fishers for 37 years. Both fishers have an average fishing experience of 25 years.

On the other hand, the average monthly income of CIPLS fishers is PHP 5,672.00 which is higher compared to Pitogo fishers' monthly income of PHP 3,709.52. Income refers to the average monthly income for all income sources or livelihoods of fishers during the last quarter of 2022.

Table 1. Socio-demographic characteristics of fishers

VARIABLE		CUATRO ISLAS w/ VSU CRM n = 200	PITOGO w/o VSU CRM n = 250	OVER- ALL n=450
Sex	Male (%)	97.50	80.80	88.20
	Female (%)	2.50	19.20	11.80
Civil Status	Married (%)	83.00	88.80	86.20
	Single (%)	15.00	7.20	10.70
	Separated (%)	1.50	2.00	1.80
	Widow(er) (%)	0.50	2.00	1.30
Age	Mean	45.17	45.03	45.09
	Standard Deviation	14.32	13.01	13.59
Education (years)	Mean	6.30	6.89	6.62
	Standard Deviation	3.13	3.05	3.10
Household Size	Mean	4	5	4
	Range	1-10	1-12	1-12
Household Workforce	Mean	1	2	1
	Range	1-4	1-5	1-5
Household Dependents	Mean	3	3	3
	Range	0-8	0-10	0-10
Dependents in School	Mean	1	2	1
	Range	0-7	0-8	0-8
Years of Residency	Mean	35.17	37.64	36.54
	Standard Deviation	17.41	17.30	17.37
Years in Fishing	Mean	25.70	25.91	25.82
	Standard Deviation	14.30	14.12	14.19
Monthly Income	Mean	5672.00	3709.52	4581.73
	Standard Deviation	5552.19	2731.56	4330.54

For livelihood diversity, the average number of sources of income is one for both groups. This is because of their geographic locations, isolated islands where most residents rely on fishing only, some may have extra jobs but are not stable. However, in Cuatro Islas, some fishers have 3 sources of income while in Pitogo fishers have at most 2 sources of income only. In Pitogo, fishing is the only major source of income although few have a sari-sari store, are construction workers or do labor, are part of the barangay officials, and others. However, in Cuatro Islas, there are other major sources of income aside from fishing: the making of Romblon products or mat weaving, boat making, and even tourism. Some fishers earn extra income from sari-sari stores, buying and selling fish, wood and tuba gathering, hollow block making, and others. Mat weaving and other Romblon products can be done by both men and women. Mostly, men are the ones who get raw materials or the leaves of Romblon and dried them then sell directly or convert them to weaved mats, hats, bags, and other Romblon products before selling them. While boatmaking is usually done by men whether sell it as a finished product using their materials and expenses or are paid as laborers for making the boat without any expense.

Furthermore, tourism is one of the main sources of income for both men and women in Cuatro Islas. Unfortunately, tourism's contribution to income and livelihood diversity was not captured in this study since Cuatro Islas tourism was closed from August 2022 to February 2023 and there is no data during the conduct of the study. According to the respondents, tourism gave them an additional income as some fishers serve as pump boat operators, owned sari-sari stores whose customers are mostly tourists, other residents sell their fish catch and shells directly to the tourists, and women or fisher's spouses sell their weaved products and handicrafts made by Romblon and pandan leaves to the tourists. Thus, tourism contributed a big part to the livelihood of Cuatro Islas residents.

