

Cross node socioeconomic and governance

Cross-Node Socioeconomic and Governance Assessments of MMAs

Giselle Samonte-Tan¹, Juan Mate², Daniel Suman³, Adele Catzim-Sanchez⁴, Diane Haylock⁴, Isabela Curado⁵, Patrick Fong⁶, Diego Quiroga⁷, Carols Mena⁷, Xuanwen Wang⁸

¹*Conservation International, USA*

²*Smithsonian Tropical Research Institute, Panama*

³*Rosenstiel School of Marine and Atmospheric Science, University of Miami, Florida*

⁴*Belize ISIS Enterprises, Belize*

⁵*Fundacao Getulio Vargas, Brazil*

⁶*University of the South Pacific, Fiji*

⁷*Universidad San Francisco de Quito, Ecuador*

⁸*Independent Consultant , USA*

1. Introduction

1.1 Development and Purpose of Cross-Node Synthesis

Worldwide, coral reefs, mangroves, seagrass beds and other highly diverse tropical marine ecosystems are under sharp decline. Anthropogenic impacts are degrading water quality, habitat configuration and the ecological structure of entire coastal systems. Consequently, most coastal marine fisheries are under an increasing threat of collapse. This global crisis poses an unprecedented challenge not only to marine biodiversity conservation, but also to the livelihood of millions of people who depend on healthy coastal ecosystems, especially in developing countries. Globally, the Food and Agriculture Organization (FAO) reports that almost 50 percent of fisheries are at maximum capacity, while more than 25 percent have been pushed beyond sustainable limits. Industrial fishing practices have depressed populations of large predatory fish to about 10 percent of pre-industrial levels throughout the global ocean. Recent assessments show that 20 percent of the world's coral reefs have been effectively destroyed, a further 24 percent are under imminent risk of collapse, and another 26 percent are under long-term threats from human-caused pressures.

Marine Managed Areas (MMAs) of various types are a form of resource management that regulates human activities in particular locations (area-based management strategy). There are many types and management regimes of MMAs, from multiple-use and community-managed areas to no-take reserves, but objectives generally converge at socioeconomic (e.g. fisheries, tourism) and biodiversity conservation benefits. Due to their immense potential and cost-effectiveness, MMAs are being proposed as central coastal and marine management tools, and there has been increasing interest-particularly among international nongovernmental and multilateral development organizations-in evaluating and developing tools to increase MMAs effectiveness. The World Summit on Sustainable Development, the IUCN's World Commission on Protected Areas, and the Convention on Biological Diversity have all called for the establishment of a global system of marine protected areas networks by the year 2012. These agreements illustrate the high-level of global political commitment for MMAs. The current challenge, however, is to ensure that these commitments are transformed into meaningful actions.

Conservation International's Marine Management Area Science Program (MMAS) works to conserve marine ecosystems and improve human welfare by providing the science critical to marine conservation and decision-making. The Program is a four-year initiative established in October 2005, with funding by the Gordon and Betty Moore Foundation. This report is concerned with the socioeconomic and

governance dimension of MMAs, targeting key issues that still impede the design and implementation of Marine Managed Areas.

1.2 Literature review

Van Beukering et al (2007) studied the impact of marine protected areas on the poverty reduction in Fiji, Indonesia, Solomon Island, and Philippine using both qualitative and quantitative analysis. The sample in each country is divided into two subgroups: Marine Protected Areas (MPAs) and Non-Marine Protected Areas (Non-MPAs). They found that both income and fish catch of respondents from marine protected areas are higher than those of from non-marine protected areas. In addition, the empowerment of governance in MPAs is stronger than that of in Non-MPAs.

Cinner et al (2009) analyzed the socioeconomic conditions in nine communities of Kenyan coast by dividing the respondent into fishers and non-fishers. The statistical results show that fishers are likely poorer and have more diversified occupation than non-fishers. Compared to non-park fishers, park fishers are likely to have low diversified occupation.

1.3 Research objectives

1. Determine how MMAs have affected socioeconomic and governance conditions. This will also look into the objectives of the MMAs and which types of MMAs are effective at meeting their objectives.
2. Evaluate how socio-economic (e.g., demographics) and governance (e.g. institutional frameworks and processes) characteristics impact on management effectiveness of MMAs (e.g., are wealthy communities correlated with more or less successful MMAs?).

In general, this study will assess the social, economic and governance conditions of MMAs in Belize, Brazil, Fiji, Ecuador, and Panama in terms of their impact on factors such as economic development, quality of life, livelihoods, environmental awareness, stakeholder participation, and policy enforcement. The results will substantially contribute to the design and implementation of other socio-economic studies as well as to the employment of more effective MMA management practices in five countries and globally.

1.4 Flow of Report

The rest of report is organized as follows: in Chapter two, background information of all five countries is provided. This is followed by the data and method part. Chapter

Cross node socioeconomic and governance

four and five summarized the socioeconomic and governance effects of Marine Managed Areas (MMAs), respectively. Chapter six and seven reported the socioeconomic and governance factors of MMAs, respectively. This is followed by the challenges of MMAs in Chapter eight. Conclusions and policy implications are in Chapter 9, and is followed by the last Chapter, science to action.

2. Brief description of study sites

2.1 Socioeconomic context

Country statistics eg: GDP, Population, Poverty rate are reported in **Table 1**

Table 1: Socioeconomic context of five countries

Country	Belize	Brazil	Fiji	Ecuador	Panama
Sociodemographic					
Population (Est.)	307,899	198,739,269	944,720	14,573,101	3,360,474
Population growth rate	2.154% (2009 est.)	1.199% (2009 est.)	1.379% (2009 est.)	1.497% (2009 est.)	1.503% (2009 est.)
Population density (2006)	12.17/sq. km. (31.52/sq. mi.)	21.86/sq. km. (56.63/sq. mi.)	48.90/sq. km. (126.65/sq. mi.)	47.13/sq. km. (122.06/sq. mi.)	38.86/sq. km. (100.66/sq. mi.)
Migration rate	n/a (2009)	-0.09/1,000	-2.47/1,000	-0.81/1,000	-0.49/1,000
Literacy rate	76.9% (2000)	88.6% (2004)	93.7% (2003)	91% (2001)	91.9% (2001)
GDP (PPP)	\$2.574 bil.	\$2.03 tril.	\$3.431 bil.	\$107 bil.	\$39.33 bil.
Primary occupation	Services: 61.9% (2005)	Services: 66% (2003)	Agriculture: 70% (2001)	Services: 70.4% (2005)	Services: 67% (2006)
Secondary occupation	Industry: 17.9%	Agriculture: 20%	Industry, Services: 30%	Industry: 21.2%	Industry: 16.1%
Tertiary		Industry:		Agriculture:	Agriculture:

Cross node socioeconomic and governance

Country	Belize	Brazil	Fiji	Ecuador	Panama
occupation		14%		8.3%	6.2%
Total Fertility Rate	3.36 (2009 est.)	2.21 (2009 est.)	2.65 (2009 est.)	2.51 (2009 est.)	2.53 (2009 est.)
% Pop. Below Poverty Line	33.5% (2002 est.)	31% (2005)	25.5% (FY 90/91)	38.3% (2006)	28.6% (2006 est.)
Labor Force (Total)	113,000 (2006 est.)	100.9 mil. (2008 est.)	117,500 (2006 est.)	4.64 mil. (Urban-2008 est.)	1.392 mil. (2008 est.)
Unemployment Rate	8.5% (2007)	8.0% (2008 est.)	7.6% (1999)	8.7% (2008 est.)	6.3% (2008 est.)
Marine related activity					
% of Population in the Coastal Zone	100% of Population within 100 km of coast	49% of Population within 100 km of coast	100% of Population within 100 km of coast	61% of Population within 100 km of coast	100% of Population within 100 km of coast
Macroeconomic indicators (2005)					
Fisheries exports	\$42,911,000	\$404,657,000	\$50,551,000	\$569,961,000	\$427,220,000
Fisheries imports	\$540,000	\$313,693,000	\$37,041,000	\$5,609,000	\$21,974,000
Contribution of fisheries to GDP	5% (2003) (FAO)	0.4% (FAO)	2.4% (FAO)		
Religion					

Cross node socioeconomic and governance

Country	Belize	Brazil	Fiji	Ecuador	Panama
	Roman Cath. 49.6%	Roman Cath. 73.6%	Christian 53%	Roman Cath. 95%	Roman Cath. 85%
	Protest. 27%	Protest. 15.4%	Hindu 34%	Other 5%	Protest. 15%
	Other 14%	Spiritualist 1.3%	Muslim 7%		

Source: Center for International Earth Science Information Network (CIESIN), World Resources Institute, and International Food Policy Research Institute

Cross node socioeconomic and governance

2.2 MMA relevant information

Table 2: MMA Features-Fiji

Relevant Information on MMAs	Fiji			
	Waitabu	Kubulau	Navakavu	Malolo
Governance or institutional variables in place				
Official/registered name of MMA	Waitabu	Kubulau	Navakavu	Malolo
Year established	1997	2004	2003	2005
MMA type (eg, no take, multiple-use)	No take area and gear restrictions, especially destructive ones.			
Management regime (eg, community-based, co-management, state control)	Community-based with support from external organizations			MMA established by Tourism operators in consultation with the local communities
Policy/laws	Fisheries activities in Fiji are governed by the Fiji Fisheries Act. In terms of MMA, these are governed by customary laws and beliefs. MMAs are established through consensus by community members, especially the local chiefs. The Fiji Government Fisheries Department policies have also support these initiatives.			
Property rights/tenure	Dual ownership whereby government owns the fishing area while indigenous Fijians owns rights to use resources and make decisions on activities within these fishing grounds. This arrangement is recognized under the Customary Fishing Rights Areas (CFRA) regulations of the Fiji Fisheries Act			
Number of coastal villages	1 village and 2 small settlements	10 villages	4 villages	6 villages
Coastal population	150	956	640	970
Number of coastal households	40	157	120	165
Number of fishers (included in this category are the	25	150	160	100

Cross node socioeconomic and governance

Relevant Information on MMAs	Fiji			
	Waitabu	Kubulau	Navakavu	Malolo
subsistence, artisanal and commercial fishers				
Income				
Primary Occupation/Employment ?	Farming is the main source of income. Subsistence fishing and farming is also prevalent	Farming and fishing is the main source of income. Subsistence farming and fishing are also common	Fishing and working in town are the two main source of income. Subsistence fishing and farming is also prevalent	Working in hotels and resorts is the main source of employment and income although communities still practice subsistence farming and fishing
Distance from nearby community	1km	14km	0.5km	9km
Stakeholder analysis (eg, businesses, fishermen from other places, NGOs, BINGOS, etc)	Village Council Marine Ecology Fiji Bouma National Heritage Committee National Trust of Fiji Cakaudrove Provincial Council Office Coral Alliance Fiji Locally Managed Marine Areas Network	Village Council District Council Kubulau Environment Committee Wildlife Conservation Society Bua Provincial Council Office Fiji Locally Managed Marine Areas Network	Navakavu Qoliqoli Committee Vanua Council Rewa Provincial Council Office Institute of Applied Science, USP Fiji Locally Managed Marine Areas Network	Tourism Operators Mamanuca Environment Society Malolo District Council

Source: Technical report by Patrick Fong

Cross node socioeconomic and governance

Table 3: MMA Features-Ecuador

Cross node synthesis_ Relevant information on MMAs

Galapagos Islands

GOVERNANCE	
Official/registered name	Galapagos Marine Reserve
Year established	1998 with the creation of the Special Law for the Conservation and Sustainable Development of the Province of Galapagos
MMA type	multiple-use (including some non-take areas)
Management regime	co-management and state control
Policy/Laws	Political Constitution of the Republic of Ecuador
	Special Law for the Conservation and Sustainable Development of the Province of Galapagos
	Environmental Management Law
	Forestry and Conservation of Natural Areas and Wildlife Law
	Cultural Heritage Law
	Health Act
Property rights/tenure	state property
Financial Incentives	training courses for operating sport fishing activities
	diver master courses
	tourist vessel permits
Financial disincentives	Tourist vessel permits (strict requirements for obtaining permits, making tour operations inaccessible for some people)
	fines for illegal fishing or illegal tourist operations
	jail for illegal fishing or illegal tourist operations
SOCIOECONOMIC	
# of coastal villages	4 (Puerto Ayora, Santa Cruz; Puerto Villamil, Isabela; Puerto Baquerizo Morenol, San Cristobal; Floreana
Coastal population	19,184 permanent population (INEC 2006 Censo), 170,000 tourist per year estimated (2008, PNG)
# of coastal households	7,043 permanent households (INEC 2006 Censo)

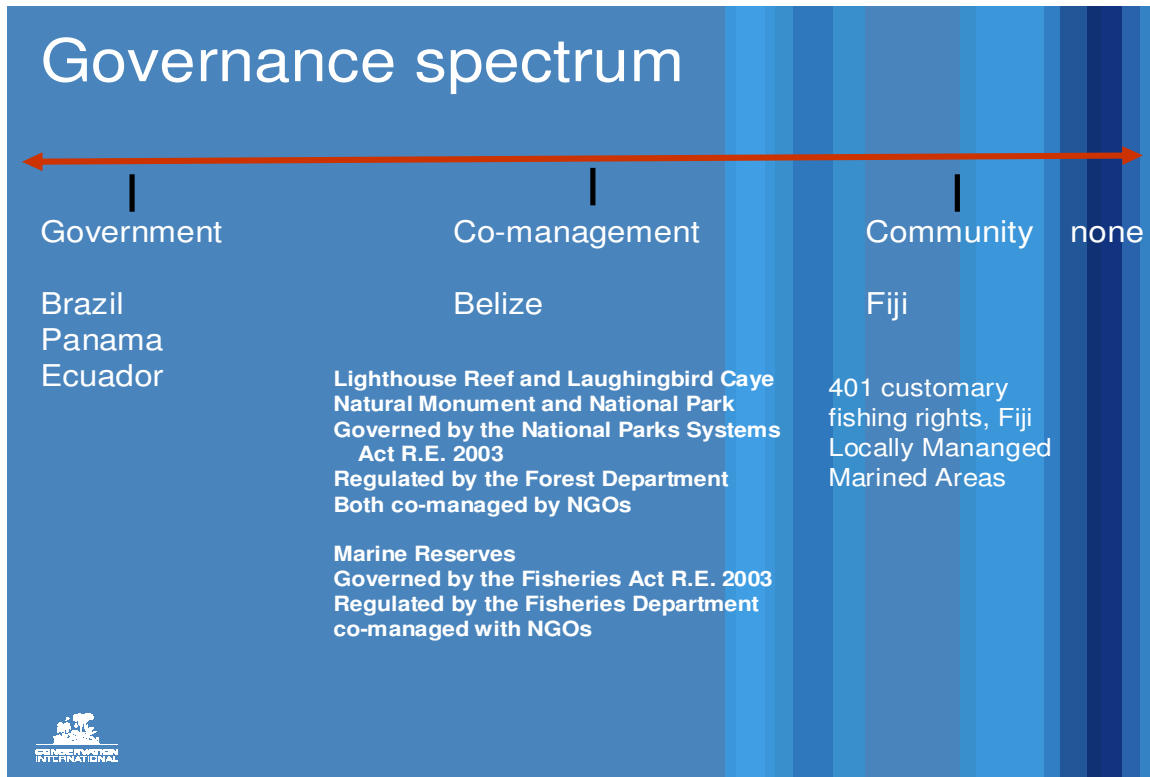
Cross node socioeconomic and governance

# of fishers	1,023 (Official, October 2007)/ 466 currently active/ 323 active full time
Income	Average 900 USD/month
Primary Occupation/Employment	tourism, service sector, public servants, agriculture, fishing, livestock raising
Level of Education	37.5% primary education, 40.1% secondary education, 15,1% university
OTHER	
Size of MMA	138,000 square km
Distance from nearest coastline	1000 km
Population growth	between 1990-2001, 5.9% (more recent data unavailable)
Market prices/inflation	Between January and April of 2008, the Galapagos had an inflation of 5.18%, thus approximating the annual rate at 15%
	(Inflation on the mainland from January-April 2008 = 3.5%)
Stakeholder analysis	40% of Galapagos residents employed in the tourist sector; 65.4% of local economy generated from tourism
	Only a small % of local economy generated from fisheries
	3 municipalities (Santa Cruz, San Cristobal, Isabela)
	Key institutions: INGALA (Instituto Nacional de Galapagos) and the Galapagos National Park
	Major nonprofits: Conservation International, World Wildlife Fund, Wild Aid, Charles Darwin Foundation, The Sea Shepherd Society

Source: Technical report by Diego Quiroga and Carols Mena

2.3 MMA Governance context

Figure 1: Governance spectrum of marine management areas in five countries



3. Methods

3.1 Data sources and sample

Study sites

Data for this study come from the household surveys conducted in Belize, Brazil, Fiji, Ecuador and Panama. A total of five monitoring locations, Lighthouse Reef, South Water Caye, Laughing Bird/Gladden Spit, Sapodilla Cayes, and Port Honduras, were selected as the study sites of Marine Management Areas (MMAs) in Belize. Three marine managed areas were chosen in Brazil. Four monitoring locations, Navakavu, Waitabu, Navatu, and Solevu, were selected as the study sites of MMAs in Fiji. Galapagos National Park and Coiba National Park (CNP) were chosen as the study areas of MMAs in Ecuador and Panama, respectively. Since the islands forming CNP are uninhabited and the local communities situating along the Panamanian coast and opposite CNP are historically dependent on the access to resources within and around CNP, nine communities out of these local communities were selected for the study. Santa Cristobal, Santa Cruz, and Isabela are selected as sample communities in Ecuador. **Table 4** lists the selected MMAs and coastal communities in these five countries.

All the households interviewed in these three countries were randomly selected. The total sample size for Belize, Brazil, Fiji, Ecuador and Panama, are 1341, 680, 183, 365, and 497, respectively. The total sample size for cross node analysis is 3065.

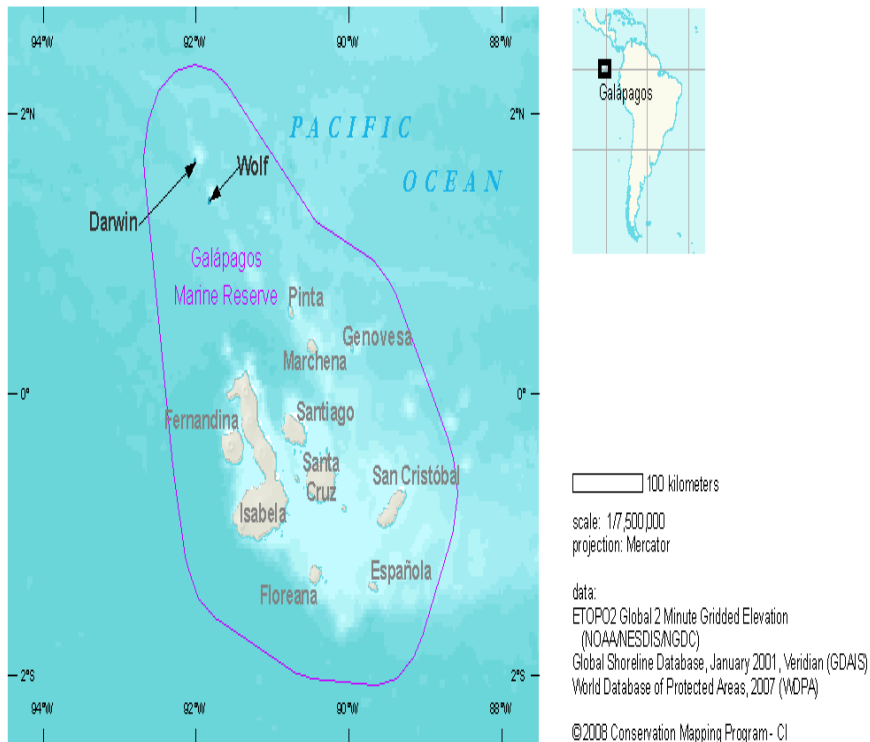
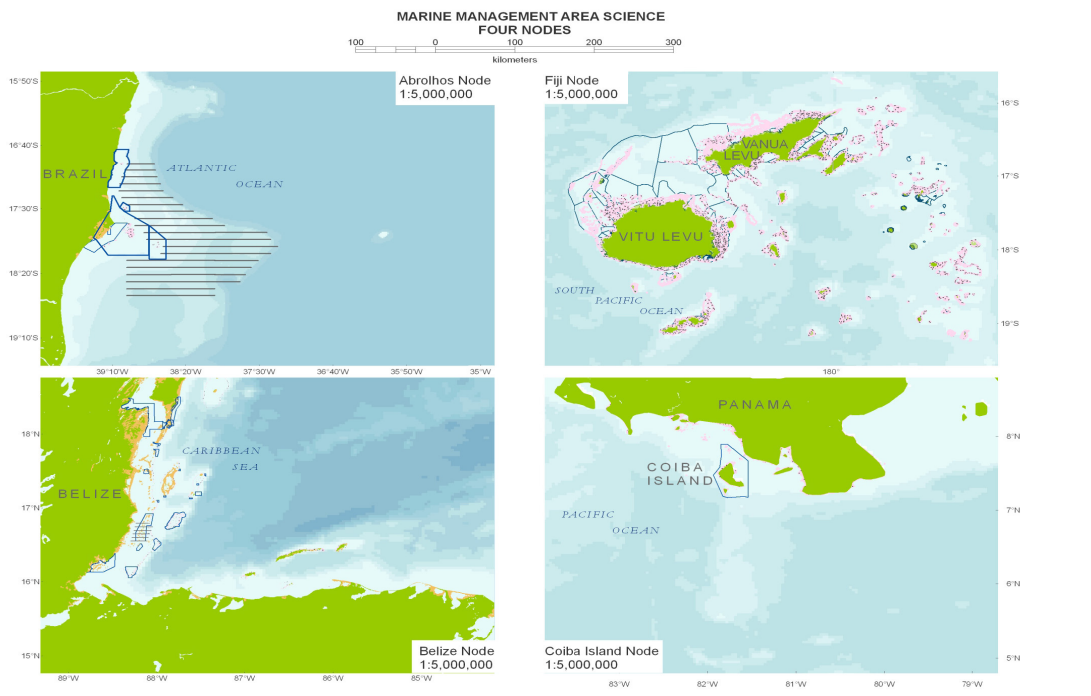
Cross node socioeconomic and governance

Table 4: Sample sizes for selected MMAs and coastal communities

Country/Node	Marine Managed Areas	Coastal Communities	Respondents
Belize (n=1341)	Lighthouse Reef South Water Caye Laughing Bird/Gladden Spit Sapodilla Cayes Port Honduras	Chunox	76
		Copper Bank	65
		Dangriga	276
		Hopkins	105
		Independence	187
		Monkey River	27
		Placencia	97
		Punta Negra	229
		Punta Gorda	7
		Sarteneja	141
		Seine Bight	104
		Sittee River	27
Brazil (n=680)	RESEX Corumbau ParNaM Abrolhos RESEX Cassurubá	Alcobaça	
		Barra de Caravelas	
		Ponta de Areia	
		Centro	
		Nova Viçosa	
		Caraíva/Nova Caraíva	
		Barra Velha	
		Corumbau/Bugigão	
		Veleiro	
		Imbassuaba/Barra do Cahy	
		Cumuruxatiba	
		Prado sede	
Fiji (n=183)	Navakavu Waitabu Kubulau Malolo	Waiqanke	28
		Muaivuso	16
		Namakala	11
		Nabaka	5
		Wai	5
		Waitabu	14
		Vurevure	6
		Navatu	15
		Raviravi	10
		Kiobo	10
		Namalata	7
		Solevu	23
Ecuador (n=365)	Galapagos National Park	Santa Cristobal	113
		Isabela	63
		Santa Cruz	189
Panama (n=497)	Coiba National Park	Bahia Onda	28
		El Puerto	76
		Gobernadora	15
		Hicaco	89
		Malena	26
		Pedregal	120
		Pixvae	69
		Puerto Mutis	15
Santa Catalina	59		
Cross Node (n=3066)	14	48	3066

Cross node socioeconomic and governance

Figure 2: Map of marine management area nodes



3.2 Socioeconomic and governance variables

A household survey instrument was used to obtain information on socio-economic characteristics and governance factors for each household and community. The inventory of socioeconomic and governance variables are summarized in **Table 5** and **Table 6**, respectively.

1. Socio-economic Variables

Demographic Variables

Demographic variables include age, gender, education attainment of respondents, the household size, and the number of children in the household. The statistical description for these five variables is summarized in **Table 7** and **Table 8**, respectively.

Perceptions on non-monetary benefits to society

Local perceptions of non-monetary benefits of MMAs were collected during the interview. The statements of non-monetary benefits of MMAs include indirect non-market value, existence use and non-use value, and bequest use and non-use value of MMAs. The answers are categorized as strongly agree (1), agree (2), neutral (3), disagree (4), and strongly disagree (5). These questions were only collected in Belize and Fiji. The percentage of response of each statement is summarized in **Table 9**. The t test is used to test whether the mean of each statement is significantly different from the neutral ($\mu = 3$). The mean and variance of non-monetary benefit statements are shown in **Table A2.2**. As shown in the **Table A2.2**, the means of all non-monetary benefit statements are significantly different from the neutral at 1% level.

Perceptions on local values and beliefs about marine resources

Local perceptions of values and beliefs about marine resources were asked during the survey. The answers are also categorized as strongly agree, agree, neutral, disagree, and strongly disagree. The t test is used to test whether the mean of each statement is different from the neutral ($\mu = 3$). The mean and variance of these six statements are shown in **Table A2.3**. As shown in **Table A2.3**, the means of all statements are significantly different from the neutral at 1% level.

Perceptions on human threats to the marine resources reduced

Local perceptions of human threats to the marine resources reduced are presented in **Table** . The answers are categorized as very negative, negative, neutral, positive, and very positive. The t test is utilized to test whether the mean of each statement is different from the neutral ($\mu = 3$). The mean and variance of these six statements are reported in **Table A2.4**. As shown in **Table A2.4**, the means of all statements are significantly different from the neutral at 1% level.

Perceptions on Benefit from the MMA equitably distributed

Perceptions of both economic and health benefits from the MMA were asked in the survey. The answers are categorized as much better, better, neither better or worse, worse, and much worse. The t test is used to test whether the mean of each statement is different from neither better nor worse ($\mu = 3$). Both means are significantly different

Cross node socioeconomic and governance

from neither better nor worse at 1% level. The mean and variance of economic and health benefits are summarized in **Table A2.5**.

Contributions for the economic and health benefits were also collected. **Figure A2.1** and **Figure A2.2** summarize the contributions in improving the economic and health benefits. **Table A2.6 and A2.7** summarizes the contributions in deteriorating the economic and health benefits.

2. Governance Variables

Information dissemination

Information dissemination variables are deduced from the question whether the MPA body shares information with the respondent and his/her family as it relates to marine protected areas. The percentage values for each variable are reported in **Table** and **Table** .

Community participation and awareness

The community participation and awareness of marine protected areas are treated as governance factors of this study. The answers are categorized as yes, no, and don't know or not sure. The percentage values for respondents' perception of each statement are presented in **Table** .

