Handbook on the Economics of Ecosystem Services and Biodiversity

HALF-TITLE VERSO

Handbook on the Economics of Ecosystem Services and Biodiversity

Edited by

Paulo A.L.D. Nunes
Scientific Coordinator, Policy and Technical Experts Committee, WAVES – Wealth Accounting and Valuation of Ecosystem Services, The World Bank

Pushpam Kumar
Chief, Ecosystem Services Unit, United Nations Environment Programme

Tom Dedeurwaerdere
Director, BIOGOV Unit, Université Catholique de Louvain, Belgium

Edward Elgar
Cheltenham, UK • Northampton, MA, USA

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Contents

Governance is critical to managing coastal and marine resources: Effects of Marine Management Areas

Giselle Samonte[1], Daniel Suman[2], Juan Mate[3], Diego Quiroga[4], Carlos Mena[4], Adele Catzim-Sanchez[5], Patrick Fong[6], Xuanwen Wang[7]

[1]*Conservation International, Arlington, Virginia, U.S.A.*
[2]*University of Miami, Florida, U.S.A.*
[3]*Smithsonian Tropical Research Institute, Panama*
[4]*Universidad San Francisco de Quito, Ecuador*
[5]*Belize ISIS Enterprises, Belize*
[6]*University of the South Pacific, Fiji*
[7]*Center for Construction Research and Training, U.S.A.*

Abstract

Marine managed areas (MMAs) are resource management measures that seek to achieve an array of social, cultural, and economic objectives. In this paper, we demonstrate the application of socioeconomic and governance monitoring to support improved understanding and adaptive management of coral reefs and related ecosystems. Resource use, dependence governance effects of MMAs in Belize, Fiji, Ecuador, and Panama are assessed using a household survey conducted in 36 coastal communities adjacent to 11 MMAs involving 2,386 households. Four governance hypothesis effects are tested. They are effective management structures and strategies maintained, effective stakeholder participation and representation ensured, environmental awareness and knowledge, and information dissemination. This empirical assessment of resource use, dependence and governance in coastal and marine conservation has significant implications for how we think of social capital and on efforts for adaptive management.

Keywords: Governance; Marine management areas; Marine protected areas; Stakeholder participation.

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* E-mail address: gsamontetan@conservation.org (G. Samonte)