Fishing Characteristics

Fishing productivity depends on the characteristics of fishing activities done in each location (Table 2). In terms of the type of boat used in fishing, 80.5% of CIPLS fishers used motorized boats while 86% in Pitogo which is a bit higher. However, with regards to the ownership of the boat, 81.5% of CIPLS fishers owned a boat which is higher compared to Pitogo fishers, 76% only. Pitogo fishers have a higher rate who do not own a boat even a non-motorized boat. This confirms the idea that most fishers in Pitogo have companions in fishing which are 80.4% compared to CIPLS fishers which are 31% only. There is a great difference between

the two groups because of the different types of fishing methods used. In CIPLS, fishers are mostly doing solo fishing which is the hook and line fishing while Pitogo fishers are mostly doing the crab collection and fishing nets which requires at least one companion. For the fishing time, almost half (47.2%) of Pitogo fishers are doing it during the morning because they do not want to sell dead crabs if overly exposed to the heat of the sun. In CIPLS, more than half (62.5%) of the fishers are fishing both morning and evening as their major fishing method is hook and line fishing followed by net fishing. On the other hand, in terms of fisher organization, 50.5% of CIPLS fishers are members while 60% in Pitogo fishers.

Table 2. Fishing characteristics by location

VARIABLE	CATEGORIES	CUATRO ISLAS		PITOGO	
		COUNT	%	COUNT	%
Boat Type Used	Motorized	161	80.5	215	86.0
	Not motorized	28	14.0	22	8.8
	None	11	5.5	13	5.2
Boat ownership	Owned	163	81.5	190	76.0
	Not owned	37	18.5	60	24.0
Presence of companion	Without	138	69.0	49	19.6
	With	62	31.0	201	80.4
Time in fishing	Morning	59	29.5	118	47.2
	Evening	16	8.0	14	5.6
	Both	125	62.5	118	47.2
Organization	Member	101	50.5	150	60.0
Membership	Not member	99	49.5	100	40.0

Fishing Gears and Techniques

Fishing methods/ techniques vary across locations which may affect fishing productivity (see Figure 3). In Cuatro Islas, the majority of the fishers are doing solo fishing methods using hook and line followed by net fishing using different types of gill nets. Simple hook and lines or locally known as *pasol* do not require companions in catching fish and this can be done anytime, morning or evening. This is also called single hook and line or simple handline with a single vertical line with baited one or two hooks for fish to bite when drop into the water. Bigeye scads are the most common fish caught by simple hook and line and other solo fishing techniques such as troll line (*subid*), multiple handline (*undak*), surface-set longline (*bahan*), and fish jig (*saranggat*). On the other hand, net fishing uses different types of gillnets (*pukot*) including surface/drift and bottom-set types which are usually done by morning or afternoon and this requires at least one companion which usually caught reef fish. Most of the companions are those

fishers who do not own fishing gear/equipment like boats and fishing nets. Some CIPLS fishers are doing spearfishing and only a few are using fish traps/pots.

In Pitogo, the majority of the fishers are doing crab or *lambay* collection and net fishing which require at least one companion. This suggests that there is a high number of fishers who do not own fishing gear/equipment and they are just paid or given a share of their fish catch. It is an advantage if you own the gear/equipment because she/he will have a higher share. In regards to crab collection, there are two types of techniques used: fishing net (*pukot*) which is more common, and crab trap/pot (*panggal*), a green screen-like fish pot but with bait for crabs. Crab is seasonal and only a few fishers are doing solo fishing which greatly affects their livelihood, especially those fishers who do not own fishing gear/equipment. This confirms the low fish catch and monthly income of Pitogo fishers during the last quarter of 2022. In terms of net fishing, Indian mackerels and sardines are the common fish types caught by Pitogo fishers depending on the type of fishing nets they are using. Some fishers used hook and line (*pasol* and *subid*), bottom-set longline (*kitang*, and *palangre*), fish traps, and spear guns.