Cross node socioeconomic and governance

Table 5: Socioeconomic changes of MMAs

Socioeconomic Changes	Baseline data (variable, units, year)	Variables				
		Brazil	Ecuador	Belize	Fiji	Panama
1 Income/Livelihoods			Diversity of marine related livelihood (Q3.2-Be,Q14-F, Q3.1-P, QF1.4-E)			
		Household monthly income (Q3.1-Be, Q14-F, Q3.3-P, Q31-Br Q2.8-2.9-E)				
			Perception of life (QK.1-E)	Perception of economic situation (Q11.1-Be, Q66-F)		Perception of life (Q3.12)
			Income from fishing (QF2.4-E)		Income from fishing (Q14-F, Q3.7-P)	
			Type of fishing (QF1.1-E)			Type of fishing (Q3.7a-P)
					Income by occupation (Q14-F)	
2 Use of marine resources				Resource use pattern (Q6.1-Be, Q15-F, Q3.7-P)		
		Frequency of use (Q6.1-Q6.6-Be, Q15 & Q17-F, Q3.7-P Q8-9-Br, QF.1.3-E)				

Cross node socioeconomic and governance

Socioeconomic Changes	Baseline data (variable, units, year)	Variables				
		Brazil	Ecuador	Belize	Fiji	Panama
3 Non-monetary benefits				Perceptions on non-monetary benefits (Q7.1-Be, Q55-F)		
4 Environmental awareness and knowledge				Local values and beliefs (Q8.1-Be, Q63-F)		
				Information shared by MMA (Q10.1&10.2-Be, Q49 &50-F)		
5 Health of coastal residents				Perception on health situation (Q11.5-Be; Q27-F)		
			Frequency of seafood/fish consumption (Q25-F QF.3-E)		Frequency of seafood/fish consumption (Q25-F QF.3-E)	
		Perception on change of seafood/fish harvest (Q23-Br) / Reasons for change in seafood/fish harvest (Q24-25-Br)	Perception on change of seafood/fish harvest (QF2.6-E) / Reasons for change in seafood/fish harvest (QF2.7)		Perception on change of seafood/fish harvest (Q18-F) / Reasons for change in seafood/fish harvest (Q19-F)	

Cross node socioeconomic and governance

Socioeconomic Changes	Baseline data (variable, units, year)	Variables				
		Brazil	Ecuador	Belize	Fiji	Panama
			Change in seafood/fish diet (Q26-F QF.4-E)		Change in seafood/fish diet (Q26-F QF.4-E) / Reason for change in seafood/fish diet (Q27-F)	
6 Demographics of community					Education Q8-Q13	Community changes Q7.1

Cross node socioeconomic and governance

Table 6: Governance effects of MMAs

Governance Changes	Baseline data (variable, units, year)	Variables				
		Brazil	Ecuador	Belize	Fiji	Panama
1 Management structures and strategies			Local understanding of MMA rules and regulations (Q10.1.b-Be, Q49.b-F, Q6.1-P QH.1-E)			
		Level of participation in development of management plan (Q58-Br)	Level of participation in development of management plan (QH.2-E)			Level of participation in development of management plan (Q6.6-P)
2 Stakeholder participation and representation				Level of capacity building/training provided to stakeholders in participation (Q11.9-Q11.16-Be, Q57-Q62-F)		
3 Management plan compliance by resource users			Local understanding of MMA rules and regulations (Q10.1.b-Be, Q49.b-F, Q6.1-P QH.1-E)			
				Degree of information dissemination to encourage stakeholder compliance (Q10.3-Q10.6-Be, Q51-Q54-F)		
			Perception of compliance (QH.6-E)			Perception of compliance (Q6.9-P)
4 Resource use conflicts			Level of fishing related conflict (QH.9-E)		Level of fishing related conflict (Q31-F)	

3.3 Statistical analysis

The statistical description for these five variables is summarized in **Table 7** and **Table 8**, respectively.

Table 7: Demographic information of five countries and cross node

	Belize (n=1341)	Brazil (n=680)	Fiji (n=183)	Ecuador (n=365)	Panama (n=497)	Cross Node (n=3066)
Gender (%)						
Female	46		21	15	53	45
Male	54		79	85	48	55
Age (%)						
15-19	2		1	1	1	2
20-24	6		2	5	6	6
25-29	10		7	11	13	10
30-34	11		10	11	12	11
35-39	14		13	17	14	14
40-44	12		10	12	13	12
45-49	10		15	14	12	11
50-54	8		9	12	9	8
55-59	8		10	7	7	8
60-64	5		5	4	5	5
65 and over	14		19	7	9	13
Education (%)						
None (0)	18		1	3	4	13
Primary (1-6)	53		52	30	71	60
Secondary (7-12)	16		46	49	11	17
Tertiary (>12)	13		1	18	15	10
Household Size (%)						
1-5	71		61	85	72	70
6-10	27		37	15	25	27
>10	3		3	0	3	3
Children (%)						
0	40		33	10	17	34
1	16		26	10	23	19
2	18		19	29	23	19

Cross node socioeconomic and governance

3	12	13	17	20	14
4	8	8	14	9	8
5	4	1	12	4	4
>5	3	1	10	3	3

Source: Household surveys conducted in Belize, Brazil, Fiji, Ecuador and Panama

Notes:

Table 8: Descriptive statistics of demographic variables of cross node

Variable	Belize	Brazil	Fiji	Ecuador	Panama	Cross Node
Age of the respondent						
OBS	1314		183	330	495	2322
Mean	44.4		48.6	43.5	42.6	44.2
Std. Dev.	15.6		15.1	13.5	14.0	15.0
Min	15		18	19	16	15
Max	90		83	91	91	91
Years of the highest education of the respondent						
OBS	1319		183	330	445	2277
Mean	8.2		9.8	9.6	5.5	8.0
Std. Dev.	4.7		2.4	4.2	3.3	4.5
Min	0		0	0	0	0
Max	16		16	16	16	16
# of persons in the household						
OBS	1341		183	330	492	2346
Mean	4.4		5.1	3.9	4.8	4.5
Std. Dev.	2.6		2.3	1.8	2.6	2.5
Min	1		1	1	1	1
Max	16		13	10	26	26
# of children in the household						
OBS	1341		183	329	497	2350
Mean	1.6		1.4	0.4	1.8	1.4
Std. Dev.	1.8		1.4	1.3	1.7	1.7
Min	0		0	0	0	0
Max	12		6	10	9	12

Source: Household surveys conducted in Belize, Fiji, Ecuador and Panama

Significant test

Statistical test is conducted to test whether there is any significant difference among each country. There are significant differences among demographic variables of five countries. The statistical result is summarized in **Table 9**.

Cross node socioeconomic and governance

Table 9: Significant test of demographic variables cross countries

	Belize (n=1341)	Brazil (n=680)	Fiji (n=183)	Ecuador (n=365)	Panama (n=497)	Cross Node (n=3066)
Gender						
Belize	n.a		0.0000***	0.0000***	0.0131***	0.0000***
Brazil		n.a.				
Fiji	0.0000***		n.a.	0.0315**	0.0000***	0.0000***
Ecuador	0.0000***		0.0315**	n.a.	0.0000***	0.0000***
Panama	0.0131***		0.0000***	0.0000***	n.a.	0.0000***
Age						
Belize	n.a		0.0007***	0.3036	0.0203**	0.0000***
Brazil		n.a.				
Fiji	0.0007***		n.a.	0.0001***	0.0000***	0.0000***
Ecuador	0.3036		0.0001***	n.a.	0.3601	0.0000***
Panama	0.0203**		0.0000***	0.3601	n.a.	0.0000***
Education						
Belize	n.a		0.0000***	0.0000***	0.0000***	0.0000***
Brazil		n.a.				
Fiji	0.0000***		n.a.	0.6722	0.0000***	0.0000***
Ecuador	0.0000***		0.6722	n.a.	0.0000***	0.0000***
Panama	0.0000***		0.0000***	0.0000***	n.a.	0.0000***
Household size						
Belize	n.a		0.0002***	0.0007***	0.0035***	0.0000***
Brazil		n.a.				
Fiji	0.0002***		n.a.	0.0000***	0.1271	0.0000***
Ecuador	0.0007***		0.0000***	n.a.	0.0000***	0.0000***
Panama	0.0035***		0.1271	0.0000***	n.a.	0.0000***
Children						
Belize	n.a		0.2233	0.0000***	0.0000***	0.0000***
Brazil		n.a.				
Fiji	0.2233		n.a.	0.0003***	0.0000***	0.0000***
Ecuador	0.0000***		0.0003***	n.a.	0.0000***	0.0000***
Panama	0.0000***		0.0000***	0.0000***	n.a.	0.0000***

Null hypothesis: whether the difference of demographic variables between two countries is zero.

*, **, ***, represents significant at 10%, 5%, and 1%, respectively

4. Socioeconomic Effects of MMAs (Similarities and differences cross node)

The first objective of this study is to test the socioeconomic effects of marine managed areas. To achieve this goal, seven socioeconomic hypothesis effects are tested in this study. They are income effect, livelihoods effect, use of marine resources, non-monetary (non-market and non-use) benefits to society, environmental awareness and knowledge, health of coastal residents, and capacity of community.

4.1 Income effect

One of the most important socioeconomic effects of MMAs is whether the income of coastal population increased or maintained after the establishment of MMAs. Income variables in this study include average monthly household income, average monthly household marine related income, income from fishing, and perception of economic situation. The detailed income variables are summarized in **Table 15**. Average monthly household income is the total monthly income of all household members while average monthly marine related household income only includes the monthly income of fishing, tourism, and boat drivers or divers income.

Method

To test whether people's income or livelihoods have been increased or not after the establishment of MMAs, baseline data is needed to test the difference between the current situation and before the establishment of MMAs. However, it is very hard to get all the information before the establishment of MMAs. Therefore, we divide the whole sample into two groups, MMA beneficiaries and non-MMA beneficiaries to test whether there is any significant difference between two groups.

- Baseline-Pre MMA (note: no data by far)
- Non-MMA users: Belize 601 respondents; Fiji 2 villages 33 respondents; Panama:304 non-Park users; Ecuador 273 non-Park users
- t test

Method: t test

To test whether people's income has been increased or not after the establishment of MMAs, the whole sample is divided into two groups, MMA beneficiaries and Non-MMA beneficiaries. Non-MMA beneficiaries are treated as a baseline for those who use resources from MMAs. In total, there are 601 respondents who are non-MMA beneficiaries in Belize while 2 villages and 33 respondents in Fiji take advantage of marine resources from non-MMA sites. Out of 497 respondents in Panama, 304 are non-Park users. Out of 363 respondents in Ecuador, 90 are Park users and others are non-Park users.

A t-test with equal variance¹ is utilized to test the differences in the study. The null hypothesis is that the means of variables of the two groups are equal. The alternative hypothesis is that the mean of variable in MMA group is higher or lower than the mean of variable in the non-MMA group, which will depend on the effects we want to test. The t test with equal variance is given by

$$t = \frac{\bar{X}_1 - \bar{X}_2}{S_{12} * \sqrt{\frac{1}{N_1} + \frac{1}{N_2}}}, \quad S_{12} = \sqrt{\frac{(N_1 - 1)S_1^2 + (N_2 - 1)S_2^2}{N_1 + N_2 - 1}}$$

Assume the variance is equal across countries (Introduction of statistics, 2008).

¹ t-test with unequal variance is also conducted in the study. The paired t test with unequal variance and

unequal variance is given by $t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{N_1} + \frac{S_2^2}{N_2}}}$, Assume the variance is unequal across countries.

Cross node socioeconomic and governance

Table 10: MMA users VS Non-MMA users

Country	Respondents Surveyed	MMA beneficiaries	Non-MMA beneficiaries
Belize	1341	Total Subsample 740	Total Subsample 601
		Chunox	Chunox
		Copper Bank	Copper Bank
		Dangriga	Dangriga
		Hopkins	Hopkins
		Independence	Independence
		Monkey River	Monkey River
		Placencia	Placencia
		Punta Negra	Punta Negra
		Punta Gorda	Punta Gorda
		Sarteneja	Sarteneja
		Seine Bight	Seine Bight
		Sittee River	Sittee River
Brazil	680	Total Subsample	Total Subsample
Fiji	183	Total Subsample 150	Total Subsample 33
		Waiqanake	Kalokolevu 23
		Muaivuso	Tavulomo 10
		Namakala	
		Nabaka	
		Wai	
		Waitabu	
		Vurevure	
		Navatu	
		Raviravi	
		Kiobo	
		Namalata	
		Solevu	
Ecuador	363	Total Subsample 90	Total Subsample 273
		Santa Cristobal	Santa Cristobal 85
		Isabela	Isabela 41
		Santa Cruz	Santa Cruz 147
Panama	497	Total Subsample 193	Total Subsample 304
		Bahia Honda	Hicaco 89
		El Puerto	Malena 26
		Gobernadora	Pedregal 120
		Puerto Mutis	Pixvae 69
		Santa Catalina	

Source: household surveys conducted in these five countries

Preliminary Results

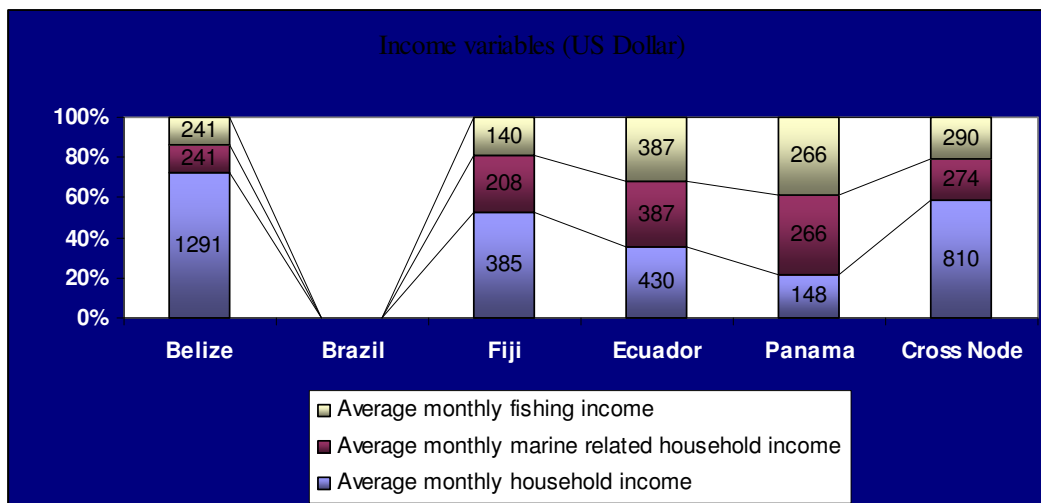
Descriptive statistics of three income variables of five countries and cross node are reported in **Table 15**. Perception of economic situation of Belize, Fiji, and cross node is summarized in **Table 16**. The respondents in Belize is the richest among five countries with a mean of \$1291 monthly income while the Panama respondents is the poorest among five countries with a mean of \$148 monthly income.

Table 15: Descriptive statistics of income variables

Variable	Belize	Brazil	Fiji	Ecuador	Panama	Cross Node
Average monthly household income (US Dollar)						
OBS	1093		183	330	489	2095
Mean	1291		385	430	148	810
Std. Dev.	1190		388	2260	112	1447
Min	50		0	0	75	0
Max	10000		2323	32224	500	32224
Average monthly marine related household income (US Dollar)						
OBS	723		183	330	195	1431
Mean	241		208	387	266	274
Std. Dev.	561		314	2578	370	1313
Min	0		0	0	5	0
Max	5000		1804	32224	3000	32224
Average monthly fishing income (US Dollar)						
OBS			183	330	195	708
Mean			140	387	266	290
Std. Dev.			228	2578	370	1776
Min			0	0	5	0
Max			1804	32224	3000	32224

Note: 1. For Ecuador and Panama, average monthly fishing income is the same as average marine related household income.

2. No fishing income in Belize

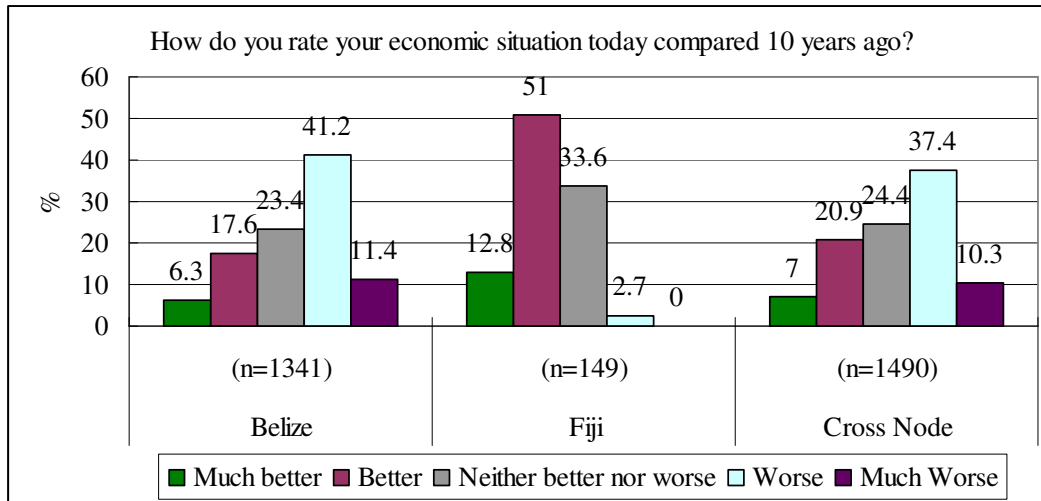


Description of respondents' perception of economic situation is summarized in **Table 16**. In total, 27.9% of respondents perceive their economic situation is either much better or better compared to 10 years ago while 47.4% of respondents perceive their health situation is worse or much worse. The rest of respondents perceive their economic situation no change.

Table 16: Perception of economic situation

How do you rate your economic situation today compared 10 years ago?			Belize (n=1341)	Fiji (n=182)	Cross Node (n=1523)
Frequency	Much better	1	85	22	104
	Better	2	236	83	312
	Neither better nor worse	3	314	66	364
	Worse	4	553	10	557
	Much Worse	5	153	1	153
Percentage	Much better	1	6.3	12.1	7.0
	Better	2	17.6	45.6	20.9
	Neither better nor worse	3	23.4	36.3	24.4
	Worse	4	41.2	5.5	37.4
	Much Worse	5	11.4	0.6	10.3

Only Belize and Fiji ask this question in the survey forms



1. Hypothesis 1 (Effect 1): income enhanced/maintained

The results of t-test with equal variance² are presented in **Table** . The null hypothesis is that the average monthly household³ income of respondents who use resources in MMA is equal to those who don't use resources in MMA ($H_0 : \mu_{MMA} = \mu_{Non-MMA}$), while the alternative hypothesis is that average monthly household income of respondents who use resources in MMA is higher than those who don't use resources in MMA ($H_a : \mu_{MMA} > \mu_{Non-MMA}$). The statistical result in Belize, Ecuador, Panama, and cross node show that there is sufficient evidence concludes that the null hypothesis is rejected, while there is no sufficient evidence in Fiji analysis concludes that the null hypothesis is rejected. The reason is probably that about 51.5% of respondents livelihood are non-marine related. The diversity of livelihood of respondents is summarized in **Table** .

The results of t-test with equal variance⁴ are presented in the following **Table** . The null hypothesis is that the average monthly marine related household⁵ income of MMA beneficiaries is equal to non-MMA beneficiaries ($H_0 : \mu_{MMA} = \mu_{Non-MMA}$), while the alternative hypothesis is that average monthly marine related household income of MMA beneficiaries is higher than non-MMA beneficiaries ($H_a : \mu_{MMA} > \mu_{Non-MMA}$). The statistical results in Belize, Ecuador, and Cross node show that there is sufficient evidence concludes that the null hypothesis is rejected, while there is no sufficient evidence concludes that the null hypothesis is rejected in Fiji and Panama.

Table 17: t test results of average monthly household income (US Dollar)

Variable	Belize	Brazil	Fiji	Ecuador	Panama#	Cross Node
Total Mean	1291		385	430	148	810
MMA beneficiaries	1378.53		370.63	3132.31	161.63	979.85

² The results of paired t-test with unequal variance are available upon request.

³ Average monthly household income is the average monthly income of all household members.

⁴ The results of paired t-test with unequal variance are available upon request.

⁵ Average monthly marine related household income includes the fishery income, tourism income, and boat dirver or diver income of all household members.

Cross node socioeconomic and governance

Non-MMA beneficiaries	1178.73	450.85	34.77	139.57	764.20
t-value	2.7643	-1.0765	8.4289	2.1276	4.1893
p-value	0.0029***	0.8584	0.0000***	0.0169**	0.0000***

#Household monthly income: 1=less than 100, 2=101-150, 3=151-200, 4=200-400,5=more than 400
*,**,***, represents significant at 10%, 5%, and 1%, respectively

Table 18: t test results of average monthly household income for fishing (US Dollar)

Variable	Belize	Brazil	Fiji	Ecuador	Panama	Cross Node
Total Mean						
MMA beneficiaries	387.97		140.39	3060	275.25	821.37
Non-MMA beneficiaries	24.86		140.97	0	261.24	180.72
t-value	8.9967		-0.0131	8.4673	0.2475	2.8754
p-value	0.0000***		0.5052	0.0000***	0.4024	0.0021***

*,**,***, represents significant at 10%, 5%, and 1%, respectively

On average, Belize respondents think that their economic situations have been negatively affected by the establishment of MMAs while Fiji respondents have an opposite opinion. The results of t-test are presented in **Table .** The null hypothesis is that the perception of economic situation of MMA beneficiaries is equal to non-MMA beneficiaries ($H_0 : \mu_{MMA} = \mu_{Non-MMA}$), while the alternative hypothesis is that perception of economic situation of MMA beneficiaries is stronger than non-MMA beneficiaries ($H_a : \mu_{MMA} < \mu_{Non-MMA}$). The statistical results in cross node show that there is sufficient evidence concludes that the null hypothesis is rejected and favoured that MMA beneficiaries think that their economic situation have been improved compared non-MMA beneficiaries.

Table 19: t test results of perception of economic situations

Variable	Belize	Fiji	Cross Node
Total Mean	3.34	2.26	3.23
MMA beneficiaries	3.33	2.26	3.15
Non-MMA beneficiaries	3.34	2.85	3.32
t-value	-0.20	-4.03	-2.90
p-value	0.42	0.00***	0.00***

Only Belize and Fiji ask this question in the survey forms

Answers for perception on economic situation: 1=Much better;2=Better;3=Neither better nor worse;4=Worse;5=Much Worse

*,**,***, represents significant at 10%, 5%, and 1%, respectively

4.2 Livelihoods effect

The diversity of livelihood and marine related livelihood of respondents is summarized in **Table 20**, **Table 21**, respectively. The livelihood is divided into non-marine related livelihood and marine related livelihood, which includes fishing, tourism, and boat drivers or divers. Figures 3 and 4 show the diversity of marine related livelihood.

Figure 3: Diversity of marine related livelihood (%)

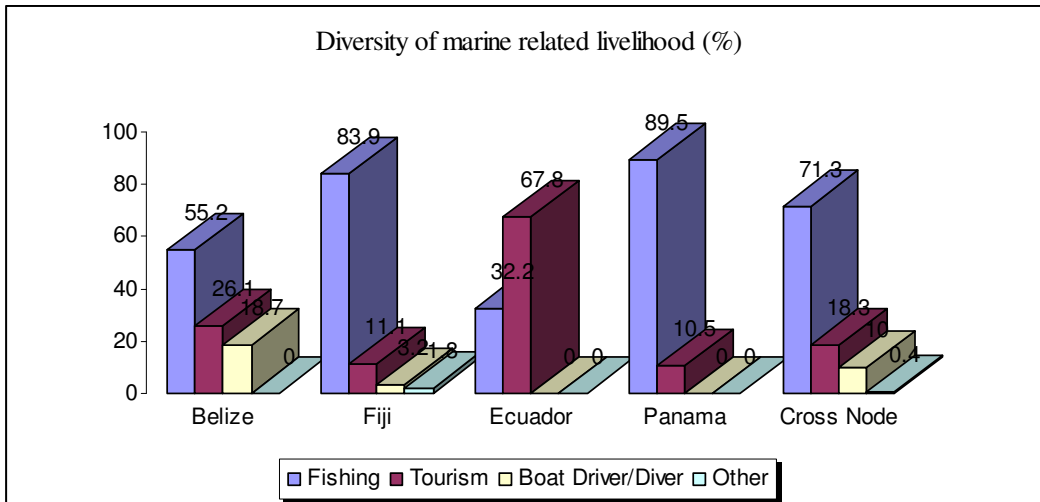
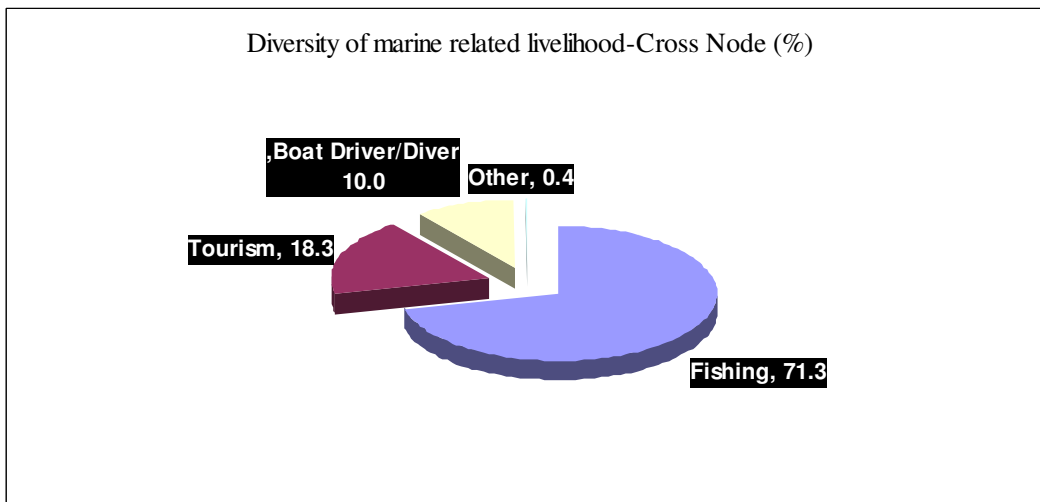


Figure 4: Diversity of marine related livelihood-Cross node (%)



Cross node socioeconomic and governance

Table 20: Diversity of Livelihood

	Belize	Brazil	Fiji	Ecuador	Panama	Cross Node	Belize	Brazil	Fiji	Ecuador	Panama	Cross Node
	Frequency						Percentage					
Marine Related	460		217	121	256	933	43.8		57.1	85.2	52.1	48.5
Fishing	254		182	39	229	665	24.2		47.9	32.2	46.6	34.6
Tourism	120		24	81	27	171	11.4		6.3	53.0	5.5	8.9
Boat Driver/Diver	86		7	0	0	93	8.2		1.8	0	0.0	4.8
Other	0		4	0	0	4	0.0		1.1	0	0.0	0.2
Non-marine Related	591		163	21	235	989	56.2		42.9	14.8	47.9	51.5
Total	1051		380	142	491	1922	100.0		100.0	100.0	100.0	100.0

Table 21: Diversity of Marine Related Livelihood

	Belize	Brazil	Fiji	Ecuador	Panama	Cross Node	Belize	Brazil	Fiji	Ecuador	Panama	Cross Node
	Frequency						Percentage					
Marine Related	460		217	121	256	933	100.0		100.0	100.0	100.0	100.0
Fishing	254		182	39	229	665	55.2		83.9	32.2	89.5	71.3
Tourism	120		24	81	27	171	26.1		11.1	67.8	10.5	18.3
Boat Driver/Diver	86		7	0	0	93	18.7		3.2	0	0.0	10.0
Other	0		4	0	0	4	0.0		1.8	0	0.0	0.4

2. Hypothesis 2 (Effect 2): Livelihoods are more diversified

The results of t-test with equal variance⁶ are presented in **Table 14**. The null hypothesis is that the number of fishermen among MMA resource users is equal to those among non-MMA users ($H_0 : \mu_{MMA} = \mu_{Non-MMA}$), while the alternative hypothesis is that the number of fishermen among MMA resource users is greater than those among non-MMA users ($H_a : \mu_{MMA} > \mu_{Non-MMA}$). The statistical results in Belize, Ecuador, Panama, and Cross node show that there is sufficient evidence concludes that the null hypothesis is rejected, while there is no sufficient evidence in Fiji concludes that there is significant difference between MMA users and non-MMA users when it comes to fishing, however, there are more respondents who are involved in tourism among MMA users than those among non-MMA users.

⁶ The results of paired t-test with unequal variance are available upon request.

Cross node socioeconomic and governance

Table 22: t test results of livelihood-cross node

Variable	Belize	Brazil	Fiji	Ecuador	Panama#	Cross Node
Marine Related						
MMA beneficiaries	0.35		0.67	1.00	0.60	0.41
Non-MMA beneficiaries	0.06		0.58	0.11	0.48	0.17
t-value	13.76		1.07	25.40	2.57	13.31
p-value	0.00***		0.14	0.00***	0.01***	0.00***
Fishing						
MMA beneficiaries	0.31		0.59	0.47	0.47	0.35
Non-MMA beneficiaries	0.01		0.58	0.00	0.45	0.14
t-value	15.83		0.12	14.75	0.38	12.43
p-value	0.00***		0.46	0.00***	0.35	0.00***
Tourism						
MMA beneficiaries	0.10		0.16	0.64	0.13	0.11
Non-MMA beneficiaries	0.05		0.00	0.11	0.03	0.03
t-value	3.24		2.49	11.30	4.37	6.87
p-value	0.00***		0.01***	0.00***	0.00***	0.00***
Boat Drivers/Divers						
MMA beneficiaries	0.08		0.05	0.00	0.00	0.06
Non-MMA beneficiaries	0.00		0.00	0.00	0.00	0.00
t-value	6.86		1.26			8.12
p-value	0.00***		0.10*			0.00***

*, **, ***, represents significant at 10%, 5%, and 1%, respectively

4.3 Perceptions of non-monetary (non-market and non-use) benefits to society

Perceptions of non-monetary benefits to society include eight statements on the indirect non-market value, existence value, bequest value, and option value of marine resources such as mangroves, coral reefs. Respondents were asked to choose among strongly agree, agree, neutral, disagree, and strongly disagree. These non-monetary benefits variables were only collected in Belize, Fiji, and Panama. Therefore, cross node analysis in this section is limited in these three countries. On average, the majority of respondents agrees the positive statements and disagrees the negative statements.