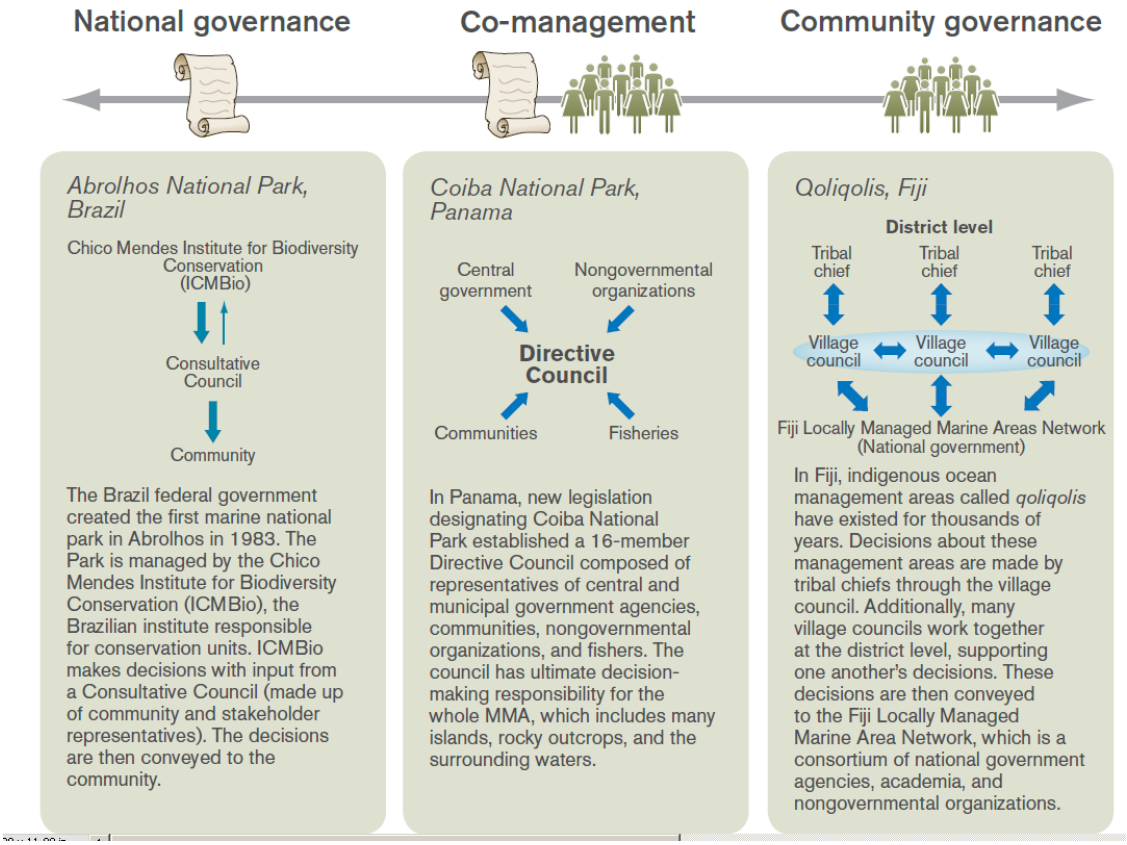
1. Introduction

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 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 (Orbach 2010). 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.

Governance systems—those arrangements by which communities of people at different scales make common rules of behavior-occur in many different forms across nations and cultures (**Figure 1**). There is also a significant difference between governance structures on land and in the sea. On land, most property and many resources are subject to private ownership, as private

Figure 1. *Governance spectrum (source: Samonte et al 2010).*



property. In the sea, it is generally true that the water, seabed, and resources are common pool, or common property. That is, those environments and resources are held in trust by governments and managed for the benefit of all people. Within the common pool of marine environments and resources, there are many different governance arrangements, such as national governance, co-management, and community governance (Samonte et al 2010). These arrangements can also extend across national boundaries for transboundary, international environments and resources. All, however, feature different scales of human communities with specific cultural values pertaining to the use of the marine environment. For example, a particular area may be valued by a society for spiritual or aesthetic reasons, and significant use or alteration may not be desirable. Another area may be valued for a particular extractive resource such as fish, and significant use may be desirable. The key is that the values of the culture and society are reflected in the marine managed area governance.

The importance of governance has been the focus and emphasis for the sustainability socioecological systems (Ostrom 2009). This includes studies on governance issues across geographical scale, that is from being able to simultaneously maintain access and use controls for the continuing sustainability of their fishing grounds in community based parks (Basutro

