

UC San Diego

Capstone Papers

Title

Through the Author's Eyes: Why are we succeeding and why aren't we succeeding in managing our own marine resources in the South Pacific region

Permalink

<https://escholarship.org/uc/item/3177d5tz>

Author

Metai, Tekateteke

Publication Date

2018-04-01

THROUGH THE AUTHOR'S EYES: WHY ARE WE SUCCEEDING AND WHY AREN'T WE SUCCEEDING
IN MANAGING OUR OWN MARINE RESOURCES IN THE SOUTH PACIFIC REGION

"Self-sufficiency of the subsistence community is an asset that must not be overlooked or undermined. We have a degree of self-sufficiency that provides important protection from the risk of vulnerability." Hon. Dr. Derek Sikua, Prime Minister of Solomon Islands

BY

Tekateteke Metai

Capstone Project

Master of Advanced Studies in
Marine Biodiversity and Conservation

University of California, San Diego
Scripps Institution of Oceanography

2018



Approved by _____

Dr. Stuart Sandin (Chair of Committee)

Samantha Murray (Committee member)

Dr. Eleanor Sterling (Committee member)

Ben Namakin (Committee member)

Abstract:

The South Pacific Islands have a massive ocean with numerous marine resources; however, these resources can be overfished or even depleted as the majority of humans rely on these natural resources as their sustenance. Having the right strategy with the precise marine conservation toolkit is very critical for the local communities in the South Pacific for conserving and protecting their marine resources. There are many marine management tools used throughout the Pacific region within communities, such as Marine Managed Areas (MMAs), Community based fisheries management (CBFM) and locally managed marine areas (LMMAs). These marine management tools are formed from a variety of traditional conservation methods; however, the western perspective does not always take into account these methods. In this case, this research mainly focuses on how the change in Governance concerning regulations and structure can achieve the conservation goals of LMMAs in the Pacific region, which leads to the two research questions; (1) Does an LMMA design process that integrates traditional conservation methods result in more favorable conservation outcomes than one that does not? (2) How do different models of social hierarchy (such as chiefly driven or community driven) impact compliance with LMMA rules? The conservation outcomes and LMMA governance are the main indicator and predictor, respectively, to determine the strength of LMMA. Furthermore, this research was based on a collection of several articles, reports and literature reviews using Google Scholar. The collected data are then analyzed through Atlas.Ti8 and tableau. The results show that islands which used traditional methods have a higher increased percentage in fisheries productivity, coral reef health and CPUE, which definitely determines that LMMA design process that integrates traditional methods results in more favorable conservation outcomes than one that does not. In relation to that, Social hierarchy (chiefly/ community and national governance) can impact compliance with LMMA rules. Chiefly governance results in stronger compliance and weak poaching, while national governance results in weak or poor compliance with higher poaching.

Acknowledgement

I would like to express the deepest appreciation to my committee chair, Dr. Stuart Sandin, who has the attitude and the substance of a genius on protected areas. Without his guidance, support and persistent help, this paper would not have been possible.

Also, the development of this project would not have been completed without the collaboration and support of my three committee members; Samantha Murray, Dr. Eleanor Sterling and Ben Namakin. Their support, feedbacks and inputs for this paper will never go unnoticed.

Special thanks to Dr. Taakei Taoaba for sharing his enthusiasm and everything he knew about customary tenure around the Pacific, especially Kiribati and Fiji. To my mentor, Adi Khen for her support, her time on editing and fixing this paper; and her friendship. My gratitude also goes to Lindsay Bonito and Alfredo Giron for being there for me, helping and teaching me in collecting and analyzing data on two different computer software that I've never used before.

Furthermore, I cannot forget to thank my MAS-MBC cohorts for supporting and helping me in the difficult times of understanding the differences between Kiribati and American cultures as well as some of the jokes made during class; most importantly becoming my dear friends. My best buddy, Clint Edwards for the fun time during summer and Catalina trip and for being awesome. I also need to thank Dr. Kate Furby for being there for me, from the airport, during summer class, through email and phone calls she always offers me the best advice and feedbacks on my capstone project, and pretty much on everything else.