Cross node socioeconomic and governance

Table 13: Perceptions on non-monetary benefits to society of Belize and Fiji

Statements	Percentage				
	Strongly Agree 1	Agree 2	Neutral 3	Disagree 4	Strongly Disagree 5
1. The reefs are important for protecting land from storm waves (indirect non-market value)	60.3	31.5	4.5	3.0	0.7
2. In the long-run, fishing would be better if we cleared the coral (indirect non-market value)	3.5	9.3	9.7	51.8	25.8
3. Unless the mangroves are protected, we won't have any fish to catch (indirect non-market value)	32.4	40.9	8.7	16.5	1.6
4. Coral reefs are only important if you fish or drive (existence non-use value)	8.5	15.0	16.2	49.1	11.2
5. I want future generations to enjoy the mangroves and coral reefs (bequest non-use value)	58.4	36.5	3.2	1.1	0.9
6. Fishing should be restricted in certain areas even if no one ever fishes in those areas just to allow the fish and coral to grow (existence value)	35.2	42.5	12.9	6.8	2.7
7. We should restrict development in some coastal areas so that future generations will be able to have natural environments (bequest value)	34.1	44.0	14.1	5.7	2.2
8. Sea grass beds have no value to people (existence value)	10.2	15.8	20.9	39.0	14.1

Source: Household surveys conducted in Belize and Fiji

Hypothesis 4 (effect 4) Perceptions of non-monetary benefits to society enhanced

The results of t-test with equal variance⁷ in Belize, Fiji, and cross nodes are presented in **Table** , **Table** , **Table** , respectively. The null hypothesis is that the perception of non-monetary benefits of MMA beneficiaries is equal to non-MMA beneficiaries ($H_0 : \mu_{MMA} = \mu_{Non-MMA}$), while the alternative hypothesis is that the perception of non-monetary benefits of MMA beneficiaries is higher than non-MMA beneficiaries ($H_a : \mu_{MMA} > \mu_{Non-MMA}$). The statistical results in Belize, Fiji, and cross node show that there is sufficient evidence concludes that the null hypothesis is rejected. In cross node analysis, the perception of non-monetary benefits of MMA beneficiaries is stronger than non-MMA beneficiaries except statements 4 and 5.

⁷ The results of paired t-test with unequal variance are available upon request.

Cross node socioeconomic and governance

Table :t test result of non-monetary (non-market and non-use) benefits to society in Belize

Statements	MMA beneficiaries (n=740)	Non-MMA beneficiaries (n=601)	t Value	P Value
1. The reefs are important for protecting land from storm waves (indirect non-market value)	1.47	1.57	-2.6242	0.0044***
2. Unless the mangroves are protected, we won't have any fish to catch (indirect non-market value)	2.00	2.41	-7.0305	0.0000***
3. I want future generations to enjoy the mangroves and coral reefs (bequest non-use value)	1.43	1.51	-2.2237	0.0132**
4. Fishing should be restricted in certain areas even if no one ever fishes in those areas just to allow the fish and coral to grow	2.01	1.98	0.5010	0.6918
5. We should restrict development in some coastal areas so that future generations will be able to have natural environments	1.99	1.91	1.5617	0.9407
6. In the long-run, fishing would be better if we cleared the coral (indirect non-market value)	3.98	3.65	6.2380	0.0000***
7. Coral reefs are only important if you fish or drive (existence non-use value)	3.56	3.39	2.7895	0.0027***
8. Sea grass beds have no value to people (existence value)	3.52	3.03	7.9739	0.0000***

Answers for each statements: 1=Strongly agree;2=Agree;3=Neutral;4=Disagree;5=Strongly disagree
*, **, ***, represents significant at 10%, 5%, and 1%, respectively

Cross node socioeconomic and governance

Table: Non-monetary (non-market and non-use) benefits to society in Fiji

Statements	MMA beneficiaries (n=150)	Non-MMA beneficiaries (n=33)	t Value	P Value
1. The reefs are important for protecting land from storm waves (indirect non-market value)	1.47	2.21	-3.4480	0.0004***
2. Unless the mangroves are protected, we won't have any fish to catch (indirect non-market value)	1.68	2.39	-3.4761	0.0003***
3. I want future generations to enjoy the mangroves and coral reefs (bequest non-use value)	1.63	2.15	-2.5143	0.0064***
4. Fishing should be restricted in certain areas even if no one ever fishes in those areas just to allow the fish and coral to grow	1.75	2.88	-7.3310	0.0000***
5. We should restrict development in some coastal areas so that future generations will be able to have natural environments	1.96	3.00	-6.2920	0.0000***
6. In the long-run, fishing would be better if we cleared the coral (indirect non-market value)	4.16	4.21	-0.1880	0.5774
7. Coral reefs are only important if you fish or drive (existence non-use value)	2.74	2.82	-0.3271	0.6280
8. Sea grass beds have no value to people (existence value)	3.33	3.67	-1.2329	0.8904

Answers for each statements: 1=Strongly agree; 2=Agree; 3=Neutral; 4=Disagree; 5=Strongly disagree
 *, **, ***, represents significant at 10%, 5%, and 1%, respectively.

Cross node socioeconomic and governance

Table: Non-monetary (non-market and non-use) benefits to society in Panama

Statements	Park users (n=190)	Non-Park users (n=201)	t Value	P Value
1. The reefs are important for protecting land from storm waves (indirect non-market value)	1.25	1.38	-2.14	0.02**
2. Unless the mangroves are protected, we won't have any fish to catch (indirect non-market value)	1.08	1.17	-2.46	0.01***
3. I want future generations to enjoy the mangroves and coral reefs (bequest non-use value)	1.03	1.06	-1.44	0.07*
4. Fishing should be restricted in certain areas even if no one ever fishes in those areas just to allow the fish and coral to grow (existence value)	1.15	1.19	-0.88	0.19
5. We should restrict development in some coastal areas so that future generations will be able to have natural environments (bequest value)	1.27	1.24	0.57	0.72
6. In the long-run, fishing would be better if we cleared the coral (indirect non-market value)	2.71	2.77	-1.03	0.15
7. Coral reefs are important if you fish or drive (existence non-use value)	1.06	1.18	-3.17	0.00***
8. Sea grass beds have no value to people (existence value)	1.63	2.13	-6.14	0.00***

Answers for each statements: 1=Agree;2=Neutral;3=Disagree
 *, **, ***, represents significant at 10%, 5%, and 1%, respectively.

Cross node socioeconomic and governance

Table: Non-monetary (non-market and non-use) benefits to society in cross node (Belize and Fiji)

Statements	MMA beneficiaries (n=890)	Non-MMA beneficiaries (n=634)	t Value	P Value
1. The reefs are important for protecting land from storm waves (indirect non-market value)	1.47	1.60	-3.3660	0.0004***
2. Unless the mangroves are protected, we won't have any fish to catch (indirect non-market value)	1.95	2.41	-8.3584	0.0000***
3. I want future generations to enjoy the mangroves and coral reefs (bequest non-use value)	1.46	1.54	-2.0905	0.0184**
4. Fishing should be restricted in certain areas even if no one ever fishes in those areas just to allow the fish and coral to grow	1.97	2.03	-1.1987	0.1154
5. We should restrict development in some coastal areas so that future generations will be able to have natural environments	1.99	1.97	0.3880	0.6509
6. In the long-run, fishing would be better if we cleared the coral (indirect non-market value)	4.01	3.68	6.3484	0.0000***
7. Coral reefs are only important if you fish or drive (existence non-use value)	3.42	3.36	0.9866	0.1620
8. Sea grass beds have no value to people (existence value)	3.49	3.06	7.0189	0.0000***

Answers for each statements: 1=Strongly agree;2=Agree;3=Neutral;4=Disagree;5=Strongly disagree
*, **, ***, represents significant at 10%, 5%, and 1%, respectively

Cross node socioeconomic and governance

Table: Non-monetary (non-market and non-use) benefits to society in cross node (Belize, Fiji, and Panama)

Statements	MMA beneficiaries (n=1085)	Non-MMA beneficiaries (n=830)	t Value	P Value
1. The reefs are important for protecting land from storm waves (indirect non-market value)	1.13	1.20	-3.66	0.00***
2. Unless the mangroves are protected, we won't have any fish to catch (indirect non-market value)	1.28	1.52	-7.16	0.00***
3. I want future generations to enjoy the mangroves and coral reefs (bequest non-use value)	1.06	1.07	-1.04	0.15
4. Fishing should be restricted in certain areas even if no one ever fishes in those areas just to allow the fish and coral to grow	1.27	1.31	-1.63	0.05**
5. We should restrict development in some coastal areas so that future generations will be able to have natural environments	1.29	1.29	-0.00	0.50
6. In the long-run, fishing would be better if we cleared the coral (indirect non-market value)	2.70	2.62	2.56	0.00***
7. Coral reefs are only important if you fish or drive (existence non-use value)	2.15	2.06	2.09	0.02***
8. Sea grass beds have no value to people (existence value)	2.29	2.06	5.96	0.00***

Answers for each statements: 1=Strongly agree/Agree; 2=Neutral; 3=Disagree/Strongly disagree
*, **, ***, represents significant at 10%, 5%, and 1%, respectively

4.4 Health of coastal residents

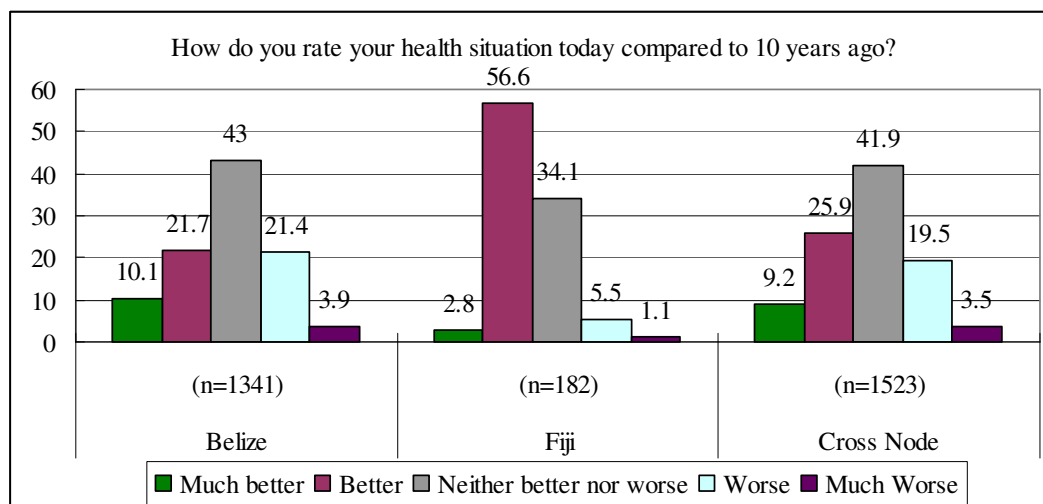
Health of coastal residents includes perception on health condition, frequency of fish or seafood consumption, and change in fish or seafood diet. For the perception on health situation, only Belize and Fiji have this variable. With regard to fishing or seafood consumption and change in fish or seafood diet, only Fiji and Ecuador collected these two questions.

Description of respondents' perception of health situation is summarized in **Table**. In total, 35.1% of respondents perceive their health situation is either much better or better compared to 10 years ago while 23% of respondents perceive their health situation is worse or much worse. The rest of respondents perceive their health situation no change.

Table : Perception of health situation-Belize, Fiji, and Cross node

How do you rate your health situation today compared to 10 years ago?			Belize (n=1341)	Fiji (n=182)	Cross Node (n=1523)
Frequency	Much better	1	135	5	140
	Better	2	291	103	394
	Neither better nor worse	3	576	62	638
	Worse	4	287	10	297
	Much Worse	5	52	2	54
Percentage	Much better	1	10.1	2.8	9.2
	Better	2	21.7	56.6	25.9
	Neither better nor worse	3	43.0	34.1	41.9
	Worse	4	21.4	5.5	19.5
	Much Worse	5	3.9	1.1	3.5

Only Belize and Fiji collect this question in the survey



Cross node socioeconomic and governance

The results of t-test are presented in **Table .** The null hypothesis is that the perception of health from respondents who use resources in MMA is equal to those who don't use resources in MMA ($H_0 : \mu_{MMA} = \mu_{Non-MMA}$), while the alternative hypothesis is that perception of health from respondents who use resources in MMA is stronger than those who don't use resources in MMA ($H_a : \mu_{MMA} < \mu_{Non-MMA}$). The statistical results in Belize, Fiji, and cross node show that there is sufficient evidence concludes that the null hypothesis is rejected.

Table : t test results of perception of health situations-Belize, Fiji and Cross Node

Variable	Belize	Fiji	Panama	Cross Node
Total Mean	2.87	2.45	2.06	2.82
MMA beneficiaries	2.84	2.34	2.03	2.75
Non-MMA beneficiaries	2.92	3.00	2.10	2.92
t-value	-1.51	-5.34	-1.58	-3.40
p-value	0.07*	0.00***	0.06*	0.00***

Only Belize, Fiji, and Panama collect this question in the survey

Answers for perception on health situation:1=Much better;2=Better;3=Neither better nor worse;4=Worse;5=Much Worse

*, **, ***, represents significant at 10%, 5%, and 1%, respectively

Fishing or seafood consumption is derived from the question that how often does your family eat fish or seafood. Fish or seafood diet change is generated from the question that has your family's fish or seafood diet change after the establishment of the MMA.

The results of t-test are presented in **Table.** The null hypothesis is that the frequency of fish or seafood consumption from respondents who use resources in MMA is equal to those who don't use resources in MMA ($H_0 : \mu_{MMA} = \mu_{Non-MMA}$), while the alternative hypothesis is that fish or seafood consumption from respondents who use resources in MMA is more frequent than those who don't use resources in MMA ($H_a : \mu_{MMA} < \mu_{Non-MMA}$). The statistical results in both Fiji and cross node show that there is sufficient evidence concludes that the null hypothesis is rejected.

Table: t test result of frequency of fish or seafood consumption-Fiji, Ecuador, and Cross node

Variable	Fiji	Ecuador	Panama	Cross Node
Total Mean				
MMA beneficiaries	2.95	3.02	2.92	2.98
Non-MMA beneficiaries	3.33	3.18	2.98	3.20
t-value	-1.59	1.22	-0.39	-2.13
p-value	0.06*	0.89	0.35	0.02**

Null hypothesis: $\mu_1 = \mu_2$; Alternative hypothesis: $\mu_1 < \mu_2$ (The lower the better)

Frequency of fish or seafood consumption :1=Every day;2=Every two days;3=Every three days;4=Every week;5=Every two weeks;6=Once a month;7=Almost never

*, **, ***, represents significant at 10%, 5%, and 1%, respectively.

The results of t-test are presented in **Table.** The null hypothesis is that the fish or seafood diet change from respondents who use resources in MMA is equal to those who don't use resources in MMA ($H_0 : \mu_{MMA} = \mu_{Non-MMA}$), while the alternative hypothesis is

Cross node socioeconomic and governance

that respondents who use resources in MMA ate more fish than those who don't use resources in MMA ($H_a : \mu_{MMA} > \mu_{Non-MMA}$). The statistical results in both Ecuador and cross node show that there is no sufficient evidence concludes that the null hypothesis is rejected, while the result in Fiji does reject the null hypothesis and favour the alternative hypothesis.

Table: t test result of fish or seafood diet change-Fiji, Ecuador, and Cross node

Variable	Fiji	Ecuador	Panama	Cross Node
Total Mean				
MMA beneficiaries	2.35	2.66	1.84	2.48
Non-MMA beneficiaries	2.03	2.63	1.79	2.55
t-value	2.07	-0.40	0.67	-0.97
p-value	0.02**	0.35	0.25	0.17

Null hypothesis: $\mu_1 = \mu_2$; Alternative hypothesis: $\mu_1 > \mu_2$ (The higher the better)

Change in fish or seafood diet: 1=Eat less fish; 2=No change; 3=Eat more fish

*, **, ***, represents significant at 10%, 5%, and 1%, respectively.

4.5 Summary-Key messages

1. Three variables, average monthly household income, average monthly fishing income, perception of economic situation, are used to measure coastal population's income. Statistical results of cross nodes analysis show that MMA beneficiaries have both higher household income and fishing income than non-MMA beneficiaries. Perceptions of economic situation were only collected in Belize, Fiji, and Panama, statistical results of Belize, Fiji, Panama, and cross nodes show that MMA beneficiaries are more positive on their economic situation than non-MMA beneficiaries.

Figure : Average monthly household income (US Dollar)-MMA beneficiaries v.s. Non-MMA beneficiaries

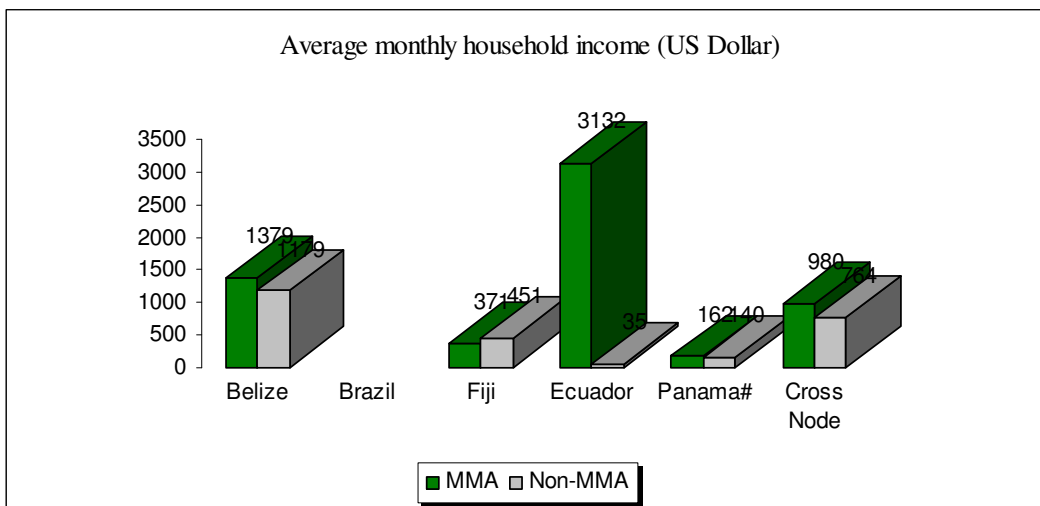


Figure : Average monthly marine related income (US Dollar) -MMA beneficiaries v.s. Non-MMA beneficiaries

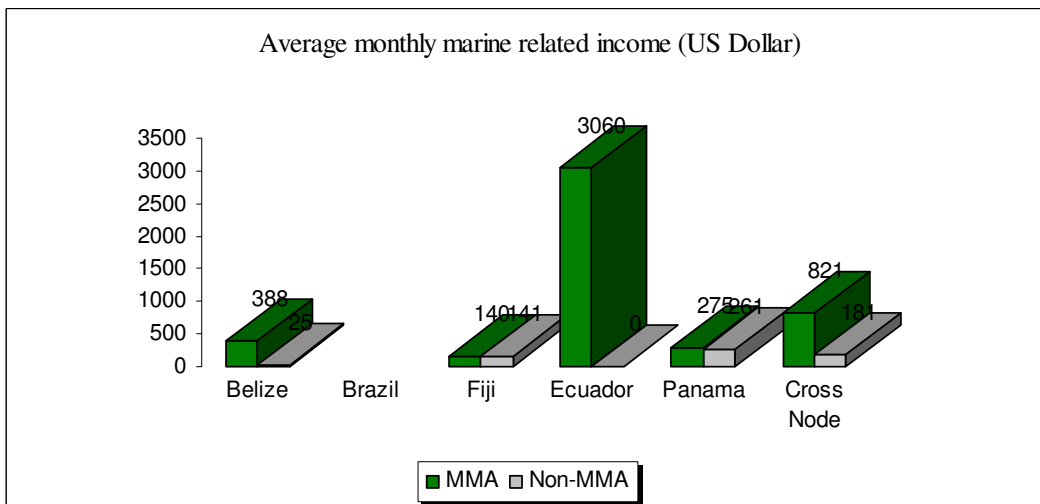


Figure : Perception of economic situation compared 10 years ago

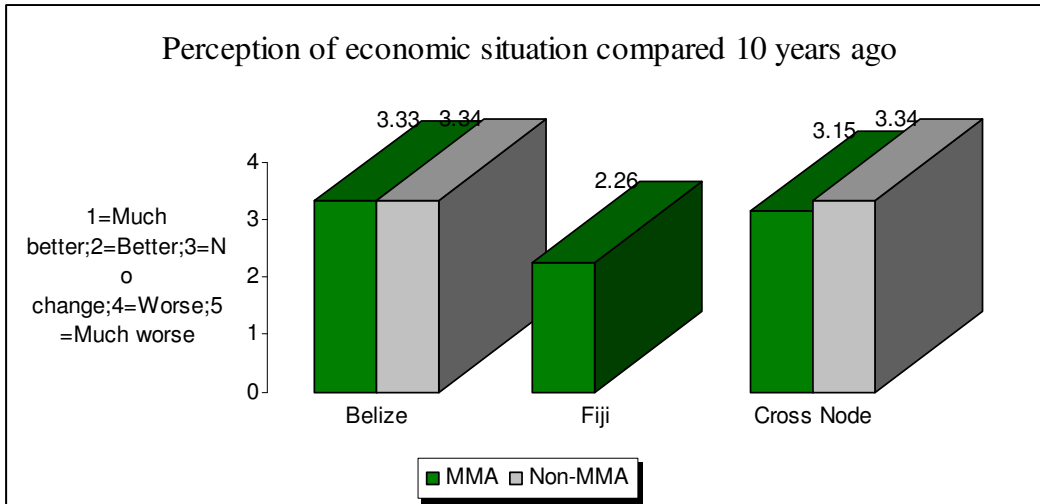
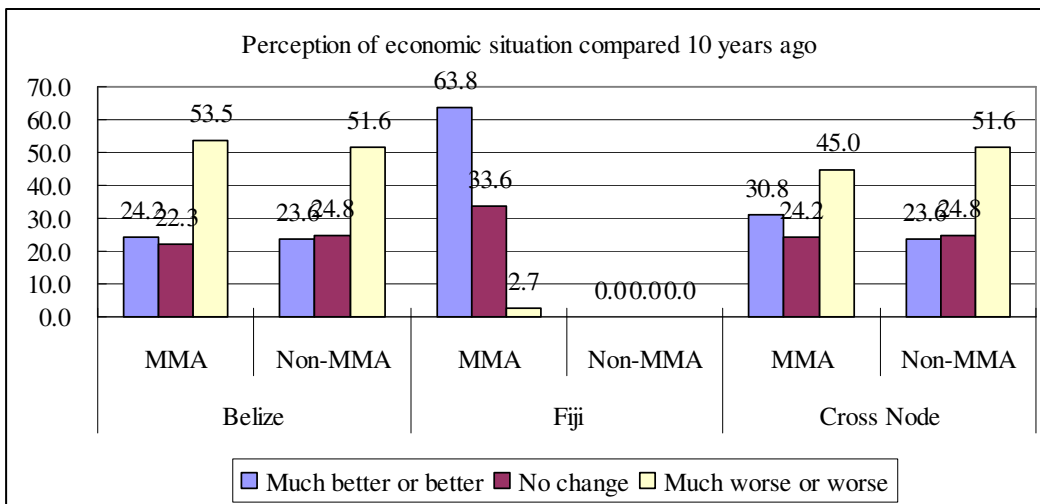
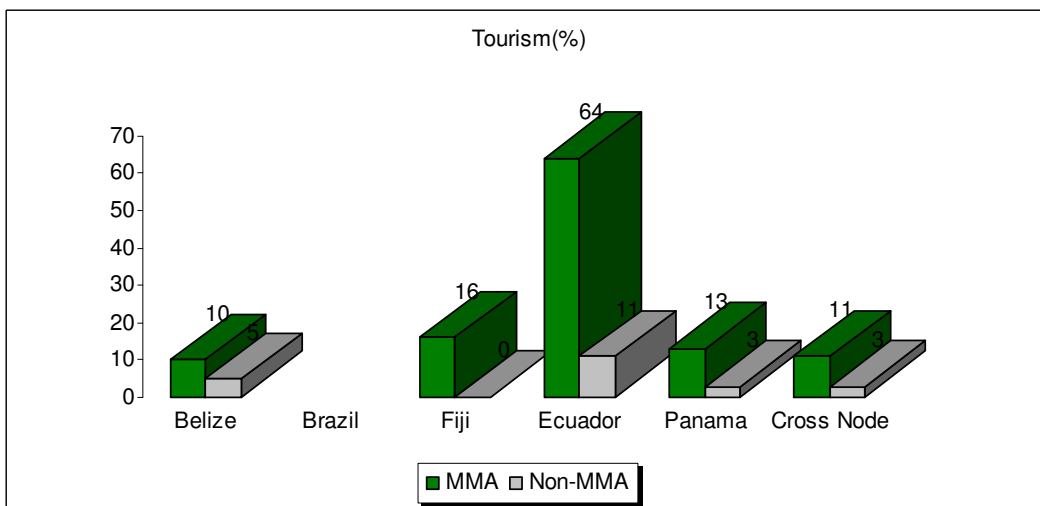
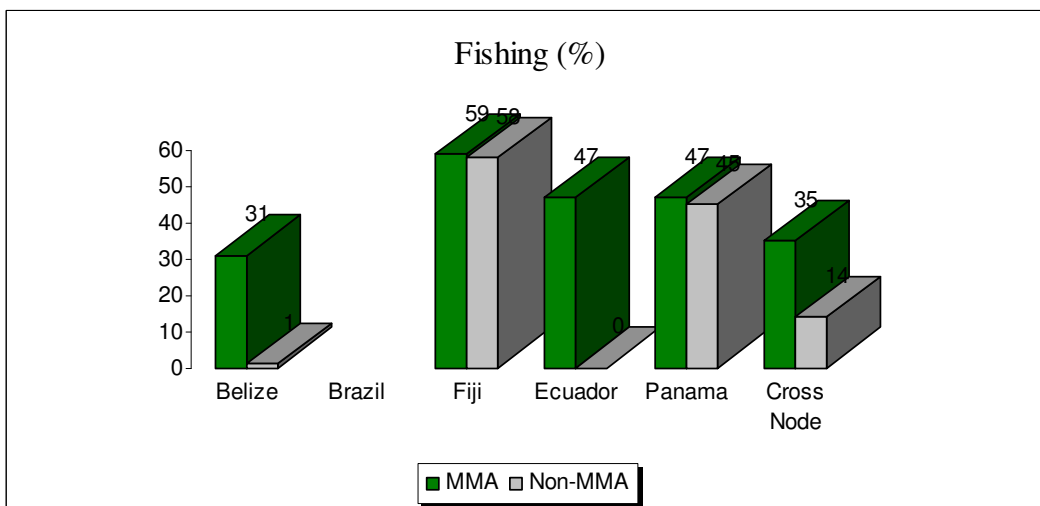
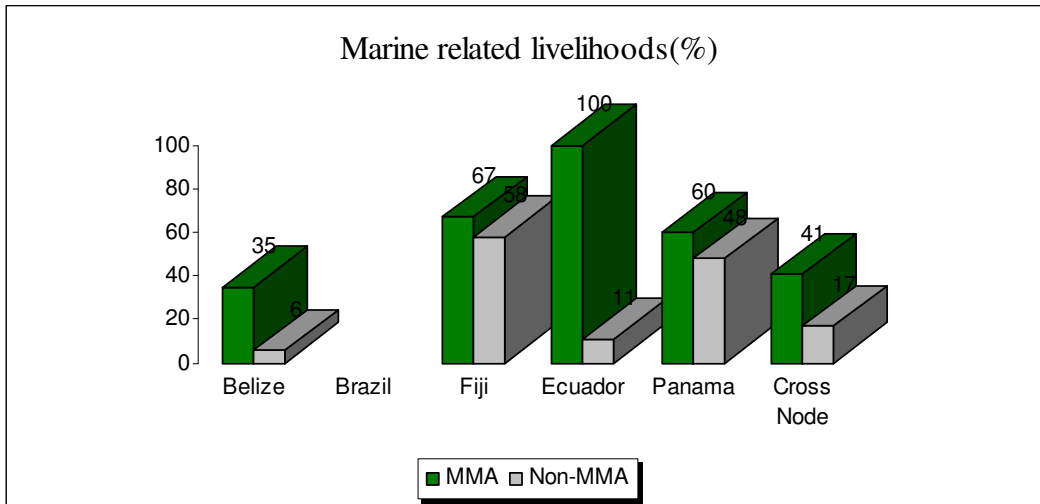