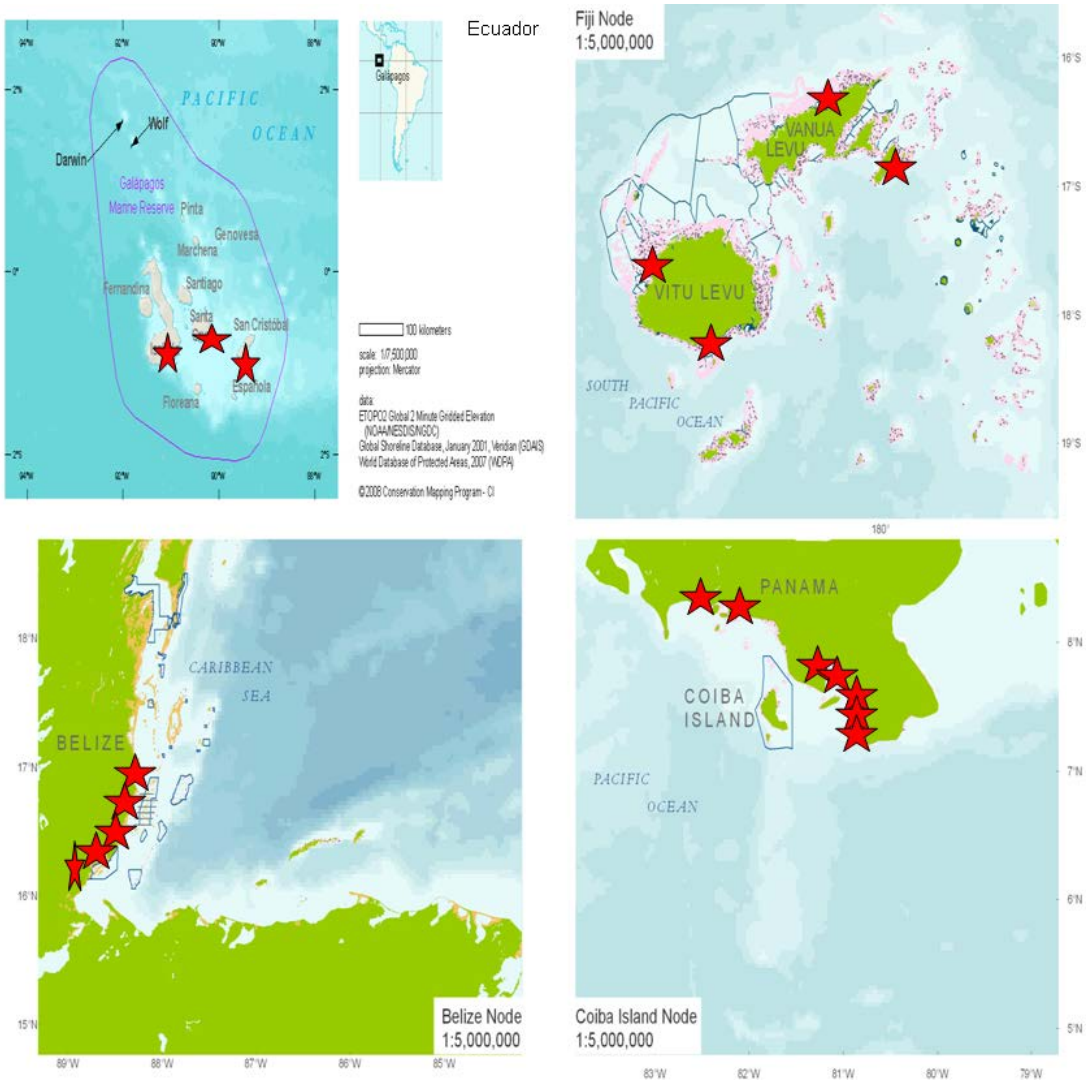
2005) to the analysis of living marine resource governance in the large marine ecosystems in the Caribbean (Fanning et al 2009). Some governance factors such as successful alternative income projects, high levels of participation in community decision making, continuing advice from the implementing organization and inputs from local government.(Pollnac et al 2001) have been identified for effective management. Although a core set of guidelines for sustainable governance (responsibility, scale-matching, precaution, adaptive management, full cost allocation, and participation) has been developed (Costanza et al 1999), common governance challenges, such as confused goals, conflict, and unrealistic attempts to scale up beyond institutional capacity (Chirstie and White 2007) still exist.

This paper contributes to the literature on marine conservation as it examines how marine managed areas have affected the resource use, dependence and governance effects of coastal communities.

2. Study Area and Data

Data for this study comes from the household surveys conducted in Belize, Fiji, Ecuador, and Panama. Five monitoring locations in Belize- Lighthouse Reef, South Water Caye, Laughing Bird/Gladden Spit, Sapodilla Cayes, and Port Honduras; four locations in Fiji- Navakavu, Waitabu, Navatu, and Solevu; the Galapagos National Part in Ecuador and the Coiba National Park in Panama. Since the islands forming Coiba National Park are uninhabited and the local communities situating along the Panamanian coast and opposite Coiba National Park are historically dependent on the access to resources within and around Coiba National Park, nine communities out of these local communities were selected for the study (**Figure 2).**

Figure 2. *Coastal communities surveyed.*



All the households surveyed in these countries were randomly selected. The total sample size for Belize, Fiji, Ecuador, and Panama, are 1,341, 183, 365, and 497, respectively. The total sample size for cross node analysis is 2,386 (**Table 1**).