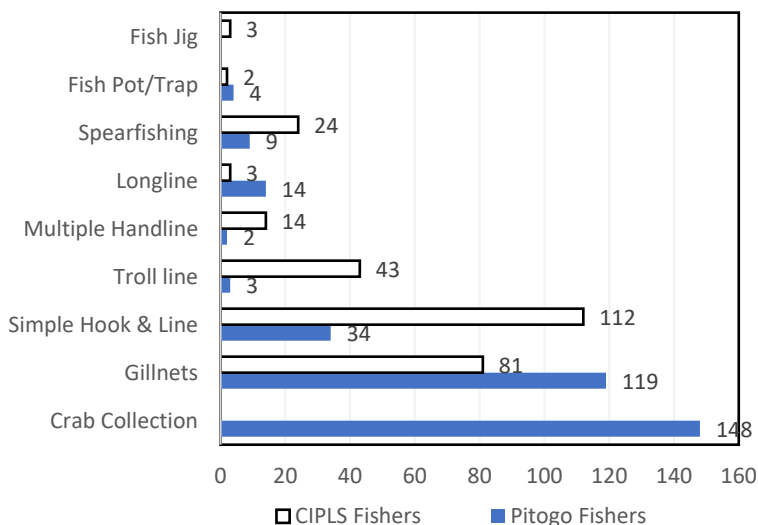


Figure 3. Fishing gears/ techniques used in Cuatro Islas and Pitogo

Fish Species

Table 3 shows the top ten common fish species caught in different locations or fishing grounds with their average selling price during the last quarter

of 2022. It shows that the type of fish varies across two locations. This suggests that the marine environment also differs across sites. Fish species differ as they have different habitats due to geographical location.

In Cuatro Islas, big-eye scads are the most common fish species caught by CIPLS through solo fishing, the hook and line fishing technique. On the other hand, crab collection is the most common fishing activity performed. Blue crab is the most common fish species caught by Pitogo fishers through fishing nets and fishing traps.

Table 3. Fish species by location

CUATRO ISLAS		PITOGO	
SPECIES	PRICE (PHP)	SPECIES	PRICE (PHP)
Big-eye Scads	200	Blue Crab	200
Reef fishes	180	Indian Mackerel	180
Skipjack Tuna	200	Sardines	70
Emperor Breams	240	Golden trevally	260
Red Snapper	260	Giant Trevally	280
Fusiliers	190	Yellows tripe Scads	110
Bullet Mackerel/ Tuna	180	Emperor Breams	220
Yellowfin Tuna	230	Threadfin Breams	180
Vermilion Snapper	240	Sweetlips	190
Frigate Tuna	215	Blackfin Scads	220

Comparison of Fishing Productivity

In terms of fishing productivity, Table 4 shows the significant difference between Cuatro Islas and Pitogo. Fish catch is significantly different between the two groups. CIPLS fishers have higher daily fish catch compared to Pitogo fishers (w/ VSU CRM=4.67, w/o VSU CRM=2.07). Thus, the daily fishing revenue between the two groups is also significant. The average daily revenue of Cuatro Islas fishers is higher compared to Pitogo fishers (w/ VSU CRM=823.35, w/o VSU CRM=332.72). Likewise, the daily fishing variable cost in Cuatro Islas is higher compared to Pitogo (w/ VSU CRM=324.99, w/o VSU CRM=100.83). This is to support the fact that Cuatro Islas fishers travel longer from the shore to the fishing grounds which need more fuels for the boat which corresponds to higher costs. In addition, Pitogo has lower fishing costs because most fishers are just accompanying other fishers and are paid or given a share of their catch while Cuatro Islas fishers often do solo fishing. Moreover, the longer travel time of Cuatro Islas is because fishers need to go farther or away from the protected area

(w/ VSU CRM=41.33, w/o VSU CRM=25.14). Furthermore, the daily fishing hour in Cuatro Islas is higher compared to Pitogo (w/ VSU CRM=6.79, w/o VSU CRM=3.45). There is also a significant difference in average fishing days per week (w/ VSU CRM=5, w/o VSU CRM=6). Pitogo fishers have more fishing days compared to CIPLS fishers which is reasonable as they have shorter fishing hours per day.

Overall, these variables greatly affect the daily gross income of fishers. The test confirmed that there is a significant difference in the daily fishing gross income between the two groups. Cuatro Islas fishers tend to have higher daily gross income compared to Pitogo fishers (w/ VSU CRM= PhP498.36, w/o VSU CRM=PhP231.89).