Moreover, my list of acknowledgements must include all the administrative support from Penny Dockry and Jane Weinzierl for their support and help in any way they offer to me. Also, I would like to thank the Phoenix Islands Protected Areas Trust for providing and funding my studies.

Most importantly, I want to thank my family and friends, who although being thousands of miles away in Kiribati, have supported me in pursuing my degree and who have never let me down in my entire life. Finally, thanks to my husband Charlie and my 6-year old Marcene for their patience, understanding, support and most of all, their love.

Table of contents

List of figures	IV
List of tables	IV
1. Introduction.....	1-3
2. Overview of theory, background and context.....	3
2.1 Marine Managed Areas.....	3
2.2 Community Based Fisheries Management.....	4
2.3 Locally Managed Marine Areas.....	4
3. Locally Managed Marine Areas (LMMAs) Overview.....	5
3.1 LMMAs Governance.....	6
3.2 LMMAs customary management measures.....	7
4. Topic concept.....	7-8
5. Research context.....	8
6. Limitations of study.....	9
7. Methodology.....	9
7.1 Data collection.....	10
7.2 Study site.....	10
7.3 Analysis of collected data.....	10
7.3.1 Atlas.Ti8 computer software	10-11
7.3.2 Tableau software.....	11
8. Results.....	12-14
9. Discussion.....	15-17
9.1 LMMA Customary marine of the South Pacific.....	18-20
10. Failure and Success LMMA characteristics- Lessons learned.....	20
11. Conclusion.....	21
References.....	22-25

List of figures

Figure 1: LMMA Cartoon.....	5
Figure 2: Overview map of Kiribati.....	9
Figure 3: Fisheries productivity.....	12
Figure 4: Fisheries catch per unit effort (CPUE)	12
Figure 5: Coral reef health.....	13
Figure 6: Customary marine management.....	13
Figure 7: Community compliance and poaching.....	14

List of tables

Table 1: Summary of customary management measures.....	7
Table 2: Types of governance structure used within LMMAs.....	14

1. Introduction

Surrounded by an enormous ocean replete with marine resources, the South Pacific Islands are known to be most prosperous to other countries when it comes to fisheries (Vierros et al., 2012). These marine resources include biological diversity, fish and seafood supplies, and unique ecosystems and habitats like coral reefs. However, with the ever-increasing human populations, these marine resources are vulnerable to overuse (Govan, 2009). Degradation of habitats, destruction of coral reefs, and overexploitation of marine resources are key challenges throughout the South Pacific Islands (Vierros et al., 2012). Harvesting fish at a rate that exceeds productive capacity of certain fish species is the primary cause of overfishing and overexploitation. Subsistence and commercial activities are not adequately managed and fishing activities using highly advanced technological gears can be destructive to unique ecosystems and essential habitats ((Brodie et al., 2013; Lovell et al., 2004). Without protective laws and regulations, these impacts can continue to increase as human population grows.

For many years, in the South Pacific Islands, there have been traditional conservation management measures that were put in place as laws for marine waters. Marine tenures include no-take areas, restricted areas (spatial regions) and periodic and seasonal areas (Jupiter et al., 2014). Nevertheless, in some places such as Kiribati and Tuvalu, their marine tenures were eliminated and are no longer practiced since European contact (Berthold, 2016). By not practicing these marine tenures, nowadays, this can efficiently contribute to overfishing and overexploitation problems (UNDP, 2009). Also, these marine tenures are known as challenges in some places; especially since people depend on these marine resources as their principal supply of food and source of income (Vierros et al., 2012). Marine Managed Areas (MMAs) had been practiced throughout the Pacific Islands, although they are not well enforced due to some existing Western national laws since the institutions of marine laws changed; most people are not complying with the rules within the MMA (Berthold, 2016).