Figure : Perception of economic situation compared 10 years ago (%)

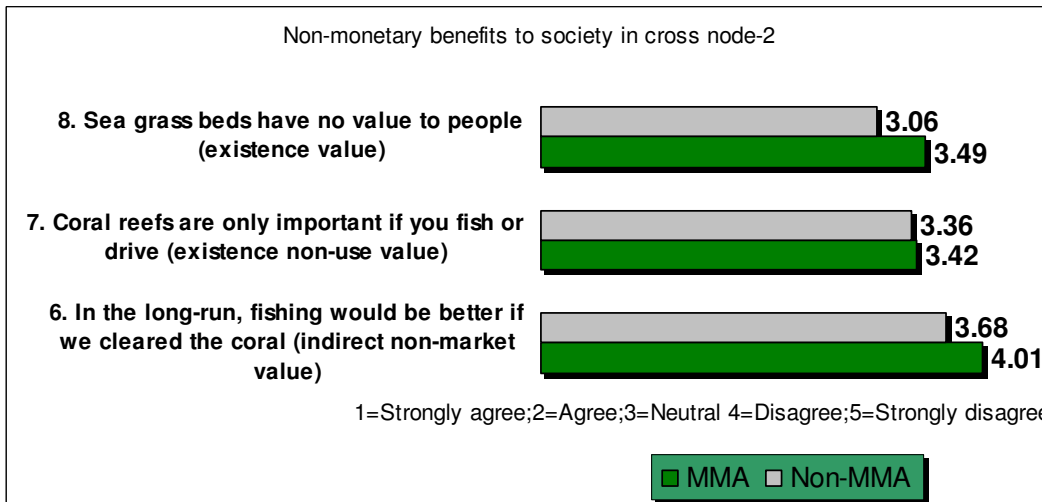
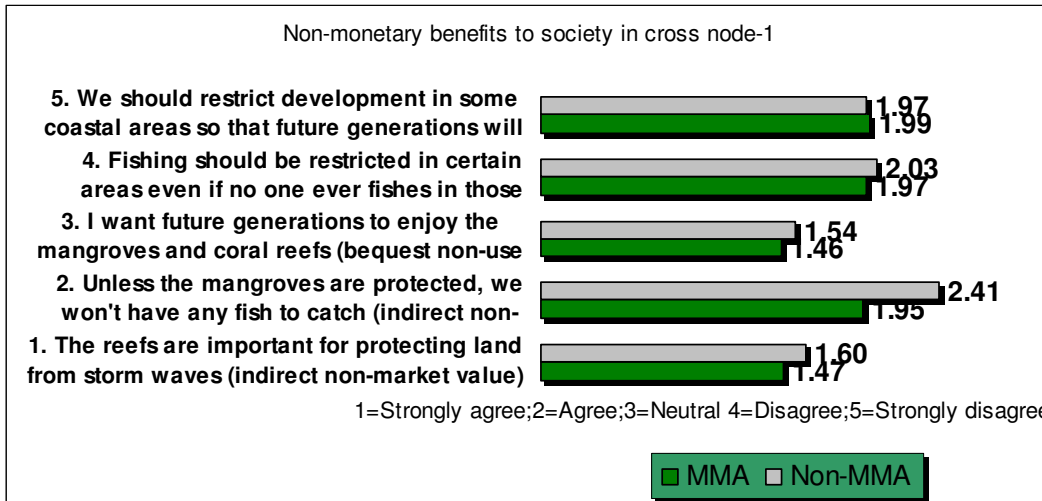


Cross node socioeconomic and governance

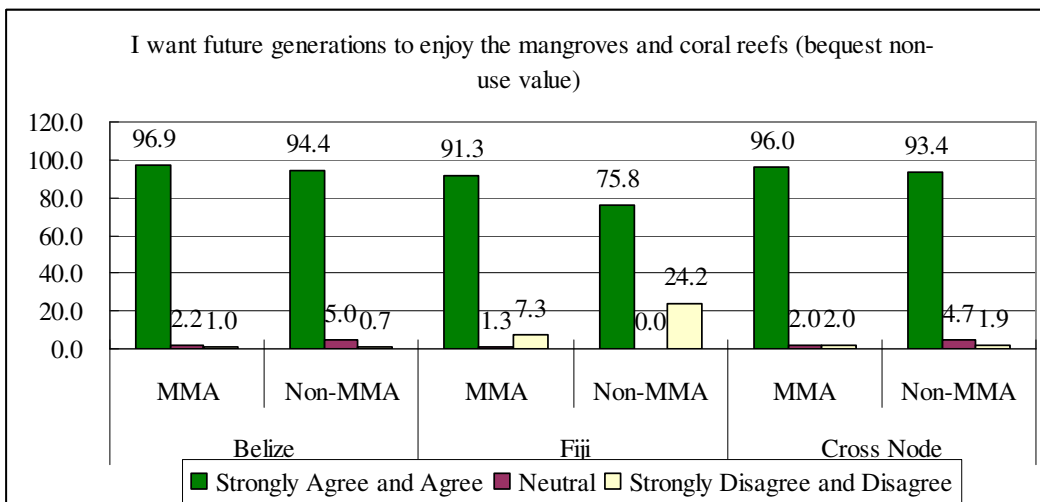
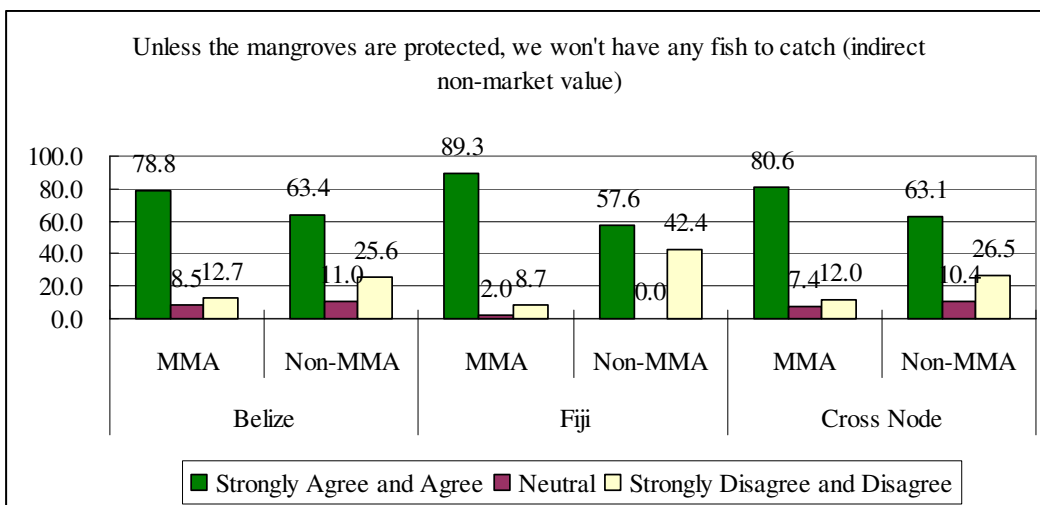
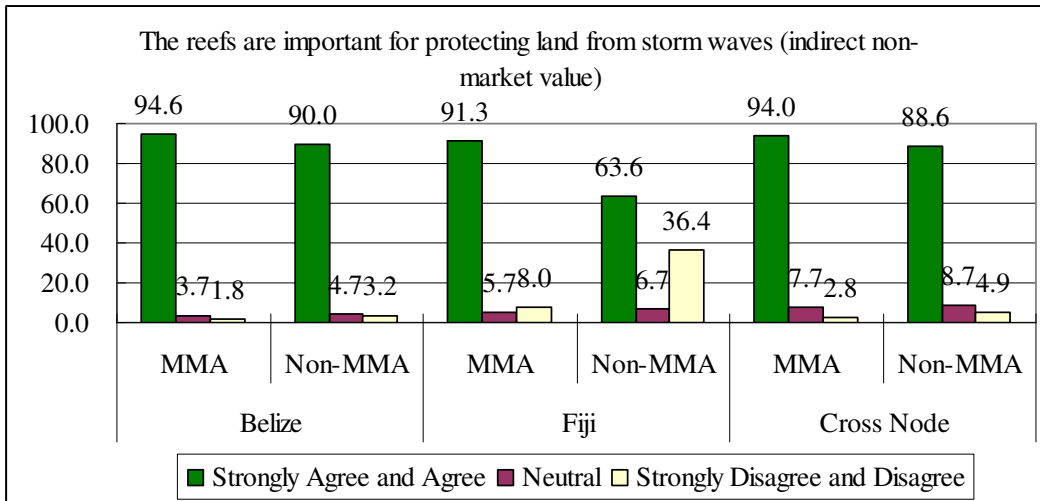
2. Statistical results show that MMA beneficiaries are likely to have more diversified livelihoods than non-MMA beneficiaries. In other words, the percentage of fishermen, tourist guide, and boat drivers or divers among MMA beneficiaries is higher than their counterparts among non-MMA beneficiaries.



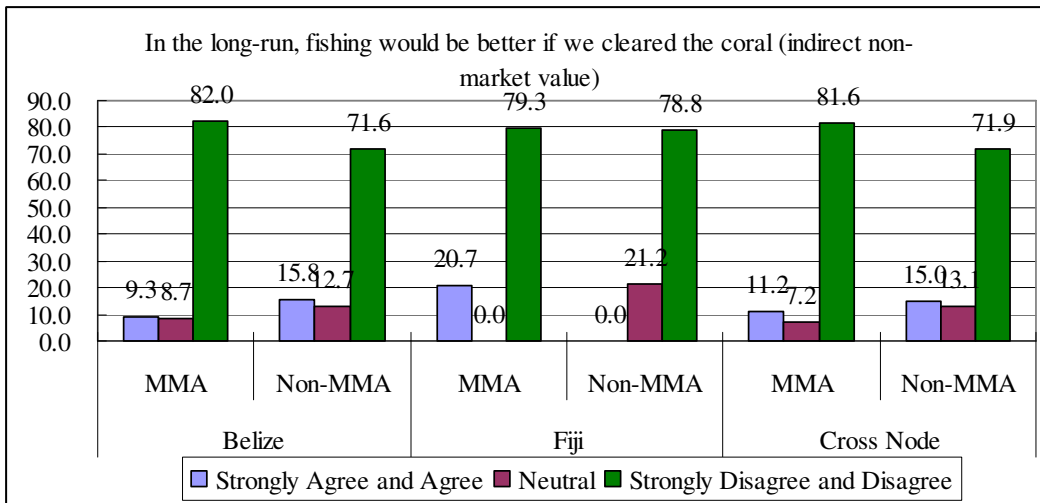
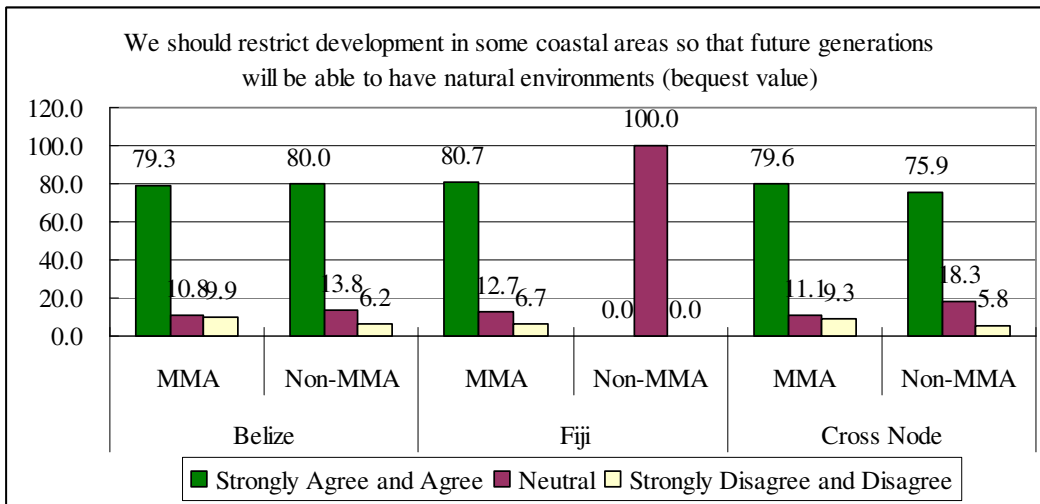
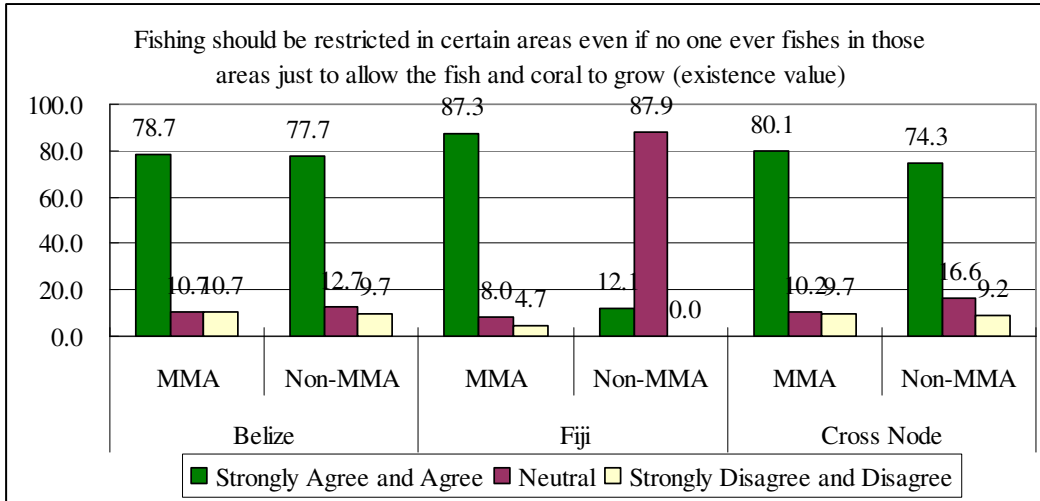
3. On average, both MMA beneficiaries and non-MMA beneficiaries have strong perceptions on non-monetary benefits of MMAs and local values and beliefs. However, MMA beneficiaries have stronger perceptions of non-monetary benefits of MMAs and local values and beliefs than non-MMA beneficiaries. These perceptions of non-monetary benefits of MMAs are only collected in Belize and Fiji.



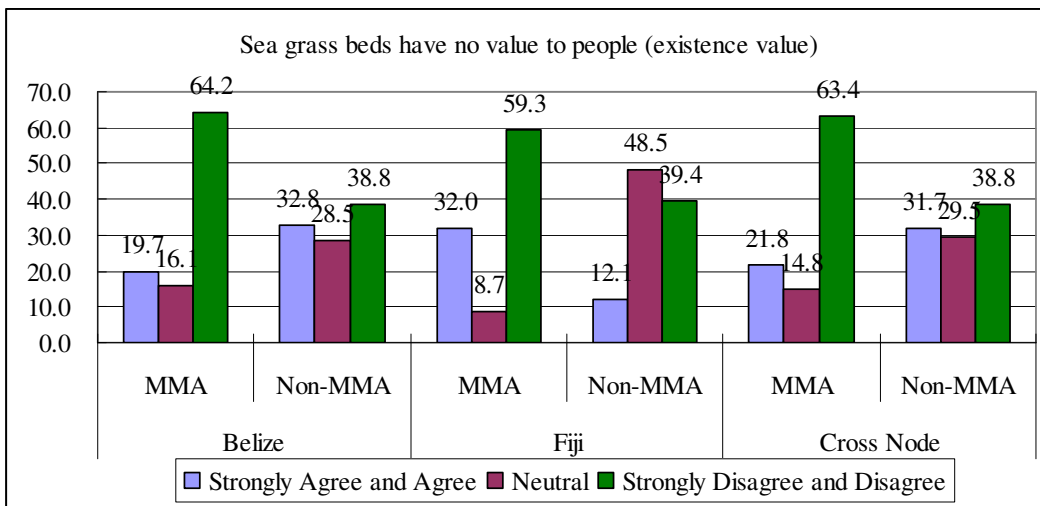
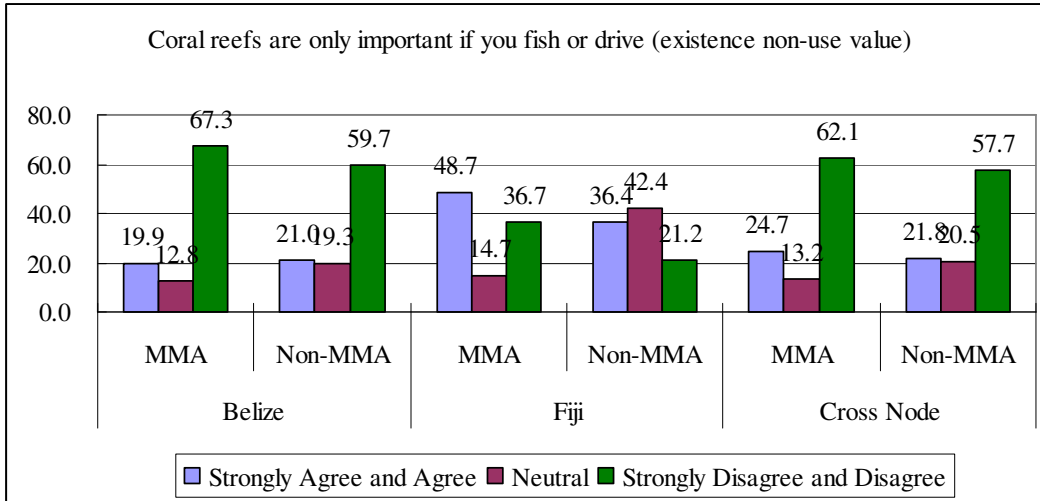
Cross node socioeconomic and governance



Cross node socioeconomic and governance

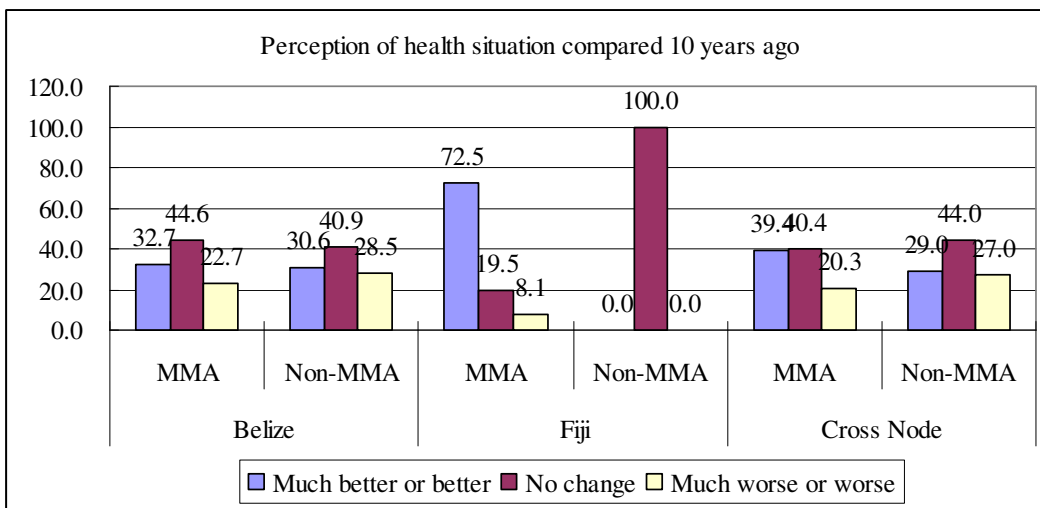
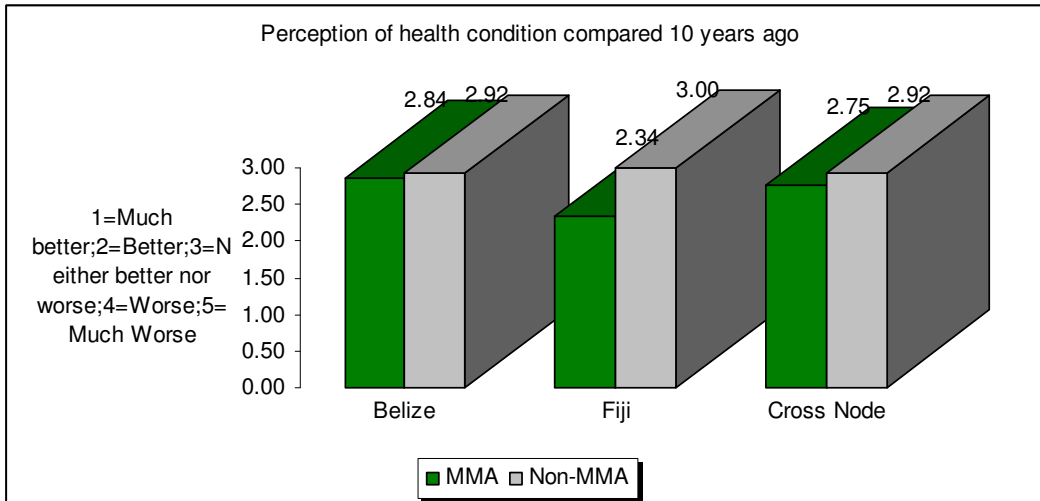


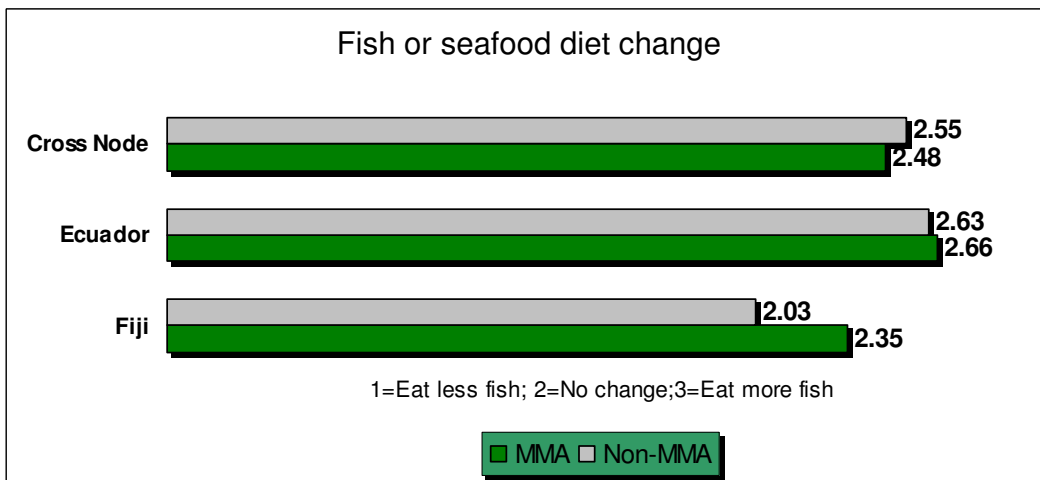
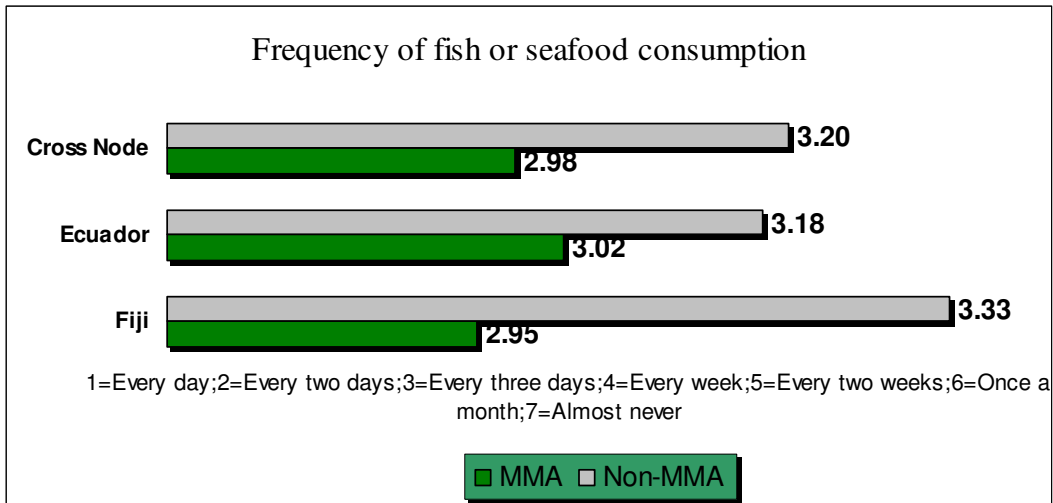
Cross node socioeconomic and governance



Cross node socioeconomic and governance

4. Perceptions of health situation were only collected in Belize and Fiji, statistical results of Belize, Fiji, and cross nodes show that MMA users are more positive on their health situation than non-MMA users. Seafood consumption frequency and seafood diet change are only collected in Fiji and Ecuador. Although Ecuador data doesn't support MMA beneficiaries eat more fish than non-MMA beneficiaries, statistical results in Fiji and cross node do conclude this hypothesis.





5. Governance Effects of MMAS (Similarities and differences cross node)

The first objective of this study is to test the socioeconomic and governance effects of marine managed areas. Six socioeconomic effects have been test in chapter four. In this chapter, five governance hypothesis effects are test. They are effective management structures and strategies maintained, effective stakeholder participation and representation ensured, management plan compliance by resource users enhanced, reduced resource conflicts, effective legal and institutional structures and strategies for management established and maintained

5.1 Management structures and strategies

Management structures and strategies include local understanding of MMA rules and regulations and level of participation in development of management plan.

Figure 6: Have you ever participated in a meeting related to Marine Reserve?

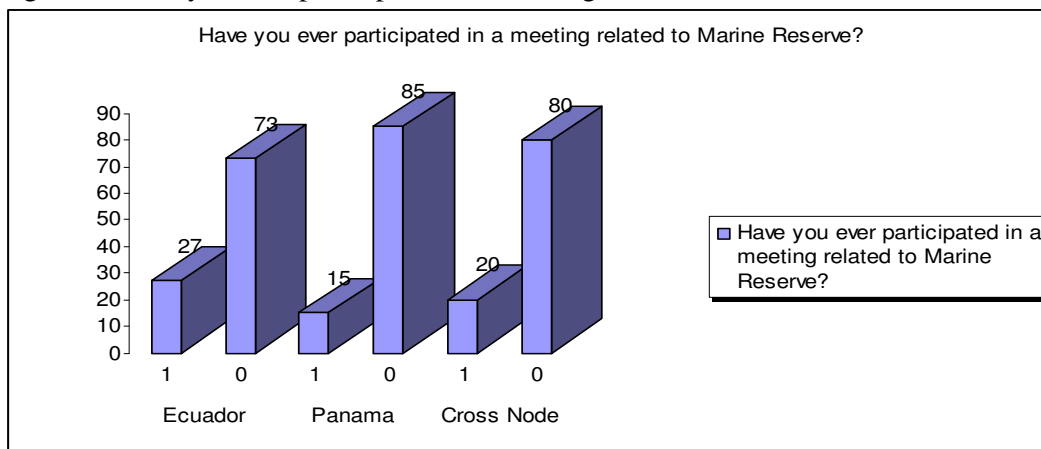
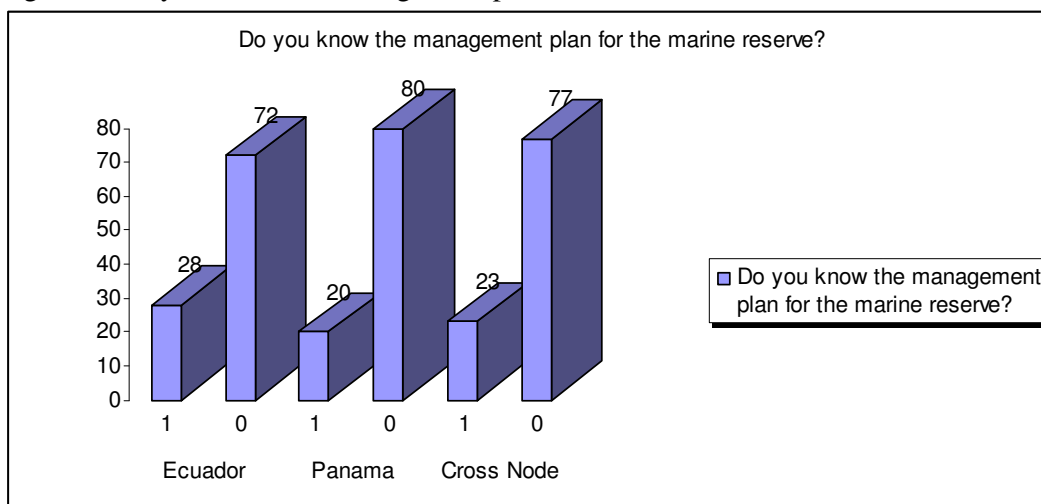


Figure 7: Do you know the management plan for the marine reserve?