Table 4. Fishing productivity comparison between Cuatro Islas and Pitogo

VARIABLES	W/ VSU CRM	W/O VSU CRM	DIFFERENCE
Ave. Daily Fish Catch (kg)	4.67	2.07	2.60***
Ave. Daily Fishing Revenue	823.35	332.72	490.63***
Ave. Daily Fishing Variable Cost	324.99	100.83	224.16***
Ave. Daily Fishing Hours	6.79	3.45	3.34***
Ave. Travel Time in Minutes	41.33	25.14	16.19***
Ave. Fishing Days per Week	5	6	-1***
Ave. Daily Gross Income	498.36	231.89	266.77***

*** indicates significance at the 99% level

Impact of VSU CRM Project on the Livelihood of Small-Scale Fishers

Table 5 shows the comparison between the two groups on the observable characteristics of fishers before matching. The variables male, married, education, household size, and working spouse show a significant difference between Cuatro Islas and Pitogo. While age, boat ownership, and using a motorized boat are having similar characteristics between groups.

Table 6 shows the non-significant difference of all observable fisher characteristics between Cuatro Islas and Pitogo after matching. The two samples are matched and have reduced the differences between the groups. Thus, selection bias is reduced and ready for impact estimation.

Moreover, the changes in propensity scores' distribution can be observed on Figure 4, before and after matching the two groups. Before matching, there is a huge difference in the distribution of propensity scores as seen in the differences in shape. But after matching, there are significant changes in the distribution of

propensity scores as seen in the similarities of shape between treatment and control groups.

Table 5. Comparison of groups on observable fisher characteristics before matching

VARIABLES	CUATRO ISLAS w/ VSU CRM	PITOGO w/o VSU CRM	T-VALUE	P-VALUE
Age	45.165	45.032	-0.103	0.918
Male	0.975	0.808	-5.639	0.000***
Married	0.830	0.888	1.776	0.076*
Education	6.295	6.888	2.026	0.043**
Household Size	4.280	4.788	2.924	0.004***
Working Spouse	0.160	0.348	4.587	0.000***
Boat Ownership	0.815	0.760	-1.410	0.159
Motorized Boat	0.805	0.860	1.565	0.118

Table 6. Comparison of groups on observable fisher characteristics after matching

VARIABLES	CUATRO ISLAS w/ VSU CRM	PITOGO w/o VSU CRM	T-VALUE	P-VALUE
Age	45.165	46.66	-1.06	0.290
Male	0.975	0.98	-0.34	0.737
Married	0.830	0.88	-1.42	0.156
Education	6.295	6.19	0.36	0.720
Household Size	4.280	4.5	-1.31	0.192
Working Spouse	0.160	.125	1.00	0.318
Boat Ownership	0.815	0.86	-1.22	0.224
Motorized Boat	0.805	0.82	-0.38	0.702

Impact on Fish Catch

Table 7 shows that all algorithms: nearest neighbor, radius matching, and kernel matching are exhibiting significant impact estimates, the robustness of the result. In this study, the nearest neighbor matching technique was used to estimate the average treatment effect of the treated. Table 8 shows that the ATT is 2.395 kg which means that VSU CRM has increased the fish catch of CIPLS fishers after the program implemented by VSU at a 1% level. The fish catch of Pitogo fishers was doubled by CIPLS fishers. Thus, the VSU CRM project leads to higher fish catch of small-scale fishers which is considered a positive impact of CRM.