However, in the late 1990s in Melanesian Regions, which experienced high human population growth and scarcity of marine resources, “Conservationists,” local leaders with their people came up with the idea of implementing and establishing Locally Managed Marine Areas (LMMAs) throughout their Islands for protecting, conserving and managing their marine resources (UNDP, 2009). LMMAs are like MMAs, however, they are community-centered. Globally, LMMAs can be recognized as nearshore waters that are mostly managed and governed at local level by local coastal communities (Jupiter & Egli, 2011). The laws and regulations are made within the communities. In some Pacific Islands such as Fiji, Vanuatu, and the Cook Islands, LMMAs have offered significant benefits in protecting vulnerable species and conserving biodiversity, such as increasing fish species and biomass (UNDP, 2009 & 2012).

Today, the LMMAs governance system is becoming more complicated, since there are some LMMAs synthesizing with national laws or even eliminating traditional management with new-western management methods (Berthold, 2016). There are successes, failures and lessons learned from stories from the pre-existing of LMMAs for each island, whether they integrate

with traditional methods or not. Considering the pre-existing LMMAs, this study examines (1) the pre-existing successful characteristics of LMMAs in the South Pacific Islands (2) the pre-existing failure characteristics of LMMAs in the South Pacific Islands and (3) the lessons learned from the successful and not successful LMMAs across the South Pacific

This Capstone Project explores the following specific research questions:

- (1) Does an LMMA design process that integrates traditional conservation methods result in more favorable conservation outcomes than one that does not?
- (2) How do different models of social hierarchy (such as chiefly driven or community driven) impact compliance with LMMA rules?

This research project was encouraged by a regional program, Community-based fisheries management (CBFM) in Kiribati. The CBFM program began in 2016 on Butaritari Island and North Tarawa, where staff and managers worked closely with local communities and trained them to maintain, protect, conserve and manage their marine resources traditionally (Delisle et al., 2016). The results of this Capstone Project will benefit the CBFM program by providing information and understanding on why and how to implement and maintain LMMAs throughout the communities of Kiribati islands.

2. Overview of theory, background, and context

There are a variety of tools that have been used to protect marine resources in the South Pacific Islands. These marine management tools are known as Marine Managed Areas (MMAs), Community based fisheries management (CBFM) and locally managed marine areas (LMMAs).

2.1 Marine Managed Areas

Conservation Areas (CAs) are, “clearly defined geographical space[s], recognized, dedicated and managed through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values.” (IUCN Definition, 2008)

In the last decade, MMAs have been commonly used in the South Pacific as useful marine management tools (Hastings et al., 2015). MMAs have been developed at the national level and built on unique features of a region, customary tenures and resource access (Govan, 2009). MMAs take many forms, addressing many different issues and achieving the same goals for fisheries conservation and sustainable use of marine resources. They are usually established in support of tourism or fishing and typically involve multiple areas that restrict different activities in different regions (e.g., allow local fishing only or prohibit drilling or mining) (Orbach & Karrer, 2010). Establishing MMAs in some areas of the South Pacific has helped the nation to protect, conserve and manage the variety of resources and uses not only in an area of marine, but estuarine and adjacent terrestrial areas, by limiting the access to these areas (UNDP, 2012).

2.2 Community based fisheries management

Community-Based Fisheries Management (CBFM) “generally, refers to a system in which participants in the fishery practice management are included: participating in decision making on aspects of management; defining access rights, limiting harvesting, practicing enforcement and compliance and undertaking marketing, etc.” (Boso et al., 2010)

Many CBFM projects have been carried out throughout the Pacific Islands; Secretariat of the Pacific Community (SPC) assists many Pacific Island Countries (PICS) in establishing CBFM (SPC, 2010). In the early years, the Solomon Islands, for instance, applied CBFM in some of its communities to address the issue of “common property” control over the sea and its resources (Hviding & Baines, 1994). CBFM is established with the goals of reducing and impoverishing the issue of ‘common property’ within the communities by working together to regulate and manage their marine resources (Delisle et al., 2016). This system requires a collaboration of communities, especially fishers, to participate in decision making in key aspects of management, defining access rights, limiting harvesting, practicing enforcement and compliance, and undertaking marketing (Boso et al., 2010).