Method (Baseline-Pre MMA, Non-MMA users, t test)

The results of t-test with equal variance⁸ in Belize, Brazil, Fiji, Ecuador, Panama, and cross nodes are presented in **Table** , **Table** , **Table** , **Table** , **Table** , **Table** , respectively. The null hypothesis is that the awareness of regulation and rules of MMA users is equal to those who don't use resources in MMA ($H_0 : \mu_{MMA} = \mu_{Non-MMA}$), while the alternative hypothesis is that the awareness of regulation and rules of MMA users is stronger than those who don't use resources in MMA ($H_a : \mu_{MMA} > \mu_{Non-MMA}$). The statistical result in all countries shows that there is sufficient evidence concludes that the null hypothesis is rejected. Therefore, we can say that marine users are more aware the regulation and more active in the management of MMAs.

Preliminary Results

Table: Effective management structures and strategies maintained-Rules and regulations

Variable	Belize	Brazil	Fiji	Ecuador	Panama	Cross Node
MMA beneficiaries	0.48		0.91	0.65	0.26	0.51
Non-MMA beneficiaries	0.24		0.00	0.35	0.16	0.24
t-value	9.36		18.55	4.99	2.91	14.56
p-value	0.00***		0.00***	0.00***	0.00***	0.00**

⁸ The results of paired t-test with unequal variance are available upon request.

Cross node socioeconomic and governance

Table: Effective management structures and strategies maintained

Have you ever participated in a meeting related to Marine Reserve?	Ecuador	Panama	Cross Node
Park users	0.36	0.28	0.27
Non-park users	0.21	0.16	0.16
t-value	3.16	3.31	3.93
p-value	0.00***	0.00***	0.00***

Answers for each statements: 1=Yes;0=No

*, **, ***, represents significant at 10%, 5%, and 1%, respectively

Table: Effective management structures and strategies maintained

Do you know the Management Plan for the Marine Reserve?	Ecuador	Panama	Cross Node
Park users	0.40	0.28	0.33
Non-park users	0.20	0.14	0.17
t-value	4.12	3.84	5.22
p-value	0.00***	0.00***	0.00***

Answers for each statements: 1=Yes;0=No

*, **, ***, represents significant at 10%, 5%, and 1%, respectively

Table : Effective management structures and strategies maintained in Panama (New survey)

	Park users (n=190)	Non-Park users (n=201)	t Value	P Value
7.1 Do you know if the Coiba National Park has a Management Plan?	0.62	0.34	5.77	0.00***
7.2 Do you know the provisions of the Management Plan of the Coiba National Park?	0.12	0.07	1.41	0.08*
8.1 You ever been invited to a meeting for discussion and/or information on PMPNC	0.45	0.20	5.41	0.00***
8.2 Do you think that was considered the views of communities in these meetings?	0.27	0.24	0.48	0.32
8.3 If you are invited to participate ... would you?	0.97	0.99	-1.10	0.86

Answers for each statements: 1=Yes;0=No

*, **, ***, represents significant at 10%, 5%, and 1%, respectively

5.2 Stakeholders participation and representation

Level of capacity building/training provided to stakeholders in participation is used to measure the effective stakeholder participation. This information was only collected in Belize and Fiji. The results of t-test with equal variance⁹ in Belize, Fiji, and cross nodes are presented in **Table** , **Table** , **Table** , respectively. The null hypothesis is that the level of capacity building/training provided to stakeholders in participation who use resources in MMA is equal to those who don't use resources in MMA ($H_0 : \mu_{MMA} = \mu_{Non-MMA}$), while the alternative hypothesis is that the level of capacity building/training provided to stakeholders in participation who use resources in MMA is higher than those who don't use resources in MMA ($H_a : \mu_{MMA} < \mu_{Non-MMA}$). The statistical results in Belize, Fiji, and cross node show that there is sufficient evidence concludes that the null hypothesis is rejected.

⁹ The results of paired t-test with unequal variance are available upon request.

Cross node socioeconomic and governance

Table: Belize-Level of capacity building/training provided to stakeholders in participation

	MMA beneficiaries (n=740)	Non-MMA beneficiaries (n=601)	t Value	P Value
1. Have you or anyone in your family ever received training in Environmental Education related to the MPA?	1.92	2.51	-6.8003	0.0000***
2. Have you or anyone in your family ever received any tour guide training as a result of the MPA?	1.83	2.13	-5.4768	0.0000***
3. Have you or anyone in your family ever received any arts and craft training that uses marine resources since the establishment of the MPA?	2.06	2.18	-2.0353	0.0210**
4. Have you or anyone in your family ever received a scholarship to attend formal schooling (primary or high school) as a result of assistance from the marine management body?	2.06	2.17	-2.1125	0.0174**
5. Have you or anyone in your family ever gotten a job related in some way to the MPA?	1.94	2.14	-3.5149	0.0002***

Answers for each statements: 1=Yes; 2=No; 9=Don't know or Not sure
 *, **, ***, represents significant at 10%, 5%, and 1%, respectively

Cross node socioeconomic and governance

Table : Fiji- Level of capacity building/training provided to stakeholders in participation

Statements	MMA beneficiaries (n=150)	Non-MMA beneficiaries (n=33)	t Value	P Value
1. Have you or anyone in your family ever received training in Environmental Education related to the MPA?	1.33	2.00	-4.94	0.00***
2. Have you or anyone in your family ever received any tour guide training as a result of the MPA?	1.51	2.00	-3.57	0.00***
3. Have you or anyone in your family ever received any arts and craft training that uses marine resources since the establishment of the MPA?	1.81	2.00	-1.47	0.07*
4. Have you or anyone in your family ever received a scholarship to attend formal schooling (primary or high school) as a result of assistance from the marine management body?	2.17	2.00	0.69	0.75
5. Have you or anyone in your family ever gotten a job related in some way to the MPA?	1.64	2.00	-4.28	0.00***

Answers for each statements: 1=Yes; 2=No; 9=Don't know or Not sure

Cross node socioeconomic and governance

Table: Cross Node-Level of capacity building/training provided to stakeholders in participation

Statements	MMA beneficiaries (n=890)	Non-MMA beneficiaries (n=601)	t Value	P Value
1. Have you or anyone in your family ever received training in Environmental Education related to the MPA?	1.82	2.51	-8.5483	0.0000***
2. Have you or anyone in your family ever received any tour guide training as a result of the MPA?	1.77	2.13	-6.8197	0.0000***
3. Have you or anyone in your family ever received any arts and craft training that uses marine resources since the establishment of the MPA?	2.02	2.18	-2.9304	0.0017***
4. Have you or anyone in your family ever received a scholarship to attend formal schooling (primary or high school) as a result of assistance from the marine management body?	2.08	2.17	-1.7374	0.0413**
5. Have you or anyone in your family ever gotten a job related in some way to the MPA?	1.89	2.14	-4.7662	0.0000***

Answers for each statements: 1=Yes; 2=No; 9=Don't know or Not sure
 *, **, ***, represents significant at 10%, 5%, and 1%, respectively

5.3 Environmental awareness and knowledge

Environmental awareness and knowledge include six statements. Respondents were asked to choose among strongly agree, agree, neutral, disagree, and strongly disagree. These environmental awareness and knowledge variables were only collected in Belize and Fiji. Therefore, cross node analysis in this section is limited in these two countries.

The results of paired t-test with equal variance¹⁰ in Belize, Fiji, and cross nodes are presented in Table , Table , Table , respectively. The null hypothesis is that the perception of environmental awareness and knowledge of respondents who use resources in MMA is equal to those who don't use resources in MMA ($H_0 : \mu_{MMA} = \mu_{Non-MMA}$), while the alternative hypothesis is that the perception of Environmental awareness and knowledge of respondents who use resources in MMA is higher than those who don't use resources in MMA ($H_a : \mu_{MMA} > \mu_{Non-MMA}$). The statistical result in both Belize and Fiji shows that there is sufficient evidence concludes that the null hypothesis is rejected.

¹⁰ The results of paired t-test with unequal variance are available upon request.

Cross node socioeconomic and governance

Table: Local Values and Beliefs in Belize

Statements	MMA Beneficiaries (n=740)	Non-MMA Beneficiaries (n=601)	t Value	P Value
1. Organizations that manage the resources are taking the bread out of people's mouths.	2.85	2.85	0.0863	0.4656
2. We do not have to worry about the sea and the fish. God will take care of it for us.	3.64	3.49	2.22	0.0133**
3. We should manage the sea to ensure that there are fish for our children and their children.	1.52	1.60	-2.2088	0.0137**
4. We have to take care of the land and sea or they will not provide for us in the future.	1.51	1.58	-2.1229	0.0170**
5. We want to protect the land and the sea but this is hard because we have economic needs now.	2.28	2.05	3.8529	0.0001***
6. Protecting the land and the sea brings us more benefits than not protecting these resources.	1.83	1.76	1.54	0.9381

Answers for each statements: 1=Strongly agree;2=Agree;3=Neutral;4=Disagree;5=Strongly disagree
*, **, ***, represents significant at 10%, 5%, and 1%, respectively

Cross node socioeconomic and governance

Table : Local Values and Beliefs in Fiji

Statements	MMA Beneficiaries (n=150)	Non-MMA Beneficiaries (n=33)	t Value	P Value
1. Organizations that manage the resources are taking the bread out of people's mouths.	4.23	3.00	5.56	0.00***
2. We do not have to worry about the sea and the fish. God will take care of it for us.	3.75	3.30	1.85	0.03**
3. We should manage the sea to ensure that there are fish for our children and their children.	1.25	2.82	-12.72	0.00***
4. We have to take care of the land and sea or they will not provide for us in the future.	1.33	2.09	-6.16	0.00***
5. We want to protect the land and the sea but this is hard because we have economic needs now.	2.59	2.03	2.57	0.01***
6. Protecting the land and the sea brings us more benefits than not protecting these resources.	1.50	2.82	-9.21	0.00***

Answers for each statements: 1=Strongly agree; 2=Agree; 3=Neutral; 4=Disagree; 5=Strongly disagree
 *, **, ***, represents significant at 10%, 5%, and 1%, respectively

Cross node socioeconomic and governance

Table : Local Values and Beliefs in Panama

Statements	Park users (n=190)	Non-Park users (n=201)	t Value	P Value
1. Organizations that manage the resources are taking the bread out of people's mouths.	1.84	1.87	-0.37	0.36
2. We do not have to worry about the sea and the fish. God will take care of it for us.	2.71	2.73	-0.43	0.33
3. We should manage the sea to ensure that there are fish for our children and their children.	1.07	1.15	-2.08	0.02**
4. We have to take care of the land and sea or they will not provide for us in the future.	1.09	1.07	0.44	0.67
5. We want to protect the land and the sea but this is hard because we have economic needs now.	1.15	1.15	-0.03	0.49
6. Protecting the land and the sea brings us more benefits than not protecting these resources.	1.06	1.12	-1.70	0.04**

Answers for each statements: 1=Agree; 2=Neutral; 3=Disagree

*, **, ***, represents significant at 10%, 5%, and 1%, respectively

Cross node socioeconomic and governance

Table : Cross Node- Local Values and Beliefs

Statements	MMA Beneficiaries (n=890)	Non-MMA Beneficiaries (n=601)	t Value	P Value
1. Organizations that manage the resources are taking the bread out of people's mouths.	3.09	2.85	3.5145	0.0002***
2. We do not have to worry about the sea and the fish. God will take care of it for us.	3.66	3.49	2.5765	0.0050***
3. We should manage the sea to ensure that there are fish for our children and their children.	1.48	1.60	-3.6723	0.0001***
4. We have to take care of the land and sea or they will not provide for us in the future.	1.48	1.58	-3.1220	0.0009***
5. We want to protect the land and the sea but this is hard because we have economic needs now.	2.33	2.05	4.8821	0.0000***
6. Protecting the land and the sea brings us more benefits than not protecting these resources.	1.78	1.76	0.3148	0.6235

Answers for each statements: 1=Strongly agree;2=Agree;3=Neutral;4=Disagree;5=Strongly disagree
*, **, ***, represents significant at 10%, 5%, and 1%, respectively

Cross node socioeconomic and governance

Table :Information Shared by MMA in Belize

Does the MPA body share information with you or your family as it relates to the:	MMA Beneficiaries (n=740)	Non-MMA Beneficiaries (n=601)	t Value	P Value
1. Size and boundaries of the marine protected area?	1.76	1.96	-3.0552	0.0011***
3. Eco-system impact of having a marine protected area?(eg: the impact of having mangroves or the reef system)	1.79	2.01	-3.1239	0.0009***
4. Biodiversity found within the marine protected area?(eg: give information on the kinds of animals and plants)	1.79	2.03	-3.5	0.0002***
5. Use of the natural resources within the marine protected area?(eg: use of the animals, plants, corals, beaches, mangroves)	1.74	2.01	-3.8853	0.0001***
6. Social and economic benefits you can get from the marine protected area?	1.84	2.01	-2.6368	0.0042***
7. How you can participate in activities related to the marine protected area.	1.93	2.09	-2.1174	0.0172**

Answers for each statements: 1=Yes;2=No;9=Don't know or Not sure

*, **, ***, represents significant at 10%, 5%, and 1%, respectively

Cross node socioeconomic and governance

Table: Information Shared by MMA in Fiji

Does the MPA body share information with you or your family as it relates to the:	MMA Beneficiaries (n=150)	Non-MMA Beneficiaries (n=33)	t Value	P Value
1. Size and boundaries of the marine protected area?	1.16	2.00	-6.73	0.00***
3. Eco-system impact of having a marine protected area?(eg: the impact of having mangroves or the reef system)	1.37	2.00	-2.72	0.00***
4. Biodiversity found within the marine protected area?(eg: give information on the kinds of animals and plants)	1.64	2.00	-1.08	0.14
5. Use of the natural resources within the marine protected area?(eg: use of the animals, plants, corals, beaches, mangroves)	1.42	2.00	-2.52	0.01***
6. Social and economic benefits you can get from the marine protected area?	1.78	2.00	-0.64	0.26
7. How you can participate in activities related to the marine protected area.	1.39	2.00	-2.42	0.01***

Answers for each statements: 1=Yes;2=No;9=Don't know or Not sure

Cross node socioeconomic and governance

Table :Information Shared by MMA in Panama

Does the MPA body share information with you or your family as it relates to the:	Park users (n=190)	Non-Park users (n=201)	t Value	P Value
1. Size and boundaries of the marine protected area?	1.65	1.86	-4.80	0.00***
3. Eco-system impact of having a marine protected area?(eg: the impact of having mangroves or the reef system)	1.68	1.78	-2.16	0.02**
4. Biodiversity found within the marine protected area?(eg: give information on the kinds of animals and plants)	1.64	1.80	-3.53	0.00***
5. Use of the natural resources within the marine protected area?(eg: use of the animals, plants, corals, beaches, mangroves)	1.63	1.80	-3.74	0.00***
6. Social and economic benefits you can get from the marine protected area?	1.67	1.82	-3.40	0.00***
7. How you can participate in activities related to the marine protected area.	1.77	1.89	-3.36	0.00***

Answers for each statements: 1=Yes;2=No; 9=Don't know or Not sure (Dropped)

*, **, ***, represents significant at 10%, 5%, and 1%, respectively

Cross node socioeconomic and governance

Table : Cross Node-Information Shared by MMA

Does the MPA body share information with you or your family as it relates to the:	MMA Beneficiaries (n=890)	Non-MMA Beneficiaries (n=601)	t Value	P Value
1. Size and boundaries of the marine protected area?	1.66	1.96	-4.8522	0.0000***
3. Eco-system impact of having a marine protected area?(eg: the impact of having mangroves or the reef system)	1.72	2.01	-4.2462	0.0000***
4. Biodiversity found within the marine protected area?(eg: give information on the kinds of animals and plants)	1.76	2.03	-3.7833	0.0001***
5. Use of the natural resources within the marine protected area?(eg: use of the animals, plants, corals, beaches, mangroves)	1.69	2.01	-4.8318	0.0000***
6. Social and economic benefits you can get from the marine protected area?	1.83	2.01	-2.6796	0.0037***
7. How you can participate in activities related to the marine protected area.	1.84	2.09	-3.4316	0.0003***

Answers for each statements: 1=Yes;2=No;9=Don't know or Not sure

*, **, ***, represents significant at 10%, 5%, and 1%, respectively

Cross node socioeconomic and governance

Degree of information dissemination to encourage stakeholder compliance is used to evaluate the management plan compliance by resource users. This information was only collected in Belize and Fiji. The results of t-test with equal variance¹¹ in Belize, Fiji, and cross nodes are presented in **Table** , **Table** , **Table** , respectively. The null hypothesis is that the degree of information dissemination to encourage stakeholder compliance for those who use resources in MMA is equal to those who don't use resources in MMA ($H_0 : \mu_{MMA} = \mu_{Non-MMA}$), while the alternative hypothesis is that the Degree of information dissemination to encourage stakeholder compliance for those who use resources in MMA is higher than those who don't use resources in MMA ($H_a : \mu_{MMA} < \mu_{Non-MMA}$). The statistical results in Belize, Fiji, and cross node show that there is sufficient evidence concludes that the null hypothesis is rejected.

¹¹ The results of paired t-test with unequal variance are available upon request.

Cross node socioeconomic and governance

Table: Degree of information dissemination to encourage stakeholder compliance in Belize

	MMA Beneficiaries (n=740)	Non-MMA Beneficiaries (n=601)	t Value	P Value
1. Is the information easy to understand?	1.51	1.80	-6.5021	0.0000***
2. Has this information provided by these MPA's changed the way you or your family access the resources within the MPA?	1.68	2.04	-5.3560	0.0000***
3. Has this information provided by these MPA's changed the way you or your family use the resources within the MPA?	1.70	2.01	-4.5905	0.0000***
4. Would you share the information with others to protect the MPA resources?	1.51	1.80	-5.8857	0.0000***

Answers for each statements: 1=Yes; 2=No; 9=Don't know or Not sure
 *, **, ***, represents significant at 10%, 5%, and 1%, respectively

Cross node socioeconomic and governance

Table: Degree of information dissemination to encourage stakeholder compliance in Fiji

	MMA Beneficiaries (n=150)	Non-MMA Beneficiaries (n=33)
1. Is the information easy to understand?	1.26	
2. Has this information provided by these MPA's changed the way you or your family access the resources within the MPA?	1.31	
3. Has this information provided by these MPA's changed the way you or your family use the resources within the MPA?	1.25	These statements are not applicable for Non-MMA users
4. Would you share the information with others to protect the MPA resources?	1.28	

Answers for each statements: 1=Yes; 2=No; 9=Don't know or Not sure

Cross node socioeconomic and governance

Table: Degree of information dissemination to encourage stakeholder compliance in cross node

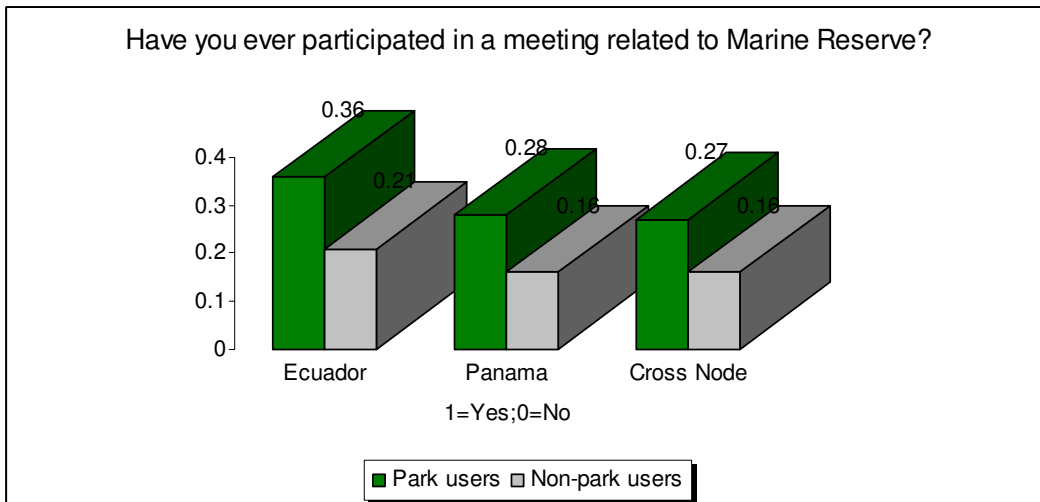
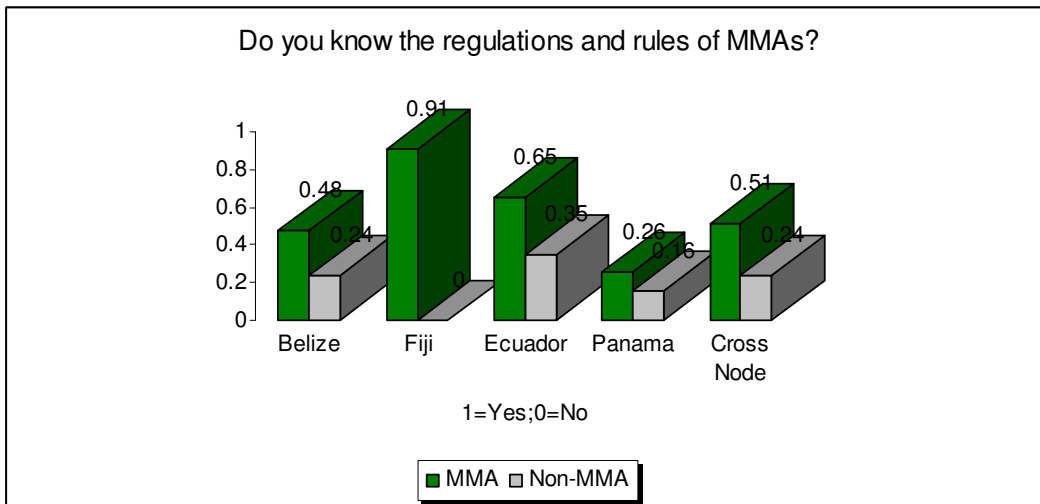
Statements	MMA Beneficiaries (n=840)	Non-MMA Beneficiaries (n=601)	t Value	P Value
1. Is the information easy to understand?	1.47	1.80	-7.3560	0.0000***
2. Has this information provided by these MPA's changed the way you or your family access the resources within the MPA?	1.62	2.04	-6.4055	0.0000***
3. Has this information provided by these MPA's changed the way you or your family use the resources within the MPA?	1.63	2.01	-5.9577	0.0000***
4. Would you share the information with others to protect the MPA resources?	1.47	1.80	-6.5700	0.0000***

Answers for each statements: 1=Yes;2=No;9=Don't know or Not sure

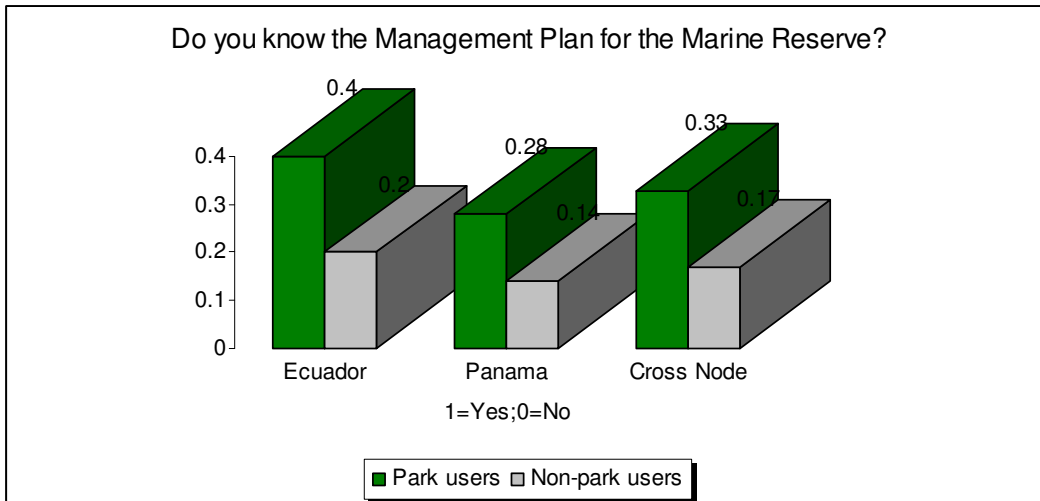
*, **, ***, represents significant at 10%, 5%, and 1%, respectively

5.4 Summary-key messages

1 MMA users perceive management in MMAs are more effective than non-MMAs compared to non-MMA users. Cross node analysis shows that MMA users are more likely to know the rules and regulations than non-MMA users. Statistical results in Ecuador and Panama show that MMA users are more likely to be involved in MMA meetings and management plans.