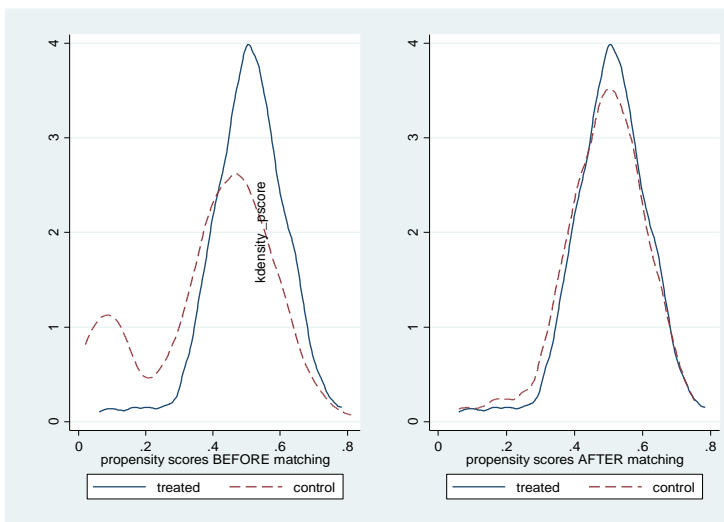


Figure 4. Comparison of propensity score before and after matching

Table 7. Impact estimate of fish catch (Kg) using the average treatment effect of the treated (ATT) of three matching algorithms

FISH CATCH	NEAREST NEIGHBOR	RADIUS MATCHING	KERNEL MATCHING
Cuatro Islas w/ VSU CRM	4.671	4.671	4.671
Control Group (Pitogo)	2.276	2.068	2.295
ATT (Fish Catch in Kg)	2.395***	2.603***	2.376***
Bootstrapped SE (100 reps)	0.284	0.238	0.230
Z	8.43	10.94	10.34
P> z	0.000	0.000	0.000
Sample Size of VSU CRM	200	200	200
Sample Size of Non-CRM	114	236	236

Note: *** p<0.01

Table 8. Fish catch (Kg) average treatment effect of the treated (ATT) using the nearest neighbor matching technique

CUATRO ISLAS (n)	PITOGO (n)	ATT (KG)	STD. ERROR	T
200	114	2.395	0.286	8.364

Note: the numbers of treated and controls refer to actual nearest neighbor matches

Impact on Monthly Income

For monthly income, the same techniques were applied to check the robustness of the results. The three algorithms exhibit a significant average treatment effect of the treated (ATT) for the monthly income of small-scale fishers (see Table 9). Using the nearest neighbor matching technique, the estimated ATT on the monthly income is PHP 1,595.50 from the matched 114 respondents of Pitogo (Table 10). This suggests that the VSU CRM project brought a positive impact on the small-scale fishers of Cuatro Islas in terms of income. There is enough evidence that CIPLS fishers increased their monthly income by PHP 1,595.50 at a 1% level.

Table 9. Impact estimate of monthly income (pesos) using the average treatment effect of the treated (ATT) of three matching algorithms

MONTHLY INCOME	NEAREST NEIGHBOR	RADIUS MATCHING	KERNEL MATCHING
Cuatro Islas w/ CRM	5672	5672	5672
Control Group (Pitogo)	4074	3709.52	3970.547
ATT (Monthly Income)	1,598***	1,962.48***	1,701.45***
Bootstrapped SE (100 reps)	580.08	411.22	425.84
Z	2.75	4.77	4.00
P> z	0.006	0.000	0.000
Sample Size of VSU CRM	200	200	200
Sample Size of Non-CRM	114	236	236

Note: *** p<0.01

Table 10. Monthly Income (pesos) average treatment effect of the treated (ATT) using the nearest neighbor matching technique

CUATRO ISLAS (n)	PITOGO (n)	ATT (PHP)	STD. ERROR	T
200	114	1,595.50	453.15	3.521

Note: the numbers of treated and controls refer to actual nearest neighbor matches

Impact on Livelihood Diversity

For livelihood diversity or the number of income sources, the three algorithms were applied which delivered similar results using different sizes of matched samples. All techniques have a significant average treatment effect of the treated (ATT) in terms of livelihood diversity at a 1% level (see Table 11). Table 12 shows the estimated impact on livelihood diversity through the nearest neighbor matching technique. At the 1% level, the estimated average treatment effect of the

treated (ATT) on livelihood diversity is 0.275. This suggests that VSU CRM had increased the number of income sources of small-scale fishers in Cuatro Islas by 0.275. This value is expected to be higher if Cuatro Islas tourism is operational during the conduct of the study since tourism promotion is one of CRM's goals.