2.3 Locally managed marine areas

Locally Managed Marine Areas (LMMAs) are “areas of nearshore waters and coastal resources that is largely or wholly managed at a local level by the coastal communities, land-owning groups, partner organizations and collaborative government representative who are based in the immediate area.” (Govan, 2009)

Community-based marine resource management (CBMRM) was practiced twenty years ago in the Pacific Islands, but has declined prior to the impacts of westernization (Hviding & Baines, 1994; Aswani, 1999 & Johannes, 2002). Demolishing of marine customary tenure led to the issue of “common property” resulting in overexploitation, overfishing and decline of marine resources (Tawake et al., 2001). Locally managed marine areas build on existing community strengths in traditional knowledge, customary tenure, and governance (Govan, 2009). In this case, tenure and taboos (traditional fishing ground) are used primarily as conventional fishery management tools for the entire Pacific region (Foale et al., 2010).

3. Locally managed marine areas overview

LMMA are commonly practiced across the South Pacific as it involves more local people to come up with and make their own plans and rules in managing their own marine resources. LMMA are governed in two ways; national governance and chiefly-community governance. In relation to that, there are tools or methods which are applied in this kind of management.

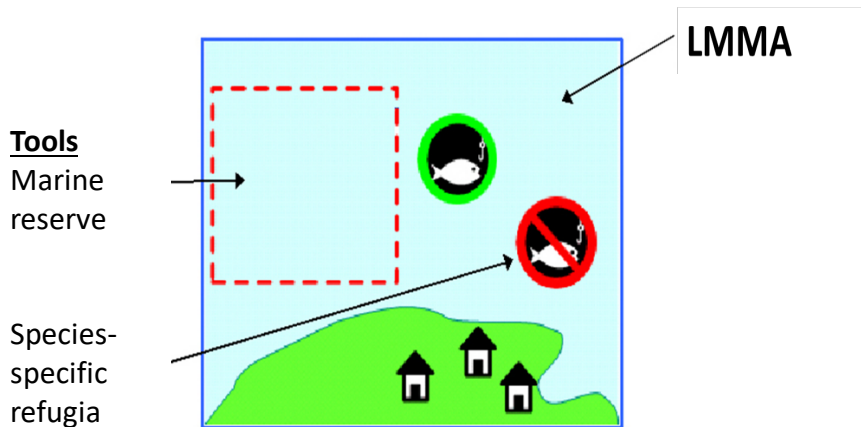


Figure 1 shows LMMA as an entirely managed area of water which includes both allowed fishing and restricted areas; along with LMMA tools

3.1 LMMAs governance

There are two key forms of LMMa governance types that have been used in the South Pacific. These governance types are known as national and chief-community governance.

1. National Governance (Top-down management)

LMMAs in some PICs are governed and managed by national governments or in a more top-down management for planning, implementing, maintaining and regulating of LMMAs (UNDP, 2012). In a National structure for the LMMAs, the decision, laws, and regulations are made from the Head of the state, whereas rules are carried out by mostly government officials, rather than local communities (Johannes, 2002). In the case of top-down management, local communities are expected to comply with regulations that had been set by their government head of state. However, some PICs generally recognized that top-down coastal protection and management do not meet the needs of Pacific islands communities (Govan et al., 2008). Thus, moving from state-controlled management towards local community co-management could meet more needs and achieve more conservation and sustainable goals of these PICs.

2. Chiefly or Community Governance (Bottom-up management)

In bottom-up control or chiefly/ community governance, local governments have jurisdiction over the marine resources and decisions with regulations made under the guidance of traditional leaders (Baker et al., 2011; Aswani & Hamilton, 2004 & Johannes, 2002). Most communities in the Pacific islands have preserved traditional management in the form of 'tabu' areas (Govan, 2009). Traditional leaders or chiefs are the ones who can initiate and designate specific areas to protect and manage natural resources (Johannes, 2002). These areas are named differently according to their language the Pacific Island Countries; however, they are referred as "marine reserves" (Govan, 2009; Hickey & Johannes, 2002; Tiira, 2006; Birkeland 2017; Govan et al., 2009 & Baker et al., 2011). Village councils or tribal members make the decisions and regulations in LMMAs as they represent their clans or people within the community (Liston & Alexander, 2013). The enforcement of custom-based fishing regulations is carried out by village authorities or community fish wardens (Clarke & Jupiter, 2010; Johannes, 2002; UNDP, 2012 & Liston et al., 2013).