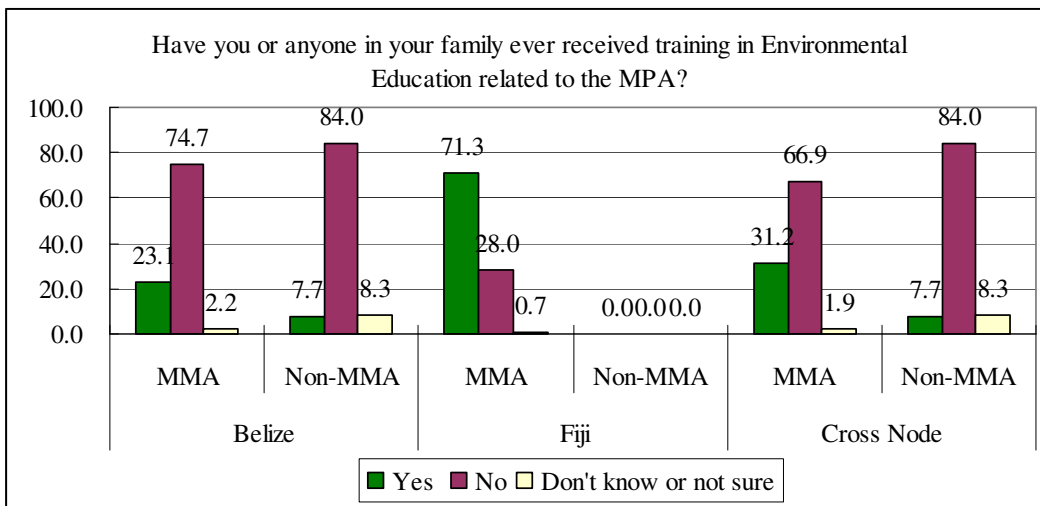
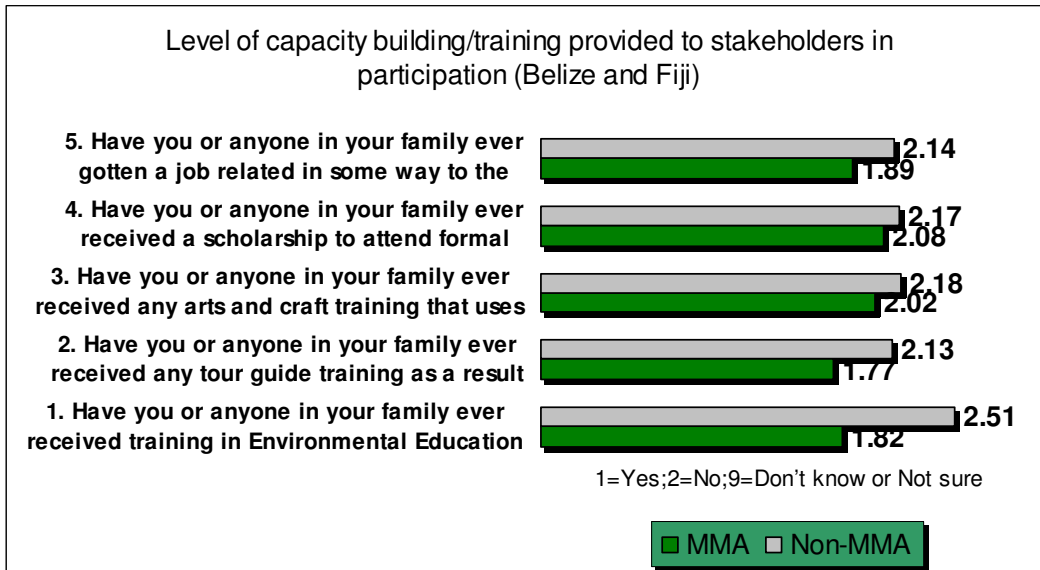


Cross node socioeconomic and governance

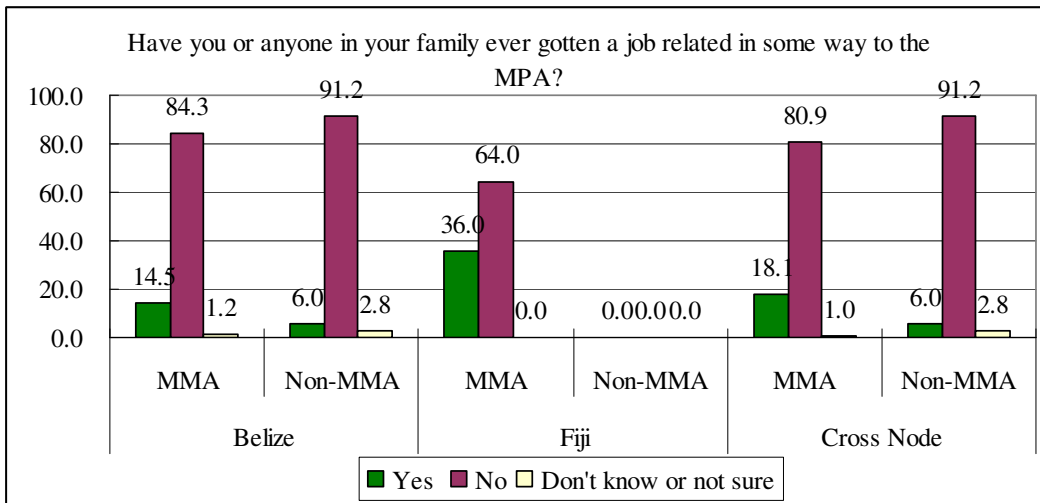
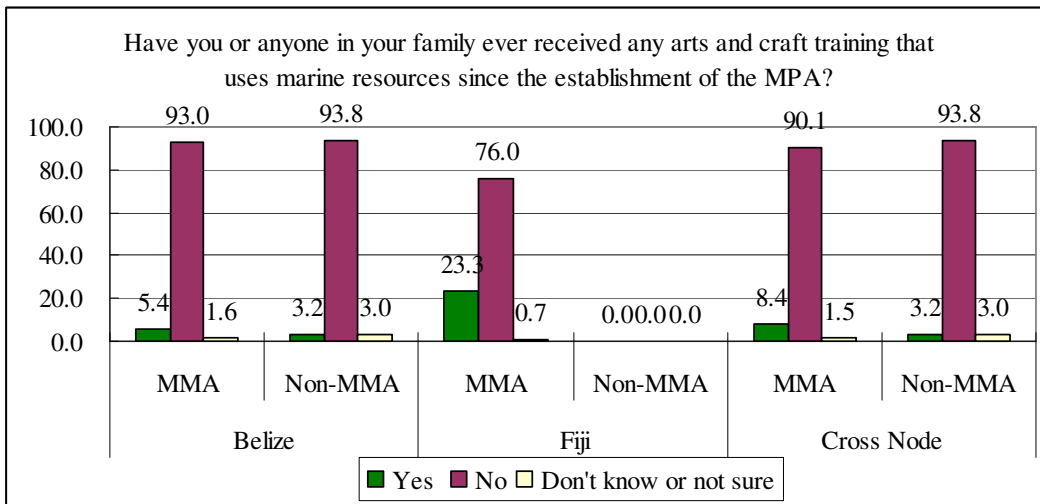
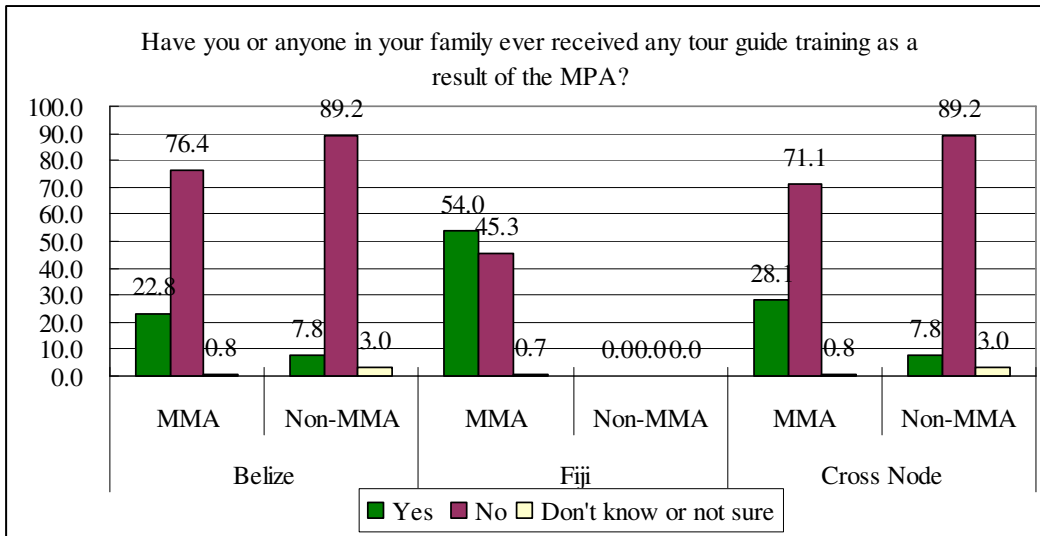


Cross node socioeconomic and governance

2 Respondents who use marine resources from MMAs more likely get information and training from MMA bodies than respondents who don't use marine resources from MMAs.

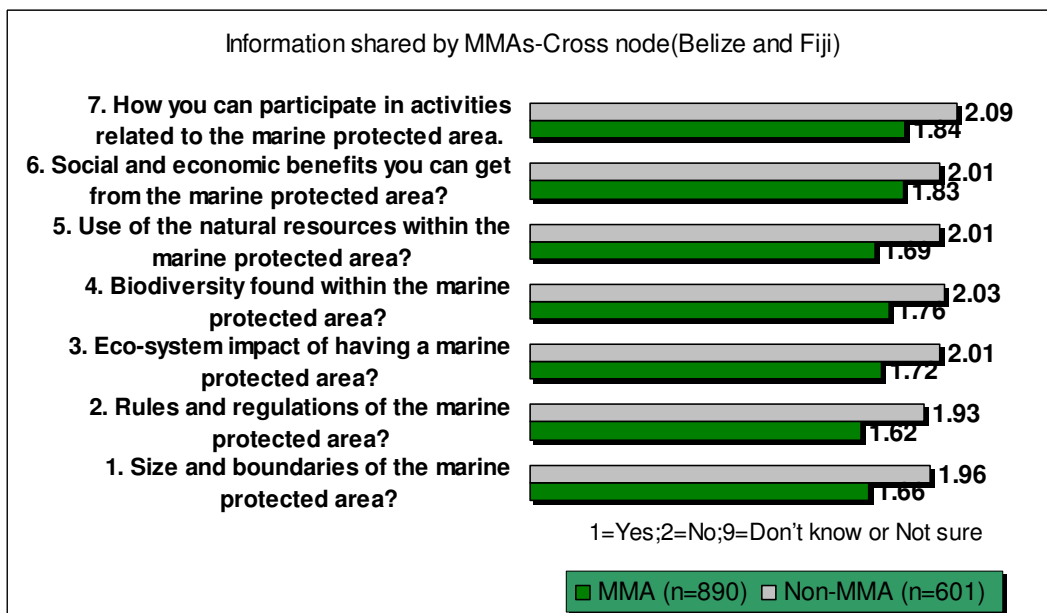
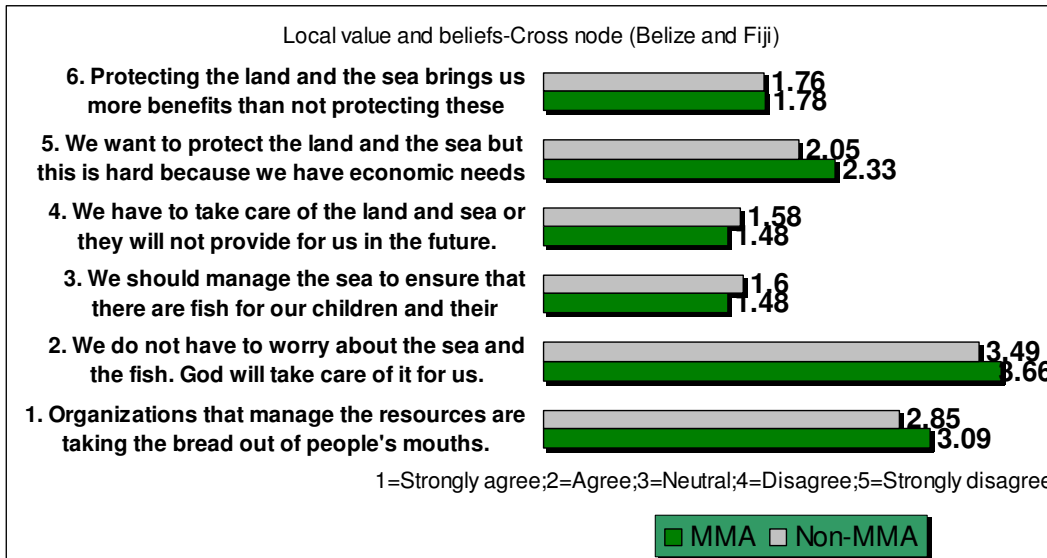


Cross node socioeconomic and governance

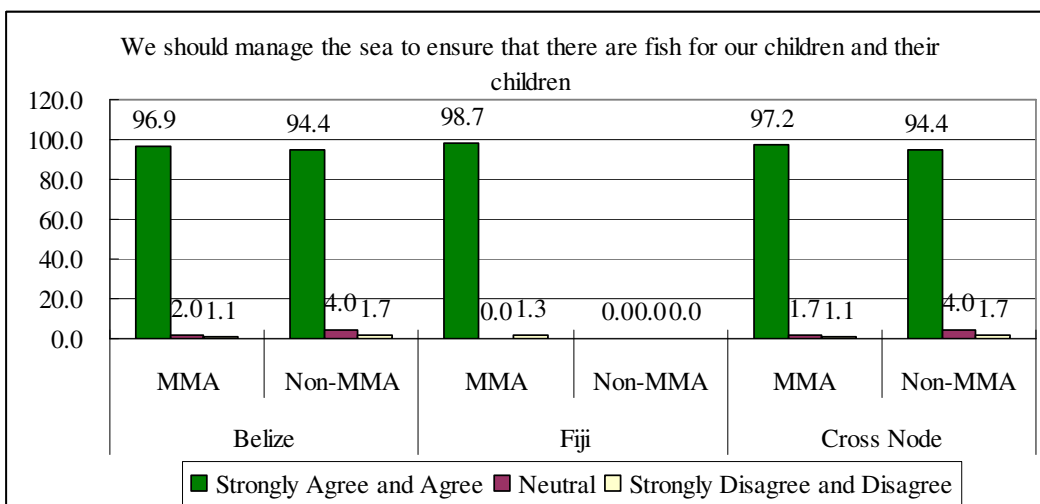
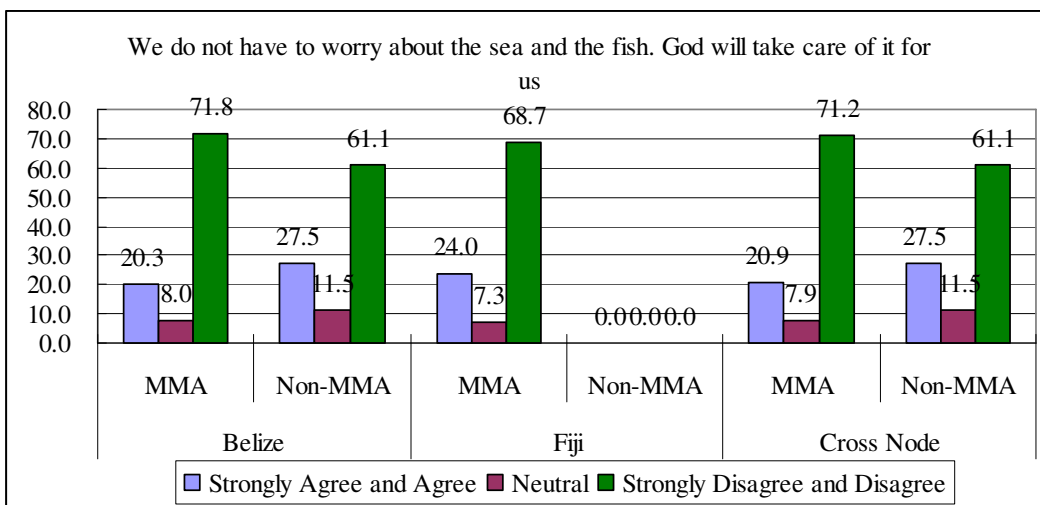
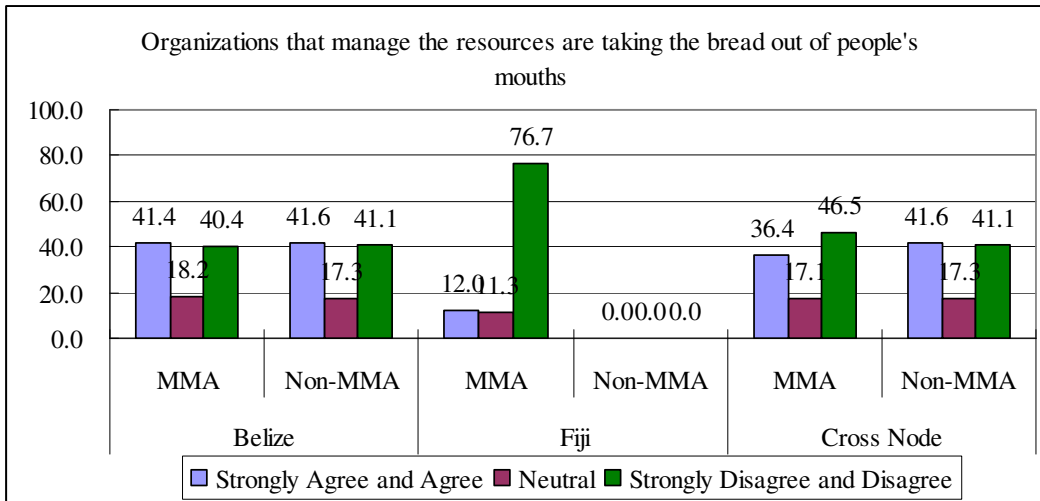


Cross node socioeconomic and governance

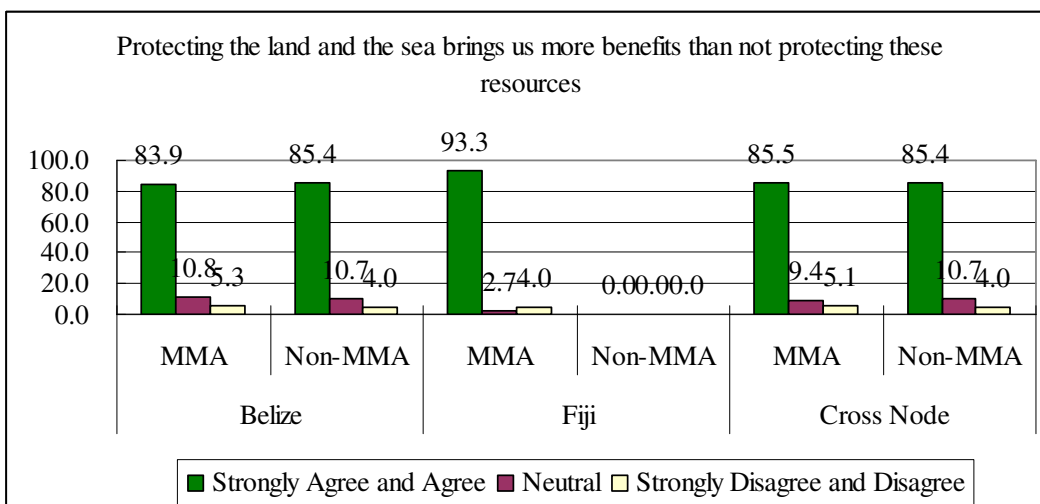
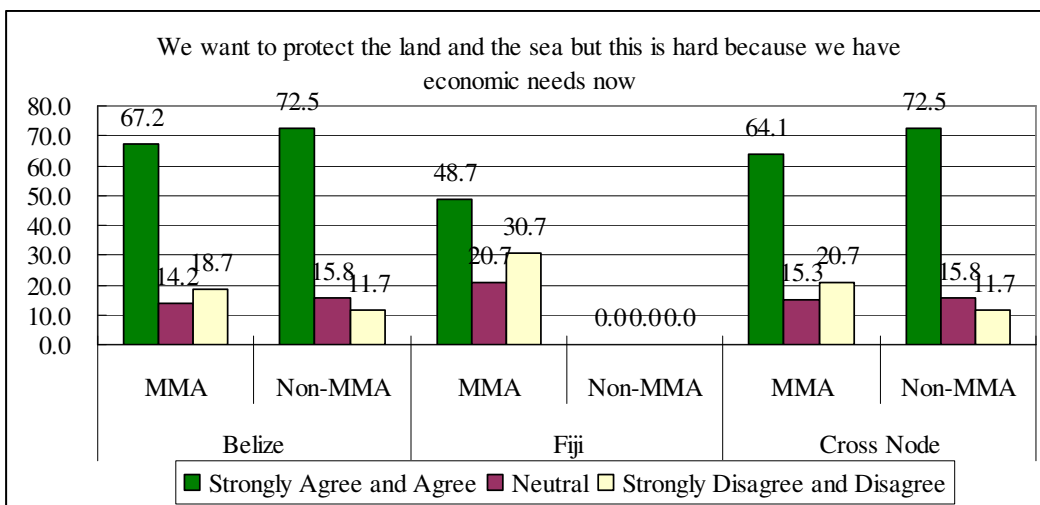
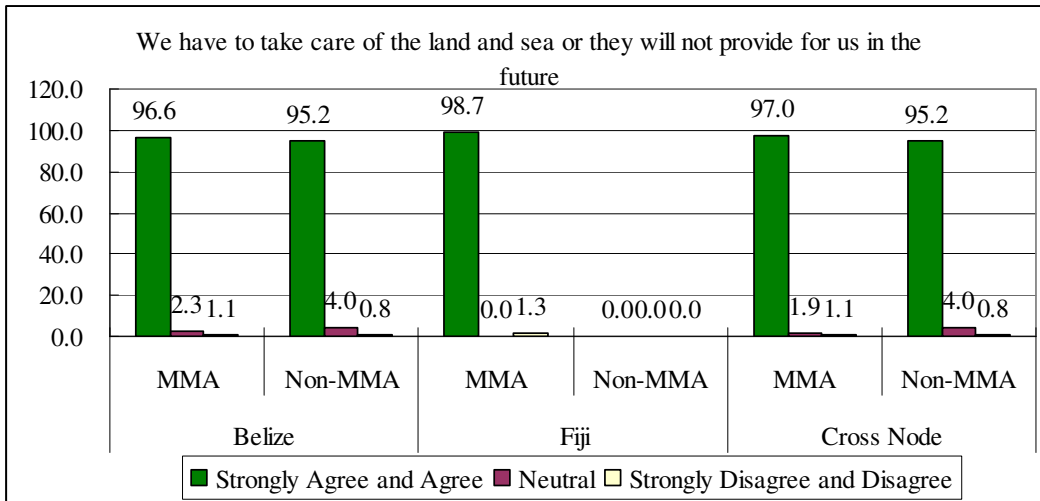
3. Respondents who use marine resources from MMAs have stronger environmental awareness and knowledge than their counterparts who don't use marine resources from MMAs. These perceptions of environmental awareness and knowledge of MMAs are only collected in Belize and Fiji.



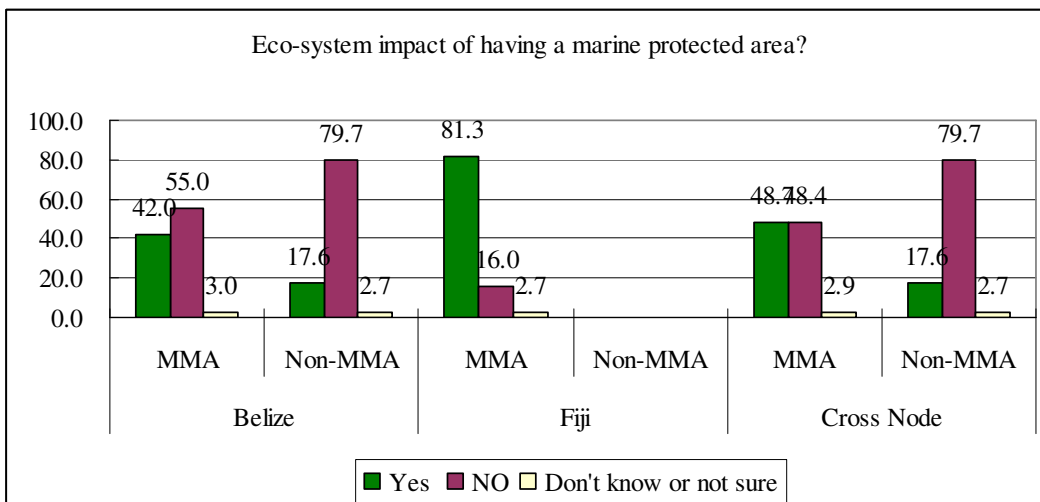
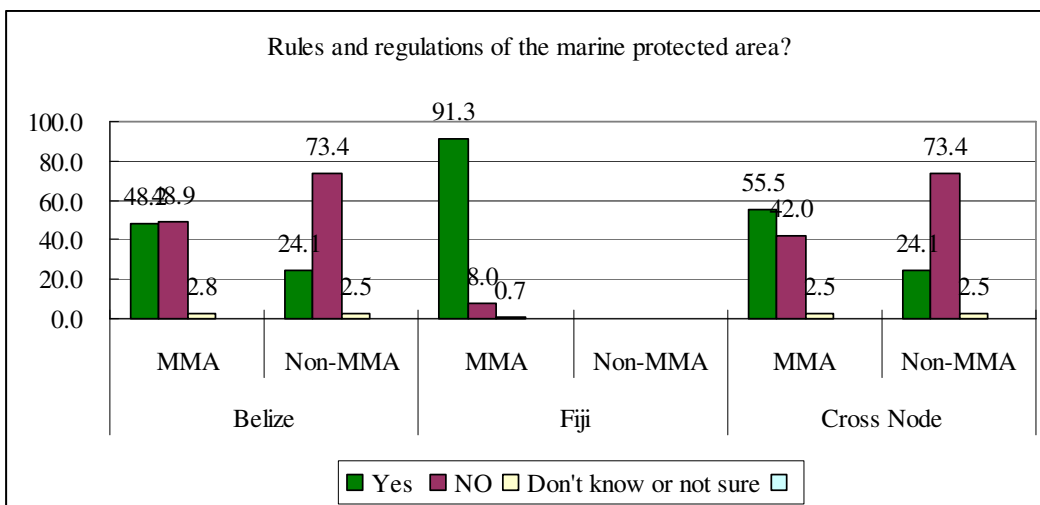
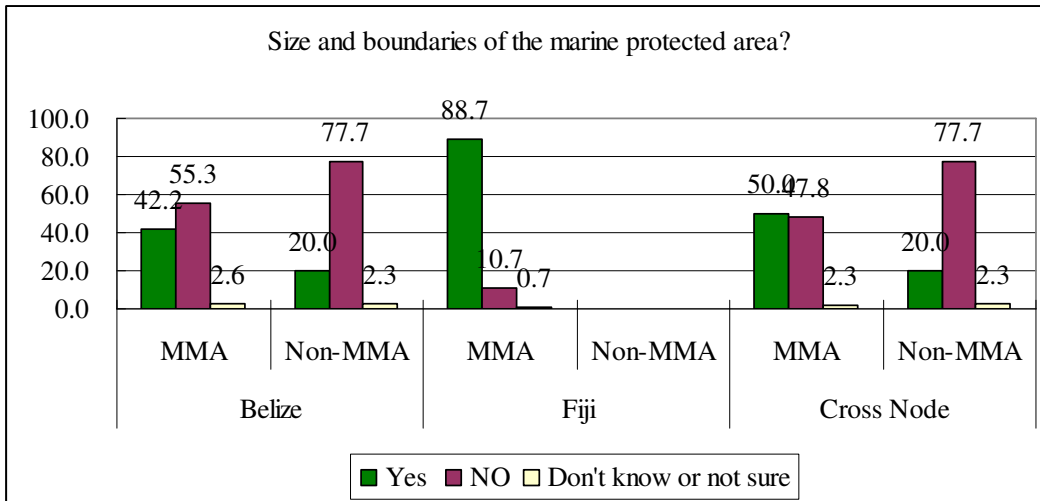
Cross node socioeconomic and governance



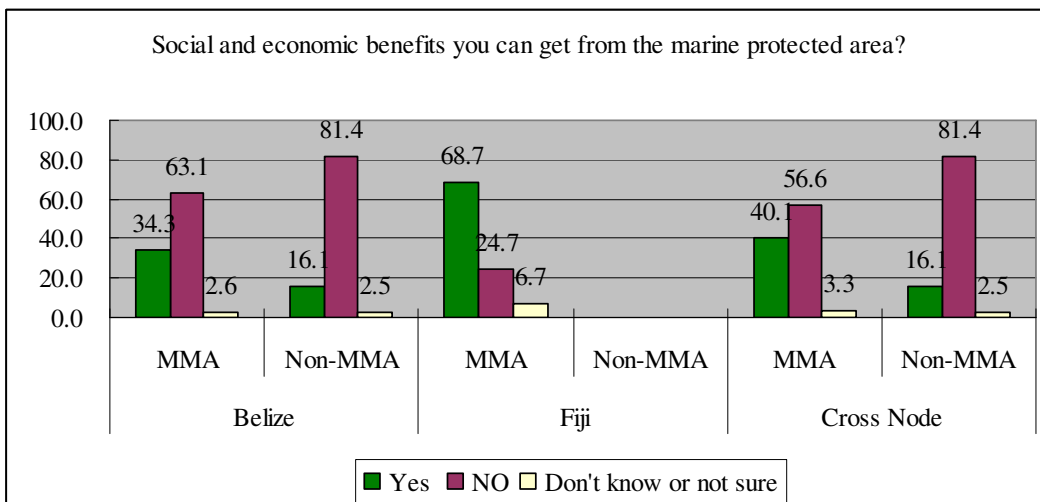
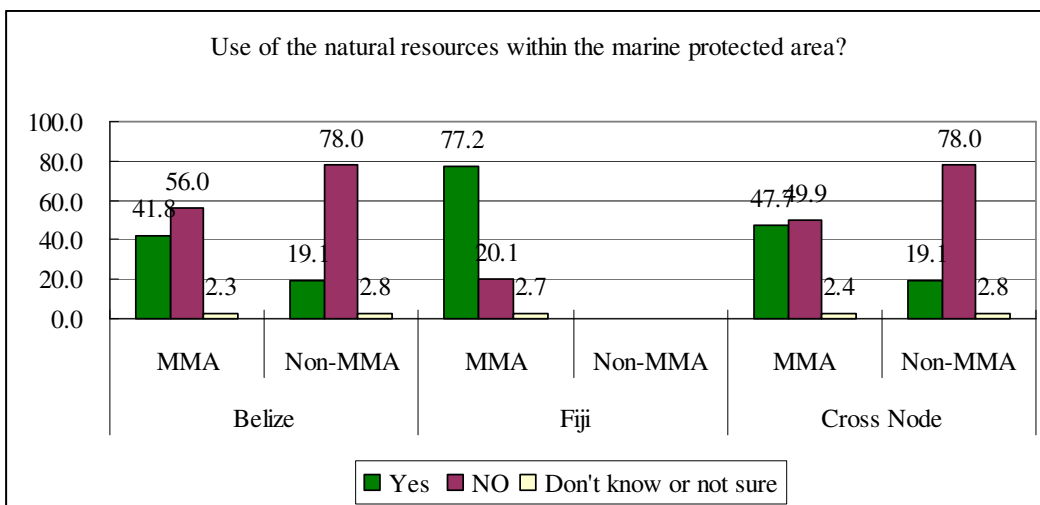
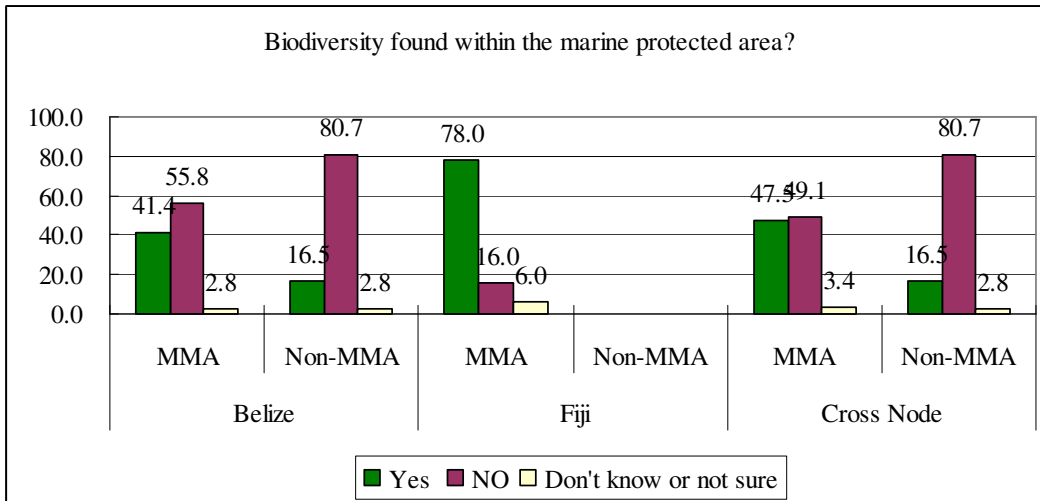
Cross node socioeconomic and governance