Table 11. Impact estimate of livelihood diversity using the average treatment effect of the treated (ATT) of three matching algorithms

LIVELIHOOD DIVERSITY	NEAREST NEIGHBOR	RADIUS MATCHING	KERNEL MATCHING
Cuatro Islas w/ CRM	1.345	1.345	1.345
Control Group (Pitogo)	1.070	1.096	1.083

Table 11. Continuation

ATT (Livelihood Diversity)	0.275***	0.249***	0.262***
Bootstrapped SE (100 reps)	0.048	0.041	0.044
Z	5.67	6.12	5.98
P> z	0.000	0.000	0.000
Sample Size of VSU CRM	200	200	200
Sample Size of Non-CRM	114	236	236

Note: *** p<0.01

Table 12. Livelihood diversity average treatment effect of the treated (ATT) using the nearest neighbor matching technique

CUATRO ISLAS (n)	PITOGO (n)	ATT	STD. ERROR	T
200	114	0.275	0.048	5.767

Note: the numbers of treated and controls refer to actual nearest neighbor matches

This impact study shows that the VSU CRM project has increased or improved fish catch, income, and livelihood diversity of the small-scale fishers of Cuatro Islas which conforms to the theoretical framework (Figure 1) based on the research of Munoz of DA Philippines. This study shows similar results to the community-based mangrove restoration in Batad, Iloilo, Philippines which provide economic benefits to the residents as mangroves were used to cultivate fish and shrimps in addition to their traditional fishing while reducing the impact of climate change and conserving the coastal environment for marine biodiversity. Hence, a community-based project using a holistic approach is an effective way of conserving the environment and securing a better livelihood and future (Hapinat 2019). Also, these results coincide with the Coastal Community Development Project (CCDP) of Indonesia, the fisherfolks who were CCDP beneficiaries had a significant increase in their fishing productivity which leads to higher income and

increases the participation of women in socio-economic activities (Cavatassi et al., 2019).

Problems and Recommendations in the Fishing Industry and Livelihood

Problems and recommendations are based on the fisher-respondent's perception, the researcher's observation, and suggestions from the Protected Area Management Board (PAMB) members of CIPLS during the presentation of preliminary results of the study.

Fishing is the major livelihood in both coastal communities of Cuatro Islas and Pitogo. However, this livelihood is risky and vulnerable to bad weather conditions which is a major problem for the small-scale fishing industry. Just like small-scale farmers (Diacamos et al., 2021), small-scale fishers faced numerous risks related to adverse impact of climate change and extreme weather events. Heavy rain, strong water currents, big waves, and extreme cold greatly affect the fishing productivity of small-scale fishers. This variable affected their fish catch, either they may get very low fish catch or nothing not all. If no catch, there is no income to provide for their daily needs. Many fishers believed that the fish catch trend is decreasing but some said it is the same, it is just seasonal and because of the increasing population, too. For them, fishing is seasonal, sometimes they have a higher catch, lower catch, or no catch, at all. With this, fishers need alternative livelihood or other income sources aside from fishing.

On the other hand, Cuatro Islas has other sources of income such as boat making, mat-weaving and other Romblon products, and even tourism. Boat making is usually done by males unlike mat-weaving and making Romblon products are suitable to both males and females, the problem is the market or buyers of these products. Thus, the LGU of Inopacan suggested that Romblon product makers and mat weavers visit the trade center located in Inopacan municipality to advertise and improve the market of their Romblon products. In terms of tourism, many residents benefited from this activity to earn extra income but during the conduct of the study, Cuatro Islas tourism was closed for almost one year which greatly affected their livelihood; some sold their passenger boats, closed their sari-sari stores, and others were in debt and loans to start a new living and focus in fishing. Fortunately, Cuatro Islas tourism was reopened on March 2023; CIPLS fishers and residents are hoping for its improvement and sustainability. While in Pitogo, there is no alternative livelihood although some may have extra sources of income. In most cases, women especially wives are fishing along with their husbands because women do not have alternative income

sources to support their families. It was observed during the stay in Pitogo that young children and a pregnant woman with her husband are seen fishing in the evening which is very dangerous. Thus, alternative livelihoods especially for Pitogo women are recommended to ensure their safety while earning money and taking care of their young children.