Table 1: *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 Copper Bank Dangriga Hopkins Independence Monkey River Placencia Punta Negra Punta Gorda Sarteneja Seine Bight Sittee River	76 65 276 105 187 27 97 229 7 141 104 27
Fiji (n=183)	Navakavu Waitabu Kubulau Malolo	Waiqanke Muaivuso Namakala Nabaka Wai Waitabu Vurevure Navatu Raviravi Kiobo Namalata Solevu	28 16 11 5 5 14 6 15 10 10 7 23
Ecuador (n=365)	Glapagos National Park	Santa Cristobal Isabela Santa Cruz	113 63 189
Panama (n=497)	Coiba National Park	Bahia Onda El Puerto Gobernadora Hicaco Malena Pedregal Pixvae Puerto Mutis Santa Catalina	28 76 15 89 26 120 69 15 59
Cross Node (n=2386)	11	36	2386

The indicators for resource use and dependence were income and livelihood. To test whether people's income and livelihoods has 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. 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. Detail information of MMA and non-MMA beneficiaries are summarized in **Table 2**.

Table 2: 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	
Fiji	**183**	**Total Subsample**	**150**	**Total Subsample**	**33**
		Waiqanake	28	Kalokolevu	23
		Muaivuso	16	Tavulomo	10
		Namakala	11		
		Nabaka	5		
		Wai	5		
		Waitabu	14		
		Vurevure	6		
		Navatu	15		
		Raviravi	10		
		Kiobo	10		

Country	Respondents Surveyed	MMA beneficiaries		Non-MMA beneficiaries	
		Namalata	7		
		Solevu	23		
Ecuador	**363**	**Total Subsample**	**90**	**Total Subsample**	**273**
		Santa Cristobal	28	Santa Cristobal	85
		Isabela	21	Isabela	41
		Santa Cruz	41	Santa Cruz	147
Panama	**497**	**Total Subsample**	**193**	**Total Subsample**	**304**
		Bahia Honda	28	Hicaco	89
		El Puerto	76	Malena	26
		Gobernadora	15	Pedregal	120
		Puerto Mutis	15	Pixvae	69
		Santa Catalina	59		

Source: household surveys conducted in these four countries

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.

3. Valuations (Ecological Valuation versus Economic Valuation)

3.1 Resource Use

The results of t-test with equal variance are presented in **Table 3.** The null hypothesis is that the number of fishermen among MMA resource users is equal to those among non-MMA users (

[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.

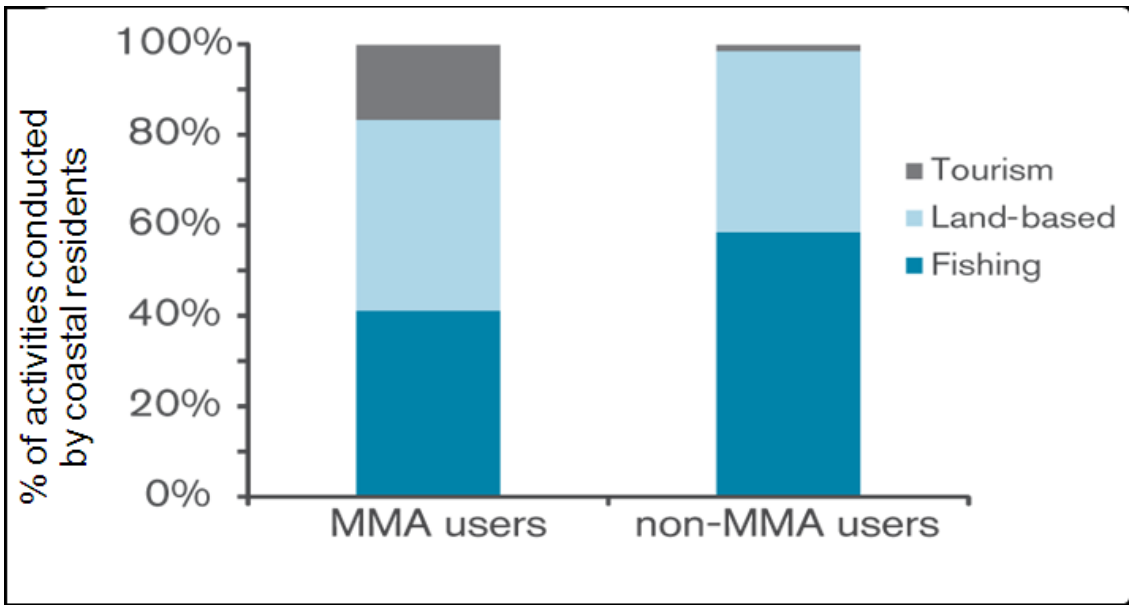
$H_0 : \mu_{MMA} = \mu_{Non-MMA}$), while the alternative hypothesis is that the number of fishermen among MMA resource users is greater than those among non-MMA users ($H_a : \mu_{MMA} > \mu_{Non-MMA}$). The statistical results in Belize, Ecuador, Panama, and Cross node show that there is sufficient evidence to conclude 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. In-depth analysis of the benefits and challenges of 17 MMAs in Belize, Ecuador, Fiji, and Panama identified the following improvements. More diversified livelihoods: Community members whose livelihood is directly tied to the MMA (MMA users) are much more likely to be engaged in both tourism and fishing than community members whose livelihood is marine based but not tied to the MMA (**Figure 3**).