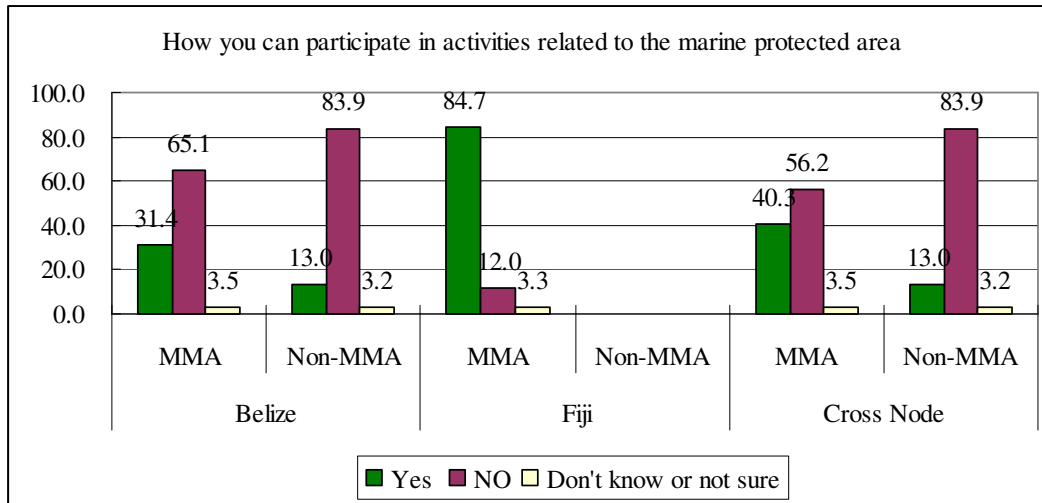
Cross node socioeconomic and governance



Cross node socioeconomic and governance

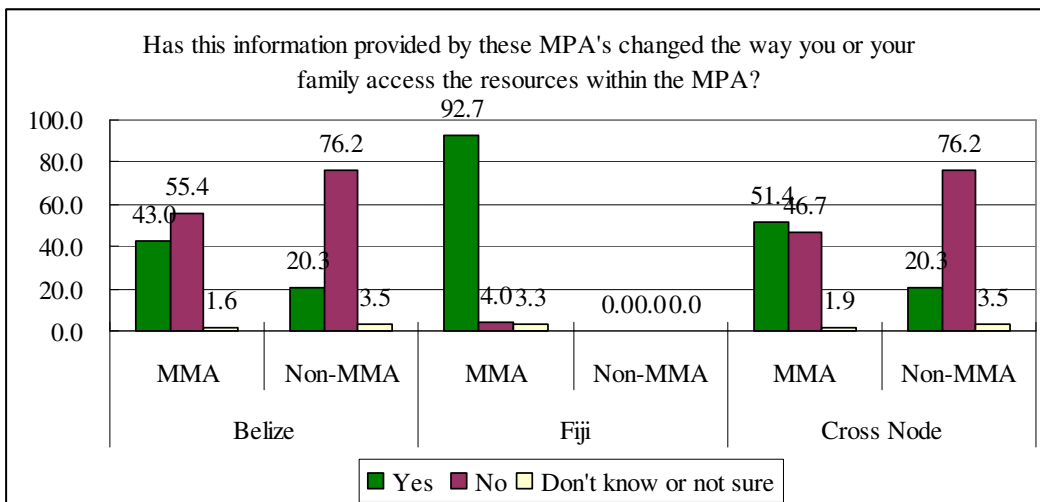
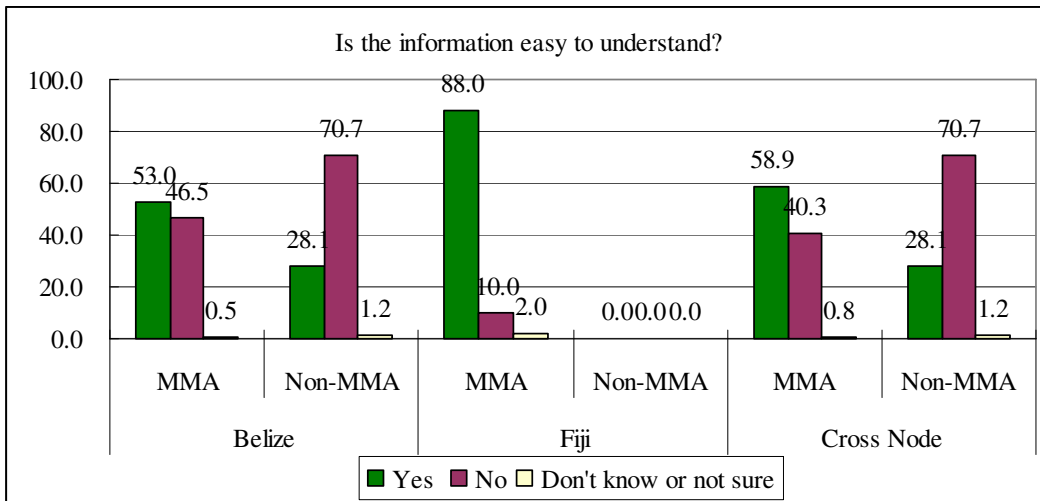
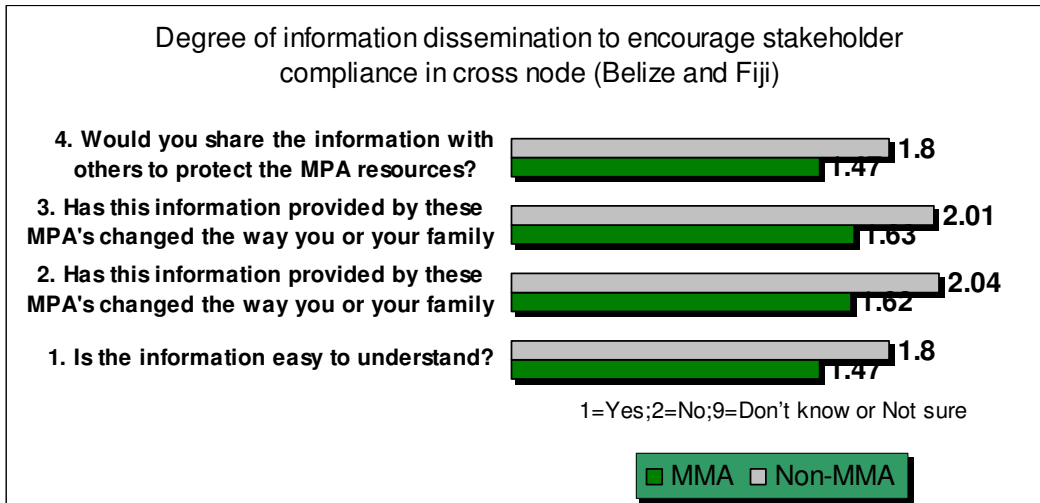


Cross node socioeconomic and governance

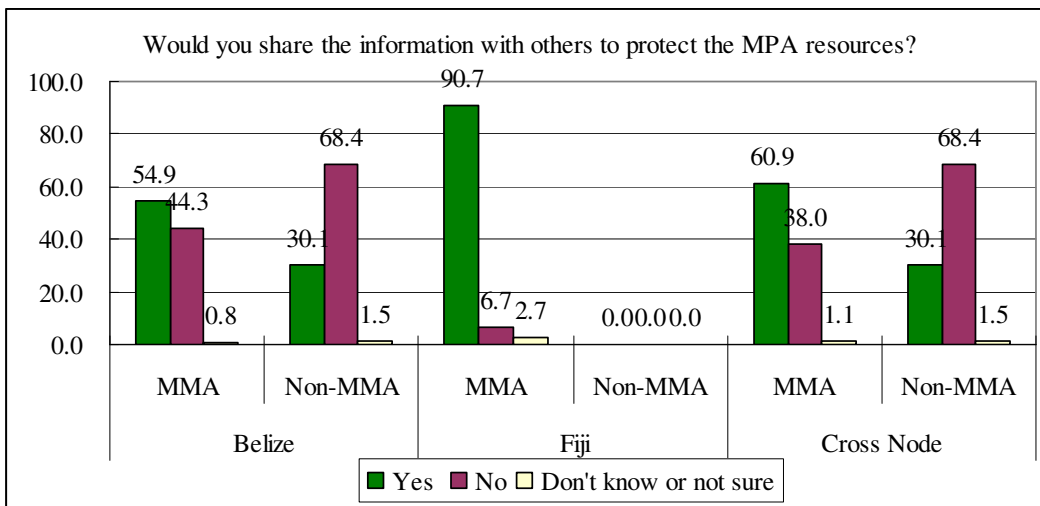
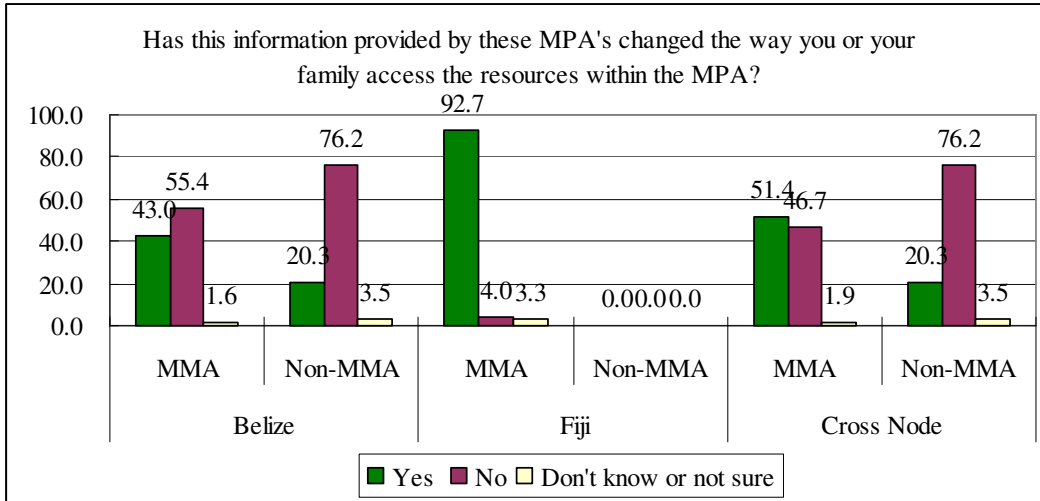


Cross node socioeconomic and governance

4. Information dissemination is more efficient among MMA users than non-MMA users



Cross node socioeconomic and governance



6. Factors Influencing Socioeconomic Effects

The second objective of this study is to find out the factors influencing the socioeconomic and governance effects of marine managed areas. Four socioeconomic effects and three governance effects have been tested in chapter four and five, respectively. In this chapter, econometric models are developed to analyze the factors determining socioeconomic effects.

A) Socioeconomic factors

Socioeconomic factors X_{1i}

- Community demographics: age, gender, education, household size, number of children, occupation

B) Governance factors

MMA Governance factors X_{2i}

- Level of community participation
- Empowerment and capacity building (training)
- Having enforcement
- management plan

C) MMA features

MMA features X_{3i}

- year establish
- size of MMA
- distance of MMA from nearest coastline (14 points)
- distance of MMA from community (36 data points)

Analytical model

$Y = f(AGE65, AGE5065, AGE4049, EDUCATION, HHSIZE, OCCUP_FISH, OCCUP_TOUR, OCCUP_DIVE, RULES_REG, RECV_TRAIN, REC_JOB, FIJI, MPA, \epsilon)$

$$Y_i = \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \epsilon_i$$

Y_i represents the average monthly household income for respondent i and the average monthly marine related household income for respondent i . X_{1i}, X_{2i}, X_{3i} denotes a vector of socioeconomic variables, a vector of governance variables, and a vector of MMA features, respectively. $\beta_1, \beta_2, \beta_3$ are coefficients to be estimated. ϵ_i denotes the error term and is assumed to be identical, independently, normal distributed. Ordinary least square is utilized to estimate the impact of socioeconomic variables, governance variables, and MMA features on the livelihood of people who use marine resources in the marine protected areas.

Significant test of demographic variables cross nodes

To test whether there is any significant test cross node, t tests are also conducted to test whether the demographic information is different across countries. The statistical results are shown in **Table**.

Results and discussions

The cross section data described in study sites and methods section is used to explain the impact of socio-economic and governance effects on the livelihood of coastal people. The dependent variable is the average monthly income for the household. The independent variables are socio-economic variables, governance variables, and features of marine management areas. The econometric results are reported in **Table**. Sensitivity analysis is also conducted to test whether the result is robust or not. The sign and significance of the estimated coefficients are relatively stable across models, indicating that the econometric results are robust. Result of F test is also reported, suggesting the null hypothesis that the independent variables are jointly equal to zero is rejected at the significant level less than 1%.

6.1 Socioeconomic factors

Age group has different impacts on the average monthly household income. Compared with respondents below 40, respondents over 65 are likely to earn less. Respondents over 65 earn \$164.63 less than respondents below 40. Respondents from 50 to 65 likely have a higher monthly household income than respondents below 40. The marginal effect for age group in 50 to 65 is \$149.85. There are no significant difference between the income of respondents from 40 to 49 and respondents below 40.

Education attainment of the respondent has a positive impact on the average monthly income. The older the respondent, the more the respondent can make monthly; the higher the education, the more the respondent can make monthly. People's average monthly household income is expected to increase \$83.82 if the year of education increases one year.

Household size is positive correlated with average monthly household income. The more people in the household, the more the household income is. The average monthly household income increases \$23.55 if the household size increases one. The other demographic variable, gender is not significant and dropped in this study.

6.2 Governance factors

The first information dissemination variable, "RULES_REG", is positively and significantly correlated with the respondent's average monthly household income. If the MPA body shared information with the respondent and his/her family as it related to the rules and regulations, the average monthly income is \$281.02 higher than the respondent who didn't get such information from the MPA body.

Two factors for effective management, "RECV_TRAIN" and "RECV_JOB", have a positive impact on the average monthly income. If the respondent has ever received

Cross node socioeconomic and governance

training in environmental education related to the MPA, the average monthly income is \$328.14 higher than the respondents who didn't receive this kind of training. If the respondent or anyone in family has ever got a job related to MPA since the establishment of the MPA, the average monthly income is \$160.19 higher than the respondents who didn't receive this kind of job.

Fiji and MPA dummies are negatively correlated with average monthly household income. Households in Fiji are likely to earn \$1257.59 less per month than household in Belize. Households using marine resources tend to earn \$121.79 less per month than household don't use marine resources.

6.3 MMA features

Cross node socioeconomic and governance

Table: OLS regression results of average monthly household income

	Belize		Fiji		Cross Node	
	Coef.	p>t	Coef.	p>t	Coef.	p>t
Socio-economic						
AGE>65	-256.164**	0.018	42.801	0.617	-164.630*	0.075
AGE(50-65)	158.150*	0.066	-38.603	0.610	149.851**	0.046
AGE(40-49)	3.524	0.966	-113.324	0.108	-17.159	0.812
EDUCATION	83.695***	0.000	23.375**	0.053	83.817***	0.000
HHSIZE	20.612	0.113	27.219**	0.021	23.554**	0.039
OCCUP_FISH	-31.248	0.764	75.311	0.165	9.254	0.908
OCCUP_TOUR	-150.885	0.516	185.377**	0.024	7.421	0.962
OCCUP_DIVE	384.660*	0.068	664.378***	0.000	385.064**	0.021
Governance						
RULES_REG	320.256***	0.000	-25.562	0.808	281.021***	0.000
RECV_TRAIN	450.205***	0.000	115.788*	0.080	328.140***	0.000
REC_JOB	156.509	0.201	122.252**	0.052	160.194*	0.087
FIJI					-1257.590***	0.000
MPA	-82.541	0.251	-226.442*	0.071	-121.787**	0.057
INTERCEPT	301.474***	0.005	54.072	0.730	328.577***	0.001
OBS	1078		183		1261	
R2	0.2281		0.2643		0.2713	
F	26.22		5.09		35.72	

Table: OLS regression results of average monthly household income

	Cross Node 1		Cross Node 2		Cross Node 3	
	Coef.	p>t	Coef.	p>t	Coef.	p>t
Socio-economic						
AGE>65	-93.6648	0.1540	-103.0516	0.1180	24.0746	0.7410
AGE(50-65)	121.4360**	0.0150	111.6962**	0.0260	103.7471**	0.0620
AGE(40-49)	-32.6083	0.4970	-38.5434	0.4230	-52.9877	0.3210
EDUCATION	59.7048***	0.0000	55.8126***	0.0000	62.4247***	0.0000
HHSIZE	17.7602**	0.0250	19.3983***	0.0140	23.2327***	0.0080
OCCUP_FISH	83.4423*	0.0990	118.2266**	0.0180	-156.9407***	0.0030
OCCUP_TOUR	13.3690	0.8390	-14.3320	0.8270	-321.9549***	0.0000
OCCUP_DIVE	333.9318***	0.0070	331.6982***	0.0080	727.3877***	0.0000
Governance						
RULES_REG	197.3538***	0.0000	173.7561***	0.0000	185.8145***	0.0000
RECV_TRAIN	373.7624***	0.0000	383.5018***	0.0000	593.2523***	0.0000
REC_JOB	168.0533**	0.0340	172.0514**	0.0300	326.3372***	0.0000
FIJI	-168.7096**	0.0630	-312.3100***	0.0000	-1024.5940***	0.0000
BELIZE	1102.7220***	0.0000	966.9682***	0.0000		
PANAMA	244.6999***	0.0000				
MPA	-19.8090	0.6470	-6.8073	0.8750	224.4419***	0.0000
INTERCEPT	-588.9916***	0.0000	-426.5189***	0.0000	2.7051	0.9700
OBS	2027		2027		2027	
R2	82.19		86.60		46.55	
F	0.38		0.38		0.23	

Table : OLS regression results of average monthly marine related household income

	Belize		Fiji		Cross Node	
	Coef.	p>t	Coef.	p>t	Coef.	p>t
Socio-economic						
AGE>65	-32.5057	0.6500	15.6478	0.7920	-8.5389	0.8700
AGE(50-65)	82.5699*	0.0570	-9.8439	0.8510	62.6893*	0.0840
AGE(40-49)	28.4031	0.4560	-10.1704	0.8340	21.9895	0.5000
EDUCATION	-7.3759**	0.0410	8.5423	0.3040	-7.2154**	0.0250
HHSIZE	10.8777*	0.0890	3.3032	0.6840	10.3028*	0.0580
OCCUP_FISH	486.4806***	0.0000	199.1055***	0.0000	410.3301***	0.0000
OCCUP_TOUR	366.7927***	0.0000	345.4567***	0.0000	367.7622***	0.0000
OCCUP_DIVE	442.3483***	0.0000	601.7004***	0.0000	514.1535***	0.0000
Governance						
RULES_REG	111.0077***	0.0020	-68.7058	0.3440	100.1667***	0.0010
RECV_TRAIN	88.4104**	0.0600	57.8637	0.2040	60.0316*	0.1010
REC_JOB	61.8332	0.2840	59.0221	0.1730	43.8736	0.2890
FIJI					-244.3512***	0.0000
MPA	18.5776	0.6180	-0.9550	0.9910	24.3600	0.4430
INTERCEPT	-27.5167	0.5970	-73.7723	0.4970	0.5667	0.9900
OBS	712		183		895	
R2	0.4545		0.4649		0.4374	
F	48.53		12.31		52.69	

*, **, ***, represents significant at 10%, 5%, and 1%, respectively.

Conclusions and Policy Implications

Age group has different impacts on the average monthly household income. Compared with respondents below 40, respondents over 65 are likely to earn less. There are no significant difference between the income of respondents from 40 to 49 and respondents below 40.

Education attainment of the respondent has a positive impact on the average monthly income. The older the respondents, the more respondents can make monthly; the higher the education, the more the respondent can make monthly.

Household size is positive correlated with average monthly household income. The more people in the household, the more the household income is. The average monthly household income increases \$23.55 if the household size increases one. The other demographic variable, gender is not significant and dropped in this study.

The information dissemination variable is positively and significantly correlated with the respondent's average monthly household income. Two factors for effective management have a positive impact on the average monthly income. Fiji and MPA dummies are negatively correlated with average monthly household income.

7. Factors Influencing Governance Effects

A) Socioeconomic factors

Socioeconomic factors X_{1i}

- Community demographics: age, gender, education, household size, number of children, occupation

B) Governance factors

MMA Governance factors X_{2i}

- Level of community participation
- Empowerment and capacity building (training)
- Having enforcement
- management plan

C) MMA features

MMA features X_{3i}

- year establish
- size of MMA
- distance of MMA from nearest coastline (14 points)
- distance of MMA from community (36 data points)

Analytical model

$$\log \frac{Y_i}{1-Y_i} = \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \varepsilon_i$$

Y_i represents the local understanding of the MMAs rules and regulations for respondent i . One represents the respondent knew the rules and the regulation of MMAs while zero denotes the respondent didn't know it. X_{1i} , X_{2i} , X_{3i} denotes a vector of socioeconomic variables, a vector of governance variables, and a vector of MMA features, respectively. $\beta_1, \beta_2, \beta_3$ are coefficients to be estimated. ε_i denotes the error term and is assumed to be identical, independently, normal distributed. Logit regression is utilized to estimate the impact of socioeconomic variables, governance variables, and MMA features on the governance effects.

7.1 Socioeconomic factors

Age is negatively correlated with the local understanding of the MMA rules and regulations. Compared with respondents below 40, respondents over 50 are less likely to know the rules and regulations of MMAs. There are no significant difference between the income of respondents from 40 to 49 and respondents below 40.

Cross node socioeconomic and governance

Gender is positive associated with the local understanding of the MMA rules and regulations, suggesting that males are more likely to know the rules and regulations of MMAs compared with females

Education attainment of the respondent has a positive impact on the local understanding of the MMA rules and regulations. The higher the education, the more likely the respondents know the MMA rules and regulations.

Occupation of the respondents have a positive impact on the local understanding of the MMA rules and regulations. If the respondent works as a fisherman or tourist guide, then the respondent is more likely to know the MMA rules and regulations.

7.2 Governance factors

Two factors for effective management, “RECV_TRAIN” and “RECV_JOB”, have a positive impact on the local understanding of the MMA rules and regulations. If the respondent has ever received training in environmental education related to the MPA, the respondent is more likely to know the rules and regulations of MMAs than the respondents who didn’t receive this kind of training. If the respondent or anyone in family has ever got a job related to MPA since the establishment of the MPA, the respondent is more likely to know the rules and regulations of MMAs than the respondents who didn’t receive this kind of job.

MPA dummy is positively correlated with the local understanding of the MMA rules and regulations. Households in Fiji, Belize, and Ecuador are more likely to know the MMA rules and regulations.

7.3 MMA features

Cross node socioeconomic and governance

Table : Logit regression results of local understanding of the MMA rules and regulations

	Cross Node 1		Cross Node 2		Cross Node 3		Cross Node 4	
	Coef.	p>t	Coef.	p>t	Coef.	p>t	Coef.	p>t
Socio-economic								
AGE>65	-0.4732	0.0070***	-0.4613	0.0080***	-0.4387	0.0120***	-0.3579	0.0360**
AGE(50-65)	-0.2394	0.0710*	-0.2218	0.0920*	-0.2190	0.0960*	-0.1932	0.1400
AGE(40-49)	0.0565	0.6510	0.0734	0.5540	0.0703	0.5700	0.0877	0.4780
GENDER	0.5189	0.0000***	0.6535	0.0000***	0.6391	0.0000***	0.6650	0.0000***
EDUCATION	0.0461	0.0000***	0.0606	0.0000***	0.0613	0.0000***	0.0654	0.0000***
HHSIZE	0.0297	0.1440	0.0259	0.1980	0.0261	0.1950	0.0321	0.1090
OCCUP_FISH	0.8105	0.0000***	0.6475	0.0000***	0.6055	0.0000***	0.6699	0.0000***
OCCUP_TOUR	0.5223	0.0020***	0.6418	0.0000***	0.5875	0.0000***	0.5871	0.0000***
OCCUP_DIVE	-0.3501	0.2890	-0.3230	0.3330	-0.2500	0.4480	-0.3076	0.3480
Governance								
RECV_TRAIN	1.2490	0.0000***	1.2378	0.0000***	1.2668	0.0000***	1.3868	0.0000***
REC_JOB	0.5396	0.0120***	0.5306	0.0130***	0.5557	0.0090***	0.5885	0.0050***
FIJI	1.2771	0.0000***	0.7583	0.0010***	0.6509	0.0020***		
BELIZE	0.6891	0.0000***	0.1533	0.1950				
ECUADOR	1.0886	0.0000***						
MPA	0.7258	0.0000***	0.6789	0.0000***	0.7168	0.0000***	0.7256	0.0000***
INTERCEPT	-2.7865	0.0000***	-2.3915	0.0000***	-2.3059	0.0000***	-2.3940	0.0000***
OBS	2306		2306		2306		2306	
Pseudo R2	0.1845		0.1731		0.1726		0.1694	
LR	563.51		528.66		526.98		517.17	

Cross node socioeconomic and governance

Table : Logit regression results of local understanding of the MMA rules and regulations

	Belize		Fiji		Ecuador		Panama	
	Coef.	p>t	Coef.	p>t	Coef.	p>t	Coef.	p>t
Socio-economic								
AGE>65	-0.9488	0.0000***	-1.3575	0.2970	0.7007	0.1600	0.3718	0.4820
AGE(50-65)	-0.2271	0.1830	-1.9211	0.0750*	0.0144	0.9640	-0.3216	0.4040
AGE(40-49)	-0.0786	0.6310	-1.4403	0.1640	0.3770	0.1930	0.5274	0.0970*
GENDER	0.4362	0.0010***			1.4113	0.0010***	0.9882	0.0000***
EDUCATION	0.0368	0.0110***	-0.1103	0.4250	0.0930	0.0020***	0.1472	0.0000***
HHSIZE	0.0513	0.0460**	0.3063	0.1110	-0.1038	0.1400	0.0416	0.3950
OCCUP_FISH	1.3463	0.0000***	-0.4426	0.5690	0.8311	0.1290	0.9522	0.0010***
OCCUP_TOUR	0.4078	0.1240	0.8110	0.4370	0.2032	0.5880	1.3878	0.0050****
OCCUP_DIVE	-0.6592	0.0710*						
Governance								
RECV_TRAIN	1.0616	0.0000***	1.6814	0.0290**				
REC_JOB	0.8378	0.0000***	-1.9175	0.0130***				
MPA	0.3766	0.0080***			0.7697	0.1040*	0.4356	0.1050*
INTERCEPT	-1.8483	0.0000***	2.8323	0.1490	-2.5957	0.0000***	-3.9575	0.0000***
OBS	1319		110		362		442	
Pseudo R2	0.1601		0.2123		0.1170		0.1443	
LR	278.94		16.96		57.53		63.27	

Cross node socioeconomic and governance

Table : Logit regression results of local participation of MMAs meetings

	Cross Node		Ecuador		Panama	
	Coef.	p>t	Coef.	p>t	Coef.	p>t
Socio-economic						
AGE>65	0.1940	0.6180	0.6316	0.2370	-0.3610	0.5510
AGE(50-65)	0.1420	0.5640	0.2350	0.4890	0.0034	0.9930
AGE(40-49)	0.2404	0.2950	0.3958	0.2000	-0.0191	0.9580
GENDER	1.0740	0.0000***	0.9611	0.0360**	1.0306	0.0010***
EDUCATION	0.0746	0.0020***	0.0839	0.0120***	0.0047	0.9170
HHSIZE	-0.0697	0.1280	-0.1234	0.1110	-0.0385	0.5070
OCCUP_FISH	0.4211	0.0670*	0.9120	0.0900	0.4622	0.1370
OCCUP_TOUR	0.0483	0.8640	0.0454	0.9100	0.4839	0.3650
Governance						
MPA	0.7186	0.0010***	0.4221	0.3970	0.9129	0.0020***
INTERCEPT	-2.9945	0.0000***	-2.7258	0.0000***	-2.8666	0.0000***
OBS	804		362		442	
Pseudo R2	0.0875		0.0736		0.0871	
LR	70.00		30.69		31.84	

Cross node socioeconomic and governance

Table : Logit regression results of local participation of MMAs plans

	Cross Node		Ecuador		Panama	
	Coef.	p>t	Coef.	p>t	Coef.	p>t
Socio-economic						
AGE>65	0.1659	0.6730	0.9500	0.0890*	-0.5767	0.3340
AGE(50-65)	0.0406	0.8680	0.3429	0.3330	-0.2652	0.4560
AGE(40-49)	0.3921	0.0750*	0.6706	0.0350**	0.0843	0.7910
GENDER	0.8779	0.0000***	0.9563	0.0420**	0.9509	0.0000***
EDUCATION	0.1161	0.0000***	0.1372	0.0000***	0.0855	0.0330**
HHSIZE	-0.0495	0.2510	-0.1147	0.1510	-0.0199	0.7000
OCCUP_FISH	0.8235	0.0000***	0.6078	0.2730	0.7961	0.0050***
OCCUP_TOUR	-0.1104	0.6930	-0.3453	0.4310	0.1698	0.7420
Governance						
MPA	0.8991	0.0000***	1.2420	0.0180**	0.8233	0.0020***
INTERCEPT	-3.2928	0.0000***	-3.5289	0.0000***	-3.0826	0.0000***
OBS	804		362		442	
Pseudo R2	0.1162		0.1299		0.1074	
LR	99.62		54.38		46.50	

REFERENCES

Van Beukering, P. J. H., Scherl, L.M., Sultanian, E., Leisher, C., and Fong, P., 2007, “The Role of Marine Protected Areas in Contributing to Poverty Reduction, Case study 1: Yavusa Navakavu Locally Managed Marine Area (Fiji)”, Nature’s Investment Bank.