In Cuatro Islas, fishers faced another problem, the presence of commercial fishing in municipal waters and illegal fishing which is usually come from other municipalities. The majority of the local fishers are aware of fishing rules established in the community, unlike those fishers who are not from the community. Bantay-dagat of Cuatro Islas has very low power in executing sanctions or penalties to those fishers who did not follow the fishing rules and regulations of the community. Local fishers of CIPLS complain about those fishers from other municipalities who performed illegal activity in their municipal waters, especially the marine sanctuaries. Bantay-dagat tried to discipline those who break the rules; however, those illegal fishers were not afraid of them rather they were hurt instead. Thus, the CIPLS community needs strong support from powerful ones to strictly implement the fishing rules and regulations. Like in Pitogo, the local sanctuary of Gaus Island is guarded and monitored by bantay-dagat along with a police officer.

There are fishers from both locations who do not own fishing gear/equipment wanted to start a living with their fishing materials but do not have the capital to start. Some fishers complained that they were not included in the fisheries program or benefits from the government. Hence, the Department of Agriculture 8 (DA-8) encouraged fishers to register in Registry System for the Basic Sectors in Agriculture (RSBSA) to enjoy benefits when there are programs from the government. These fishers look for a boss/ financier who will help them to earn money by accompanying the owners in exchange for money or a catch share or even borrow money to buy fuels or fishing materials with conditions depending on their agreement. This kind of scenario is common in Pitogo. These fishers have a smaller income or share compared to their boss or financier. Also, fishers cannot decide on the price of their fish products only the local buyers and some fishers do not have stable buyers of crabs especially if it is not season and/or no celebrations, unlike fish which is a staple food. So, it is advisable to have a diversified fishing technique to easily adjust in seasonal times.

In Pitogo, most fishers are doing crab collection using fishing nets or fishing traps/pots which are prone to damage and loss since the fishers will put the nets or traps overnight in the sea and harvest them in the early morning and place them again in the same location or other location after harvest. Lost fishing

nets and fishing traps/pots in the sea will continue to catch fish or ghost fishing which may damage the marine habitat or may contribute to the garbage. Also, trash and garbage were seen in the coastal areas of Pitogo and it was observed that the residents have no proper waste management and disposal which is important.

Based on the results, the CRM Project of VSU improved the livelihood of CIPLS fishers; increases fish catch, income, and livelihood diversity. Thus, well-managed coastal resource management (CRM) can be implemented in other coastal areas like the islands of Gaus, Butan, and Bantigue of Pitogo, Bohol to improve fishing productivity and the socio-economic status of the community. Half of the CIPLS respondents knew about CRM and they believe that it is for the betterment of their islands; where sanctuary serves as a safe habitat for marine biodiversity and increases fish production, avoids illegal fishing, cleanliness of the coastal environment, and protects the islands if the CRM is well-managed and maintained. The majority of these fishers believed that VSU CRM increases their income but only a few believed that their livelihood was diversified since the livelihood projects were not sustained and properly maintained as years passed by. They thought that CRM is better during the management of VSU. Therefore, a CRM project or any program will be successful if properly managed, all stakeholders cooperate, supported by the community, and will be sustained over time.