Table 3. *T test results for resource use.*

Variable	Belize	Fiji	Ecuador	Panama	All sites
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	n.a.	n.a.	8.12
p-value	0.00***	0.10*	n.a.	n.a.	0.00***

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

Figure 3. *Resource use as reflected by more diversified livelihoods.*



3.2 Resource Dependence

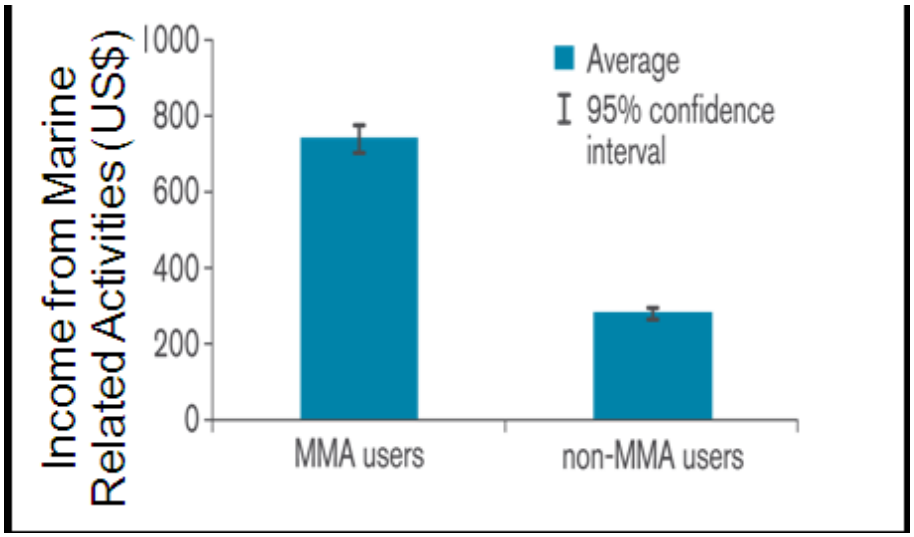
One of the most important socioeconomic effects of MMAs is whether the income of coastal population increased or maintained after the establishment of MMAs. Income variables in this study include average monthly household income and perception of economic situation. Average monthly household income is the total monthly income of all household members. The results of t-test with equal variance are presented in **Table 4.** The null hypothesis is that the average monthly household 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. Greater income: Community members whose livelihood (e.g., fishing, tourism) is directly tied to the MMA (MMA users) have a higher average income than community members whose livelihood is marine based but not tied to the MMA (**Figure 4**).

Table 4. *T test results for dependence on marine resources, average monthly household income (US $)*

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

Figure 4. *Resource dependence as indicated greater income from marine managed areas.*



3.3 Governance Effects

Management structures and strategies include local understanding of MMA rules and regulations and level of participation in development of management plan. The results of t-test in Belize, Fiji, Ecuador, Panama, and cross nodes are presented in **Table 5a**. 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 results in all countries show 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. 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 (**Table 5b**).