3.2 LMMAs customary management measures

There are a number of customary management measures that apply throughout the implementation of LMMAs across the South Pacific that are considered effective management / regulations tools;

Table 1- Summary of customary management measures			
Types of customary management	Description	Analog in modern fisheries management techniques	Examples
Spatial	Certain areas closed temporarily from fishing or reserves for special feasts (eg: wedding,)	Marine reserves/ temporary fisheries closure	Polunin (1984), McClanhan et al. (1997), Johannes (2002)
Temporal/ Periodic	Specific days, weeks, months are set for fishing/harvesting restrictions for their spawning period	Closed seasons	Thornburn (2001), Cohen et al. (2014)
Gear	Gear restrictions to limit the use of destructive methods or highly efficient gear	Gear restrictions/ prohibition	Johannes (1991) Cinner et al. (2005) Cinner & Aswani (2007) Cohen et al. (2014)
Effort	Limiting fishing effort, time of fishing	Permitting	Cinner & Aswani (2007)
Species	Prohibiting the consumption of certain species, also includes a size restriction, species-specific restrictions	Species-specific bans	Cinner & Aswani (2007), Cohen & Foale (2013), Jupiter et al (2014)

4. Topic concept

Locally managed marine areas are increasing throughout the Pacific region and also, are known globally and internationally as they draw the attention of international researchers because of their conservation outcomes and community buy-ins. For instance, in Fiji communities, the LMMAs outcomes benefit the community socially, financially and culturally; other adjacent Islands followed suit and started to implement their own LMMAs. Identifying the positive impacts of LMMA led Fiji to receive the prestigious Equator prize, granted by the United Nations Development Programme, which recognized local efforts to reduce poverty and

promote sustainability through the conservation and sustainable use of biodiversity (UNDP,2012).

Today, this research interest has a stronger focus on why some LMMAs in the South Pacific are succeeding, and some are not. With the ever-growing attention of LMMA implementation across the South Pacific, the crucial question for these Islands is how the change in Governance concerning regulations and structure can achieve the conservation goals of LMMAs in the region.

In light of the stronger focus and crucial question, this Capstone Project examines the following questions:

- (1) Does an LMMA design process that integrates traditional conservation methods results in more favorable conservation outcomes that one does not?
- (2) How do two models of social hierarchy (namely chiefly /community governance vs national governance) impact compliance with LMMA rules?

5. Research context

Of all the three main groups of Kiribati, only the Phoenix Islands are protected in their entirety in a marine protected area designated in 2006 that covers 11.2 % of Kiribati's EEZ (Economic Exclusive Zone). The Gilbert and Line Islands groups are not included and are not protected under any law.

Recently, two CBFM programs were implemented in North Tarawa and Butaritari of the Gilbert Islands (shown on the image underlined blue). The research included in this Capstone Project will sustain and strengthen what has already been done there. Most importantly, it will expand on and contribute to creating and implementing LMMAs in the Gilbert and Line Islands, by synthesizing the perspective of science and policy for marine management.