4. CONCLUSION

The descriptive analysis shows that fishers are mostly men, married, and with an elementary level of education. However, it was observed that there is high women participation in fishing activities in Pitogo compared to Cuatro Islas as there is a high percentage of female fishers in Pitogo. The average age of fishers is 45 years old, with four household members and with an average monthly income of PHP 4,581.73. Most fishers used motorized boats in fishing but not all fishers own a boat even a non-motorized boat. In Cuatro Islas, solo fishing using hook and line is the most common fishing technique/ method used where bigeye scads are the most common fish species caught, followed by net fishing. On the other hand, crab collection and net fishing are the most common fishing methods used in Pitogo where some fishers are just accompanying other fishers in exchange for money or a share of their fish catch. Fishing is the only major source of income in Pitogo while CIPLS residents have other sources of income aside from fishing: mat weaving/ Romblon products, boat-making, and even tourism.

In fishing productivity, there is a significant difference between Cuatro Islas and Pitogo. CIPLS fishers travel longer from shore to fishing sites compared to Pitogo fishers as CIPLS fishers need to go farther or away from the protected areas. With that, CIPLS fishers had longer fishing hours, too. That is why CIPLS fishers have higher variable costs because of the fuel/gasoline needed by the boat. The fishing variable cost of Pitogo fishers is lower because of the shorter travel time and most fishers are just accompanying other fishers in exchange for money or share without any cost. Fish catch of CIPLS was observed higher which result in higher fishing revenue and higher gross income compared to Pitogo fishers. Solo fishing in Pitogo is not dominant which is also the reason for the low fish catch, mostly they will not go fishing if no companions especially if no family member is available (wife or children).

Propensity score matching (PSM) employing the three algorithms: nearest neighbor, radius matching, and kernel matching exhibited robust results, revealing the positive impact on the livelihood of small-scale fishers of Cuatro Islas. Using the nearest neighboring technique, PSM reveals that the CRM project brought an increase in fish catch by 2.395kg a day. Also, CRM increased the monthly income of CIPLS fishers by PHP 1,595.50. Moreover, the CRM project leads to an increase in livelihood diversity or income sources by 0.275. Thus, the VSU CRM project has positive impacts on the livelihood of CIPLS fishers which improves the socio-economic status of the CIPLS communities.

Small-scale fishers in Cuatro Islas and Pitogo faced different problems in the fishing industry. Fishing is risky and vulnerable to bad weather conditions; thus, fishers need alternative livelihoods. CIPLS fishers already have alternative livelihoods, they just need to improve and sustain them, unlike Pitogo fishers do not have other sources of income, especially for women. On the other hand, fishing productivity was affected by commercial fishing and illegal fishing, thus, regulations must be strictly implemented. Moreover, ghost fishing, cleanliness, and no proper waste management and disposal are observed in Pitogo which are needed to be addressed.

This study is recommended as a reference to CRM implementers like VSU, DENR, and BFAR as they can implement this project in other coastal areas like Pitogo especially Gaus, Butan, and Bantigue Islands as it exhibits positive impacts on socio-economic aspects in Cuatro Islas. Researchers can also do a follow-up study focusing on the biodiversity aspect or the environmental impact of CRM to have a holistic understanding of its impact. To Inopacan and Hindang LGUs, it is recommended to strengthen the implementation of CRM in Cuatro Islas by providing police power to firmly implement the fishing rules and regulations,

especially the management of sanctuaries. Tourism is also an important aspect of the livelihood of CIPLS fishers; thus, improvement and sustainability are encouraged. CIPLS fishers are encouraged to register in Registry System for the Basic Sectors in Agriculture (RSBSA) so that they can enjoy benefits and will be included in the programs of the government like free fishing gear and equipment. Also, mat-weavers and Romblon product makers are advised to visit the trade center located in Inopacan municipality to advertise and improve the market of their Romblon products. To Pitogo particularly Gaus, Butan, and Bantigue Islands, CRM is recommended to improve the environment and socio-economic aspects of the community. Locally managed sanctuaries must be sustained. Proper waste disposal and cleanliness of the coastal environment are highly recommended. Also, alternative livelihood is suggested especially for women.

5. CONFLICT OF INTEREST

The authors declare no conflict of interest.

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