Van Beukering, P. J. H., Scherl, L.M., Sultanian, E., and Leisher, C., 2007, “The Role of Marine Protected Areas in Contributing to Poverty Reduction, Case study 2: Arnavon Community Marine Conservation Area (Solomon Islands)”, Nature’s Investment Bank.

Van Beukering, P. J. H., Scherl, L.M., Sultanian, E., Leisher, C., and Fry, J., 2007, “The Role of Marine Protected Areas in Contributing to Poverty Reduction, Case study 3: Bunaken National Marine Park (Indonesia)”, Nature’s Investment Bank.

Van Beukering, P. J. H., Cacatian, J., Stellinga, J., Sultanian, E., and Leisher, C., 2007, “The Role of Marine Protected Areas in Contributing to Poverty Reduction, Case study 4: Apo Island (Philippines)”, Nature’s Investment Bank.

Technical report by Patrick Fong

Technical report by Diego Quiroga and Carols Mena

ANNEX

Annex . Descriptive statistics of all variables

Table A2.1. Descriptions of Demographic Variables

	Belize (n=1341)	Brazil (n=680)	Fiji (n=183)	Ecuador (n=365)	Panama (n=497)	Cross Node (n=3066)
Gender (%)						
Female	46.0		21.3	14.6	52.5	45.4
Male	54.0		78.7	85.4	47.5	54.6
Age (%)						
15-19	2.0		1.1	0.6	1.4	1.8
20-24	6.3		1.6	4.6	5.6	5.7
25-29	9.7		6.6	10.8	12.7	10.1
30-34	10.5		9.8	11.0	12.3	10.9
35-39	13.7		12.6	16.5	13.7	13.6
40-44	12.0		9.8	12.1	12.9	12.0
45-49	10.3		15.3	14.1	12.1	11.2
50-54	8.0		9.3	12.4	9.3	8.4
55-59	8.1		10.4	6.9	6.6	8.0
60-64	5.2		4.9	3.9	4.6	5.0
65 and over	14.3		18.6	7.2	8.9	13.4
Education (%)						
None (0)	17.9		1.1	3.0	4.0	13.3
Primary (1-6)	53.2		51.7	30.1	70.6	59.7
Secondary (7-12)	16.3		46.1	48.9	10.5	17.2
Tertiary (>12)	12.6		1.1	18.0	14.9	9.8
Household Size (%)						
1-5	70.8		60.7	84.9	72.4	70.3
6-10	26.7		36.6	15.1	24.8	27.1
>10	2.5		2.7	0.0	2.9	2.6
Children (%)						
0	39.7		33.3	9.6	17.4	34.3
1	16.0		26.2	9.6	23.1	18.5
2	18.0		18.6	28.9	23.3	19.2

Cross node socioeconomic and governance

3	11.9	12.6	17.3	19.8	13.7
4	7.8	7.7	13.5	9.3	8.1
5	3.8	0.6	11.5	3.8	3.5
>5	2.8	1.1	9.6	3.3	2.8

Source: Household surveys conducted in Belize, Brazil, Fiji, Ecuador and Panama

Notes:

Cross node socioeconomic and governance

Table A2.2. Local perceptions of non-monetary benefits of MMAs

Statements	Belize (n=1341)	Fiji (n=183)	Cross Node (n=1524)
I want future generations to enjoy the mangroves and coral reefs (bequest non-use value)	1.46 ± 0.61 ***	1.72 ± 1.10***	1.50 ± 0.69***
The reefs are important for protecting land from storm waves (indirect non-market value)	1.51 ± 0.71***	1.60 ± 1.16 ***	1.52 ± 0.78 ***
We should restrict development in some coastal areas so that future generations will be able to have natural environments (bequest value)	1.96 ± 0.95***	2.15 ± 0.95***	1.98 ± 0.95***
Fishing should be restricted in certain areas even if no one ever fishes in those areas just to allow the fish and coral to grow (existence value)	2.00 ± 1.01***	1.96 ± 0.91***	1.99 ± 1.00***
Unless the mangroves are protected, we won't have any fish to catch (indirect non-market value)	2.18 ± 1.08***	1.81 ± 1.10***	2.14 ± 1.09***
Sea grass beds have no value to people (existence value)	3.30 ± 1.16***	3.39 ± 1.44***	3.31 ± 1.19***
Coral reefs are only important if you fish or drive (existence non-use value)	3.4 ± 1.08***	2.75 ± 1.24***	3.40 ± 1.13***
In the long-run, fishing would be better if we cleared the coral (indirect non-market value)	3.83 ± 0.97***	4.17 ± 1.25***	3.87 ± 1.01 ***

Note: **Mean ± Std.Dev. is reported**

1=Strongly agree;2=Agree;3=Neutral;4=Disagree;5=Strongly disagree

The null hypothesis: the mean of each statement is equal to 3 (Neutral)

*** represents the mean is significant different from 3 (neutral) at 1%

Cross node socioeconomic and governance

Table A2.3. Local values and beliefs about marine resources

Statements	Belize (n=1341)	Fiji (n=150)	Cross Node (n=1491)
We have to take care of the land and sea or they will not provide for us in the future.	1.54 ± 0.62***	1.33 ± 0.62***	1.52 ± 0.62***
We should manage the sea to ensure that there are fish for our children and their children.	1.56 ± 0.64***	1.25 ± 0.59***	1.53 ± 0.64***
Protecting the land and the sea brings us more benefits than not protecting these resources.	1.80 ± 0.83***	1.50 ± 0.79***	1.77 ± 0.83***
We want to protect the land and the sea but this is hard because we have economic needs now.	2.18 ± 1.06***	2.59 ± 1.20***	2.22 ± 1.08***
Organizations that manage the resources are taking the bread out of people's mouths.	2.85 ± 1.22***	4.23 ± 1.24***	2.99 ± 1.29***
We do not have to worry about the sea and the fish. God will take care of it for us.	3.57 ± 1.25***	3.75 ± 1.36***	3.59 ± 1.26***

Note: **Mean ± Std.Dev.**

1=Strongly agree;2=Agree;3=Neutral;4=Disagree;5=Strongly disagree

The null hypothesis: the mean of each statement is equal to 3 (Neutral)

*** represents the mean is significant different from 3 (neutral) at 1%

Cross node socioeconomic and governance

Table A2.4. Local perception of human threats to the marine resources reduced

Statement: How do you consider the changes as it relates to the level of impact from each below?	Belize (n=1341)	Fiji (n=183)	Cross Node (n=1524)
Waste and Pollution	1.84 ± 0.79***	1.49 ± 0.96***	1.80 ± 0.82***
Hurricanes and Storms	1.92 ± 0.93***	1.69 ± 0.89***	1.90 ± 0.93***
Uncontrolled Fishing by Foreigners (Guatemalans, Hondurans, etc.)	1.96 ± 0.82***	1.86 ± 0.92***	1.94 ± 0.83***
Population Growth	2.53 ± 0.85***	2.54 ± 1.17***	2.53 ± 0.90***
Cruise Tourism Development	2.96 ± 1.04***	2.69 ± 1.03***	2.92 ± 1.04***

Note: **Mean ± Std.Dev.**

1=VeryNegative;2=Negative;3=Neither negative nor positive;4=Positive;5=Very Positive

The null hypothesis: the mean of each statement is equal to 3 (Neutral)

*** represents the mean is significant different from 3 (neutral) at 1%

Cross node socioeconomic and governance

Table A2.5. Perceptions of economic and health benefit from the MMA equitably distributed

Statement	Belize (n=1341)	Fiji (n=149)	Cross Node (n=1490)
How do you rate your economic situation today compared 10 years ago?	3.34 ± 1.09 ***	2.26 ± 0.71 ****	3.23 ± 1.10 ****

Statement	Belize (n=1341)	Fiji (n=182)	Cross Node (n=1523)
How do you rate your health situation today compared 10 years ago?	2.87 ± 0.99 ****	2.46 ± 0.69 ****	2.82 ± 0.97 ****

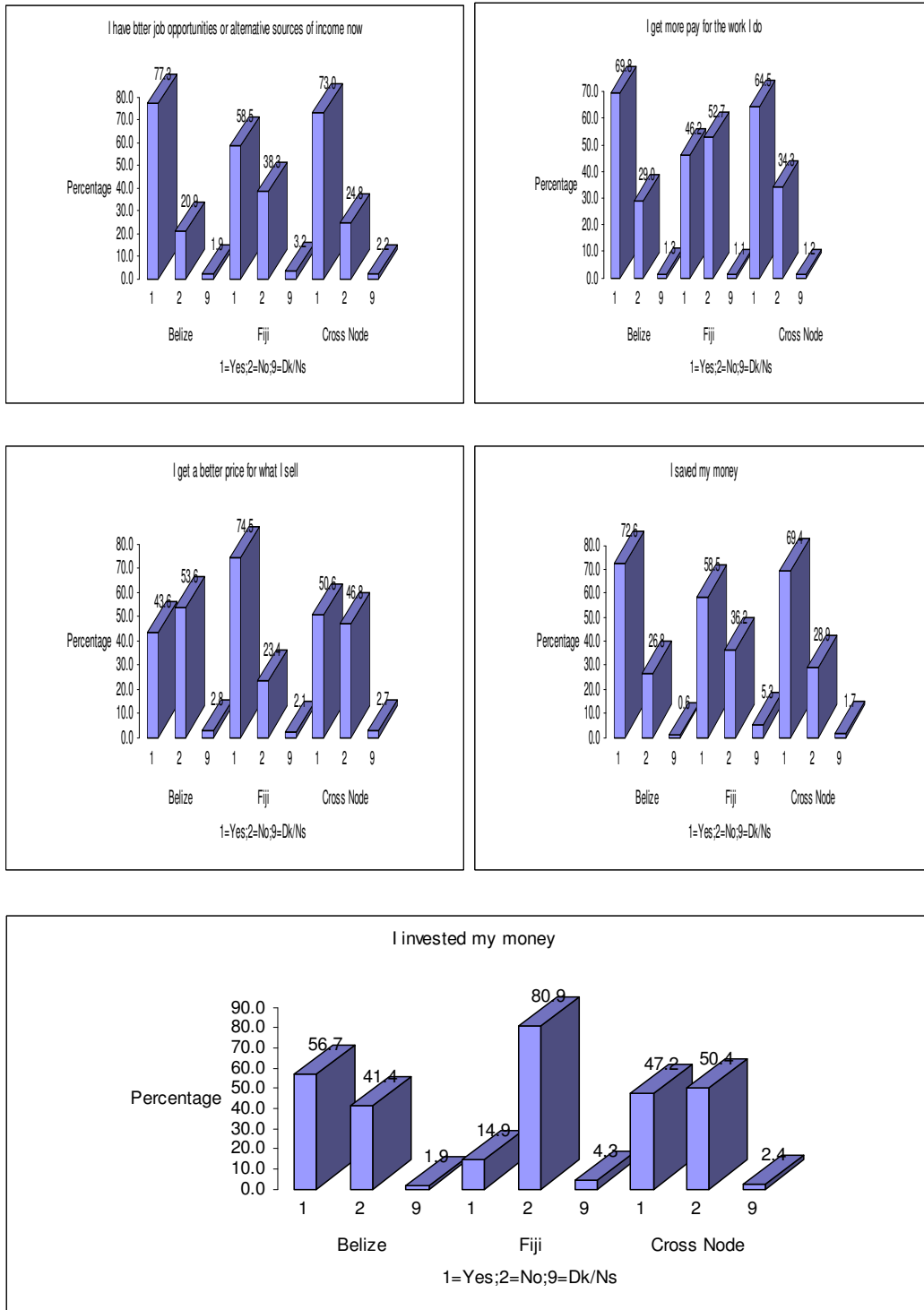
Note: **Mean ± Std.Dev. is reported**

1=Much better;2=Better;3=Neither better nor worse;4=Worse;5=Much worse

The null hypothesis: the mean of each statement is equal to 3 (Neither better nor worse)

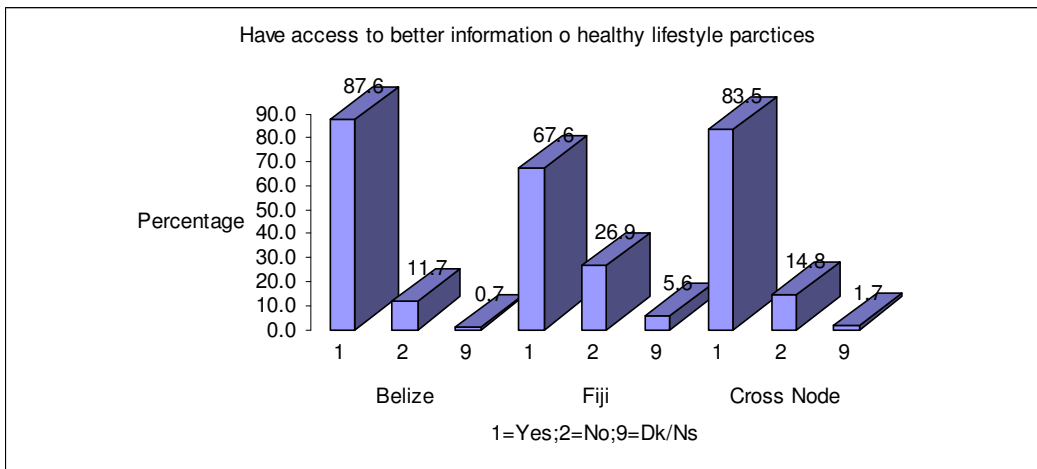
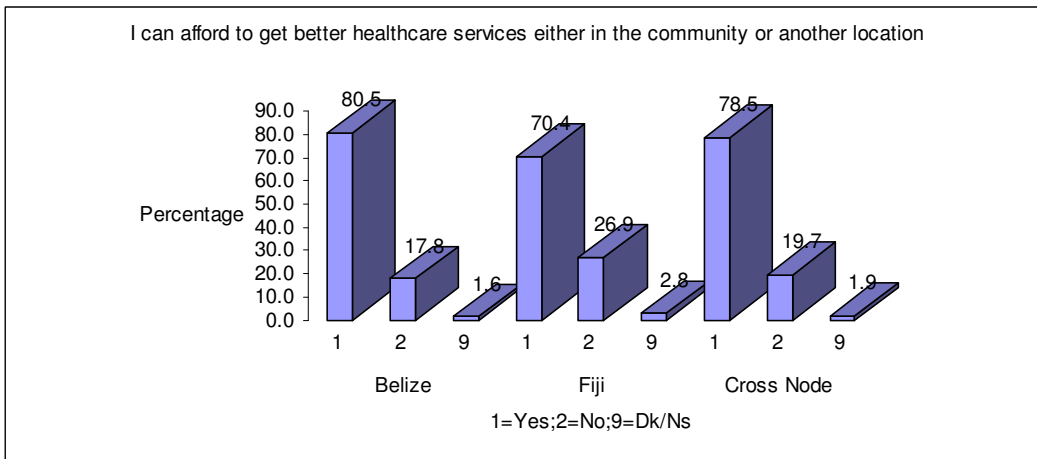
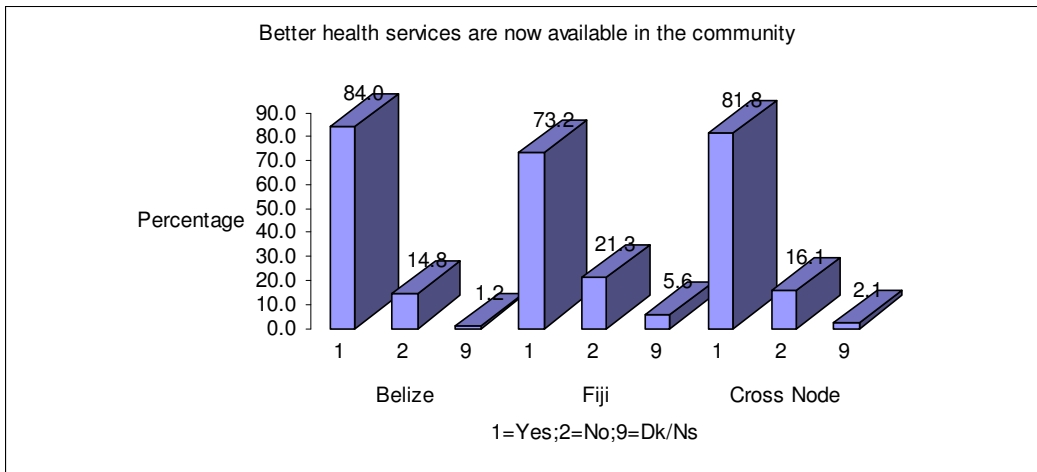
Cross node socioeconomic and governance

Figure A2.1: What has contributed to making your economic situation better or much better?



Cross node socioeconomic and governance

Figure A2.2: What has contributed to making your health situation better or much better?



Cross node socioeconomic and governance

Table A2.6. What has contributed to making your economic worse or much worse?

What has contributed to making your economic situation worse or much worse?	Belize (n=706)			Fiji (n=4)			Cross Node (n=710)		
	Yes 1	No 2	Dk/Ns 9	Yes 1	No 2	Dk/Ns 9	Yes 1	No 2	Dk/Ns 9
I get paid less for the work I do. (%)	64.6	31.7	3.7	25	50	25	64.4	31.8	3.8
The cost of living is high (eg: the cost of bread, rice, gas has gone up). (%)	97.6	2.4	0.0	100	0	0	97.6	2.4	0
I have had to spend a lot of money of medical expenses. (%)	56.8	41.8	1.4	75	0	25	56.9	41.6	1.6
The interest rates for loans are too high. (%)	72.2	18.7	9.1	50	50	0	72.1	18.6	9.3

Table A2.7. What has contributed to making your health situation worse or much worse?

What has contributed to making your health situation worse or much worse?	Belize (n=339)			Fiji (n=12)			Cross Node (n=351)		
	Yes 1	No 2	Dk/Ns 9	Yes 1	No 2	Dk/Ns 9	Yes 1	No 2	Dk/Ns 9
The healthcare service in the community has decreased. (%)	46.6	47.8	5.6	75	25	0	47.6	47.0	5.4
I am unable to access the healthcare service in the community or another location due to the cost. (%)	45.1	50.7	4.1	75	16.7	8.3	46.2	49.6	4.3

Note: 1.No respondents in Fiji report their economic or health situation worse or much worse, therefore the observations are zero.

2. Dk/Ns represents don't know or not sure.

Cross node socioeconomic and governance

Table A2.8. Descriptions of information dissemination

Does the MPA body share information with you or your family as it relates to the:	Belize (n=1341)			Fiji (n=150)			Cross Node (n=1491)		
	Yes 1	No 2	Dk/Ns 9	Yes 1	No 2	Dk/Ns 9	Yes 1	No 2	Dk/Ns 9
Size and boundaries of the marine protected area? (%)	32.2	65.3	2.5	88.7	10.7	0.7	37.9	59.8	2.3
Rules and regulations of the marine protected area? (%)	37.4	59.9	2.7	91.3	8.0	0.7	42.9	54.7	2.5
Eco-system impact of having a marine protected area?(eg: the impact of having mangroves or the reef system) (%)	31.1	66.1	2.8	81.3	16.0	2.7	36.2	61.0	2.8
Biodiversity found within the marine protected area?(eg: give information on the kinds of animals and plants) (%)	30.2	67.0	2.8	78.0	16.0	6.0	35.0	61.8	3.2
Use of the natural resources within the marine protected area?(eg: use of the animals, plants, corals, beaches, mangroves) (%)	31.6	65.9	2.5	77.2	20.1	2.7	36.2	61.3	2.6
Social and economic benefits you can get from the marine protected area? (%)	26.2	71.3	2.5	68.7	24.7	6.7	30.5	66.6	3.0
How you can participate in activities related to the marine protected area. (%)	23.1	73.5	3.4	84.7	12.0	3.3	29.3	67.3	3.4

Note: Dk/Ns represents don't know or not sure.

Cross node socioeconomic and governance

Table A2.9. Descriptions of governance variables

Statement: How is the information shared?	Belize (n=1341)			Fiji (n=150)			Cross Node (n=1491)		
	Yes 1	No 2	Dk/Ns 9	Yes 1	No 2	Dk/Ns 9	Yes 1	No 2	Dk/Ns 9
Community meetings	23.5	75.0	1.5	96.7	0.0	3.3	30.9	67.5	1.7
Brochure/pamphlets	25.1	73.3	1.6	86.7	8.0	5.3	31.3	66.7	2.0
Newsletters	15.7	82.9	1.4	67.3	24.7	8.0	20.9	77.0	2.1
Verbally by others and those working at the MMA	29.5	69.0	1.5	94.0	2.0	4.0	36.0	62.2	1.7

Cross node socioeconomic and governance

Table A2.10. Descriptions of governance variables (Continued)

Statements	Belize (n=1341)			Fiji (n=150)			Cross Node (n=1491)		
	Yes 1	No 2	Dk/Ns 9	Yes 1	No 2	Dk/Ns 9	Yes 1	No 2	Dk/Ns 9
Is the information easy to understand?	41.8	57.4	0.8	88.0	10.0	2.0	46.5	52.6	0.9
Has this information provided by these MPA's changed the way you or your family access the resources within the MPA?	32.8	64.7	2.5	92.7	4.0	3.3	38.8	58.6	2.6
Has this information provided by these MPA's changed the way you or your family use the resources within the MPA?	33.6	63.8	2.5	89.3	8.7	2.0	39.2	58.3	2.5
Would you share the information with others to protect the MPA resources?	43.8	55.1	1.1	90.7	6.7	2.7	48.5	50.2	1.3

Cross node socioeconomic and governance

Table A2.11. Description of governance variables

Statements	Belize (n=1341)			Fiji (n=150)			Cross Node (n=1491)		
	Yes 1	No 2	Dk/Ns 9	Yes 1	No 2	Dk/Ns 9	Yes 1	No 2	Dk/Ns 9
Have you or anyone in your family ever received training in Environmental Education related to the MPA? (%)	16.2	78.9	4.9	71.3	28.0	0.7	21.7	73.8	4.5
Have you or anyone in your family ever received any tour guide training as a result of the MPA? (%)	16.1	82.1	1.8	54.0	45.3	0.7	19.9	78.4	1.7
Have you or anyone in your family ever received any arts and craft training that uses marine resources since the establishment of the MPA? (%)	4.4	93.4	2.2	23.3	76.0	0.7	6.3	91.6	2.1
Have you or anyone in your family ever received a scholarship to attend formal schooling(primary or high school) as a result of assistance from the marine management body? (%)	3.2	94.8	2.0	10.7	85.3	4.0	4.0	93.8	2.2
Have you or anyone in your family ever gotten a job related in some way to the MPA? (%)	10.7	87.4	1.9	36.0	64.0	0	13.2	85.0	1.7

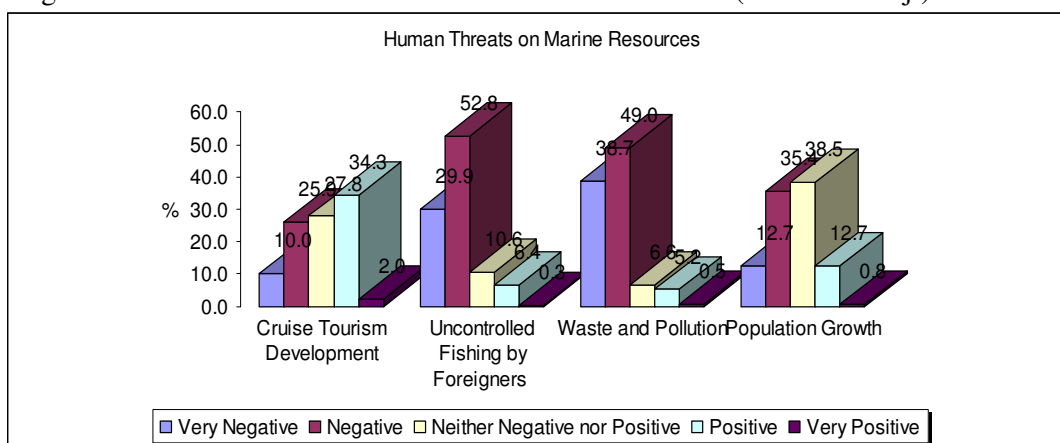
Note: Dk/Ns represents don't know or not sure

Cross node socioeconomic and governance

Table A2.12. Human threats to the marine resources reduced-cross node (Belize and Fiji)

How do you consider the changes as it relates to the level of impact from each below?	Very Negative	Negative	Neither Negative nor Positive	Positive	Very Positive
Hurricanes and Storms (%)	39.2	41.7	9.9	8.9	0.3
Cruise Tourism Development (%)	10.0	25.9	27.8	34.3	2.0
Uncontrolled Fishing by Foreigners (%)	29.9	52.8	10.6	6.4	0.3
Waste and Pollution (%)	38.7	49.0	6.6	5.2	0.5
Lack of Surveillance (%)	18.5	53.5	20.1	7.7	0.2
Population Growth (%)	12.7	35.4	38.5	12.7	0.8

Figure A2.: Human threats on marine resources-cross node (Belize and Fiji)



Cross node socioeconomic and governance

Marine resources uses

The third hypothesis socioeconomic effect is whether coastal population use marine resources more sustainable before the establishment of MMAs. Sustainable use of marine resources includes resource use pattern, frequency of use, and fishing change.

Frequency of use is derived from the question that how often do you fish or collect seafood. Fishing change is generated from the question that has fishing or seafood collection become easier or more difficult since the establishment of the MMA, or has there been no change?

Table : t test result of frequency of use of marine resources

Variable	Belize	Brazil	Fiji	Ecuador	Panama#	Cross Node
MMA			2.97			
Non-MMA			2.72			
t-value			0.93			
p-value			0.18			

Note: 1=Every day;2=Every two days;3=Every three days;4=Once a week;5=Every two weeks;6=Once a month;7=Never

*, **, ***, represents significant at 10%, 5%, and 1%, respectively

Table : t test result of fishing change

Variable	Belize	Brazil	Fiji	Ecuador	Panama#	Cross Node
MMA			2.05			
Non-MMA			4.18			
t-value			-11.30			
p-value			0.00***			

Note:1=Fishing has become very easy;2=Fishing has become easier;3=Fishing has become difficult;4=Fishing has become more difficult; 5= no change

*, **, ***, represents significant at 10%, 5%, and 1%, respectively

Cross node socioeconomic and governance

Capacity of community

Table Capacity of community improved in Fiji

Statements	MMA (n=150)	Non-MMA (n=33)	t Value	P Value
1. It has been easier for our children to go to school	2.51	1.91	3.7217	0.0001***
2. We are now better able to afford the school fees	2.29	2.52	-1.3973	0.0820*
3. My family has learned new and practical skills to earn in income	2.24	1.55	4.1438	0.0000***
4. It is important for my children to attend school	2.95	2.64	3.303	0.0006***
5. Establishment of the MMA has shown the importance of education to the community	2.77	1.36	9.4077	0.0000***
6. The chances for going to school is the same for boys and girls	2.65	2.61	0.3047	0.3805

Answers for each statements: 0= Don't know; 1=Disagree; 2=Neutral; 3=Agree
 *, **, ***, represents significant at 10%, 5%, and 1%, respectively