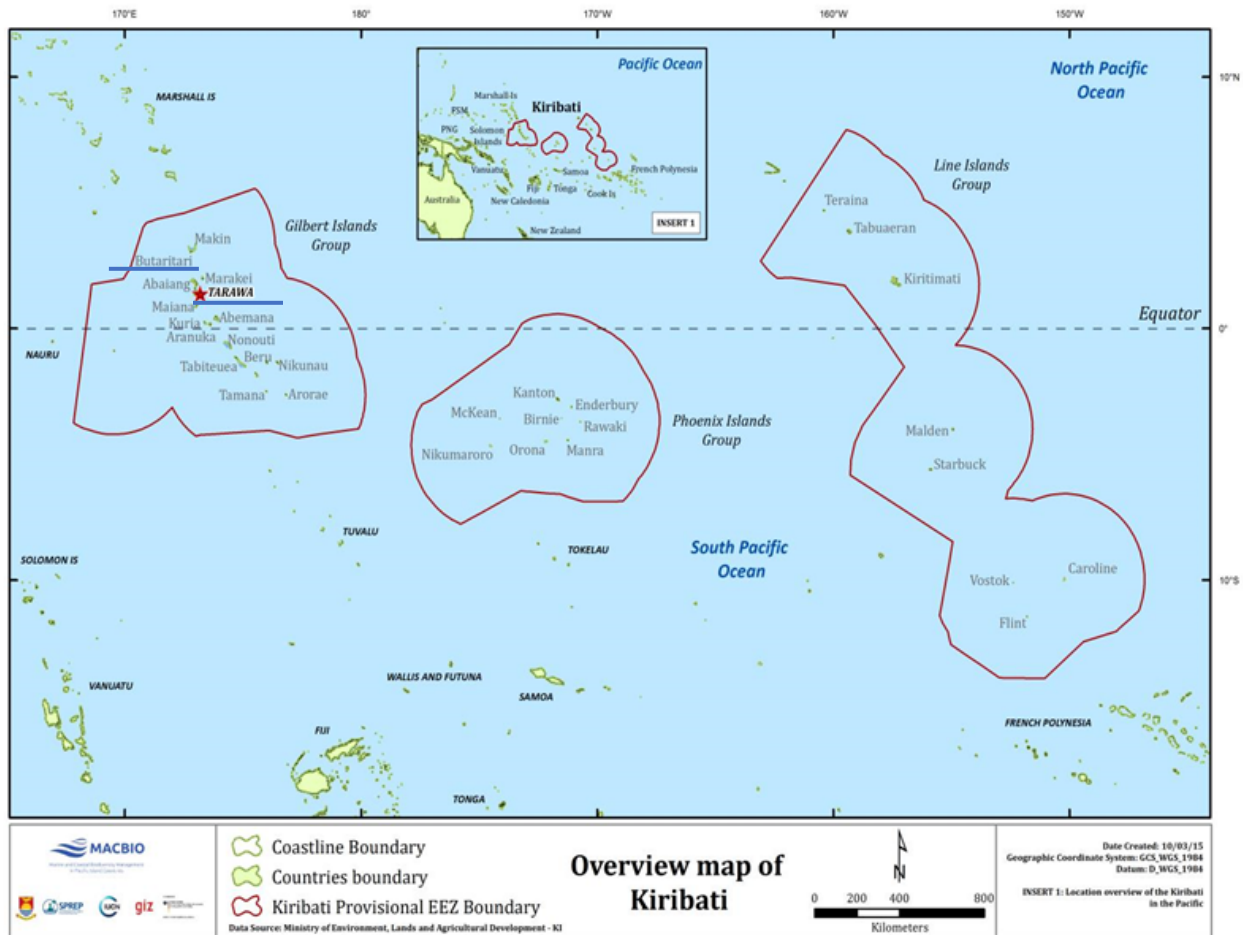


Figure 2 displays an overview map of Kiribati showing coastline and jurisdiction boundary for each Island. Kiribati has three main groups, the Gilbert, Phoenix and the Line islands.

6. Limitations of study

This Capstone Project was limited by the time available for the field study, especially when taking the LMMAs context of the South Pacific Islands (Fiji, Vanuatu, Solomon Islands, Palau, Samoa, Cook Islands, Tuvalu and the Marshall Islands) into account. The researcher also encountered limitations in searching for and accessing relevant information for each island, as some data could not be obtained outside the country range or has not been published yet.

7. Methodology

This research involves many articles, literature reviews and reports collected and analyzed. The data are collected using Google scholar search engine and then, analyzed using Atlas.Ti8 computer and tableau software.