Table 5a. *Effective management structures and strategies maintained-rules and regulations*

Variable	Belize	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**

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

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

Table 5b. *Effective management structures and strategies maintained- stakeholder participation*

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 statement:1=Yes;0=No
*,**,***, represents significant at 10%, 5%, and 1%, respectively

Level of capacity building/training provided to stakeholders is used to measure the effective stakeholder participation. This information was only collected in Belize and Fiji. 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 show that there is sufficient evidence concludes that the null hypothesis is rejected (**Table 6**).

Table 6. *Level of capacity building and training.*

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

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, Fiji, and Panama. Therefore, cross node analysis in this section is limited in these three countries. The results of paired t-test are presented in **Table 7**. 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 results show that there is sufficient evidence concludes that the null hypothesis is rejected. 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.

Table 7. *Environmental awareness and knowledge.*

Statements	**MMA Beneficiaries (n=1080)**	**Non-MMA Beneficiaries (n=835)**	**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	1.48	1.60	-3.6723	0.0001***

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

The results of paired t-test are presented in **Table 8**. The null hypothesis is that the information dissemination among 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 information dissemination among respondents who use resources in MMA is lower than those who don't use resources in MMA ($H_a : \mu_{MMA} < \mu_{Non-MMA}$). The statistical results show that there is sufficient evidence concludes that the null hypothesis is rejected. 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. Information dissemination is more efficient among MMA users than non-MMA users.

Table 8. *Information dissemination.*

Does the MPA body share information with you or your family as it relates to the:	**MMA Beneficiaries (n=1080)**	**Non-MMA Beneficiaries (n=834)**	**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 statement:1=Yes;2=No;9=Don't know or Not sure
*,**,***, represents significant at 10%, 5%, and 1%, respectively

4. Discussion and Conclusions

Marine managed areas benefit coastal communities and are important in terms of resource use, dependences and guaranteeing the possibility for local inhabitants to shift from an extractive economy based on the use of provisioning services to an economy based on the utilization of non-extractive cultural services. In the case of fisheries, marine managed areas has meant that their socioeconomic situation has improved owing to the restrictions on illegal fishing activities and the prohibition of the commercial vessels inside local fishing grounds. Users of marine managed areas are exploiting marine resources in a more sustainable way than they were 10 years ago. Statistical results show, for example, that current fishing techniques are more sustainable than those of 10 years ago. In addition, many fishermen are now hopeful that they will find alternative ways of making a living as they are already engaging in a wide range of activities that allows them to diversify their household economies and to lower the risk generated by natural and market fluctuations.

Contrary to fishing, the importance of tourism has been growing steadily. More people are increasingly getting involved in this sector, which has undoubtedly become the most important and dynamic sector of the local economy. In terms of the well being of the general population, marine managed areas ensure an adequate level of income for an important part of the local population. The income of respondents who use marine managed area have both higher household income and fishing income than respondents who do not use these resources. Coastal

communities benefitting from marine managed areas perceive that they have benefited from tourism.

Marine managed areas can be considered as governance tools for managing the natural and cultural resources. This concept includes the rules that determine who has access to the area and when access is permitted; the allowed and prohibited uses in an area – in essence, the legal framework and policies regarding resource use. Governance comprises more than the formal and informal rules of the game and also includes the structures created and adopted to reach decisions, the social actors that are responsible for the implementation of the actions that form part of the management of the marine area. A further aspect of governance embraces public participation and the degree of inclusion of the public, organized groups of users and other interested social groups.

The experience of the 11 marine managed areas is evolving, and all communties and management have had similar benefits. The process of the development of the management plan serves as a stimulus to all stakeholder groups to better define their roles and be more responsible in their approaches to marne conservation. A central principle of environmental management today is the promotion of public participation – involving the organized public in the park planning process. Nevertheless, we must ask whether the individuals who serve as members of these committees are really the best representatives of their social sectors that they apparently represent. Additionally, we must critically examine the transparency of the processes involved in the development of the management plans and search for mechanisms to more effectively include the social actors interested in and affected by the the creation of marine managed areas. Possible recommendations to improve this situation include public outreach campaigns targeted to distinct social sectors, as well as mechanisms to insure that the public representatives who serve on the various committees are truly representative of their groups.

Acknowledgments

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