7.1 Data Collection

Literature for review was primarily sourced by using the Google Scholar search engine to perform following online searches for 'Locally marine managed areas (LMMAs) in the South Pacific.' A systematic approach was used, where all papers, articles, reports, and books were included that met a criterion of documenting information that researchers believed could be attributed to LMMAs in the South Pacific.

This research project also used the "Protected Areas Database" to extract information and facts on each island based on their area marine coverage; a marine area protected entire oceanic regions and especially their active LMMAs with types of governance management.

Some government and technical papers found from the Secretariat of the Pacific Regional Environment Programme (SPREP) official website. For these, white and technical documents contain a lot of information and data of the south Pacific for LMMAs.

Preliminary information is also applied in this research which involves information discussion and casual interview with other people during the conference. The event of 'Linking Biological and Cultural Diversity through Indicators of Well-being' conference took place in New York, April this year; whereas preliminary information is mostly carried out with some people that used and still work in the field of LMMAs in the South Pacific.

7.2 Study site

The data and information collected mainly focus on the following islands; Fiji, Solomon, Vanuatu, Cook Islands, Samoa, Palau, Tuvalu and the Marshall Islands. The Micronesian region includes Fiji, Solomon, and Vanuatu, while the Polynesian region consists of the Cook Islands, Samoa, and Palau. Tuvalu and the Marshall Islands are representing the Micronesian district. The study sites are chosen in this research project regarding to their variety traditional conservation methods, customary marine tenure and LMMA establishment.

In this case, earlier information and data on LMMAs for each island showed the transition of how marine management changes over time, which also contributed to the trends of productivity, profitability, and health of the coral reef. These kinds of information and data are relevant to this research project.

7.3 Analysis of collected data

The data analysis was undertaken by using Atlas.Ti8 computer software and tableau software;

Atlas.Ti8 computer software

Regarding analyzing the received data, the 'Atlas.Ti8' computer software is used to code and analyze the information and collected data for this research project. Atlas.Ti8 is a computer software and a powerful workbench for the qualitative and quantitative analysis

of large bodies of text. This software makes it easy to analyze comprehensive data with text and reveal results or outcomes. In this software, there are steps used to analyze the data;

(1) Creating a project: This is the first step whereas the user needs to create a new plan to work on the software and inserting the collected articles, reports and information of all kind for the relevant topic.

(2) Search term: Throughout the articles, the search terms, for instance, in this case, 'Productivity, CPUE, coral reef' are typed in the search text box for the software to read through the article and highlight the terms. The search term could be your variables or measure of success to your research questions.

(3) Coding the text: This is very important as for this step, the user starts to code each search term for each article.

(4) Grouping the codes and documents: Documents and systems that you created should be a group in this software for secure visual data.

(5) Exporting to Excel: The data that the user gets from the software can now be exported into an excel document to have a raw data and to visualize into a graphic for interpretation and discussion.

Tableau Software

There are six indicators measured throughout the analysis, categorized under two themes, 'Conservation outcomes' and 'Governance' to respond to the researching questions plotted for this research. Conservation outcomes measured 'fisheries productivity,' 'fisheries Catch per unit effort (CPUE)' and 'Health of the coral reef'. The success of fisheries productivity is measured by the increase or decrease of fisheries productivity and fish biomass since the time of the LMMA establishment. This also applies to the fisheries Catch per unit effort increase or decrease after LMMA established. The increasing measures the health of the coral reef and decreasing of coral cover found on each island since the establishment of the LMMA. Concerning Governance, the other three indicators are 'Community compliance', 'Evidence of poaching' and 'Regulations.' Community compliance is measured by the community perception of how strong or weak is their compliance with LMMAs regulations. The evidence of poaching is determined by how strongly or weakly poaching is mentioned throughout the sources. Lastly, spatial, periodic and seasonal closure is categorized under regulations and considered as traditional conservation methods used in these Islands. The tableau software analyzed the data from excel in order to create and interpret the results visually, by forming bar graphs.

8. Results

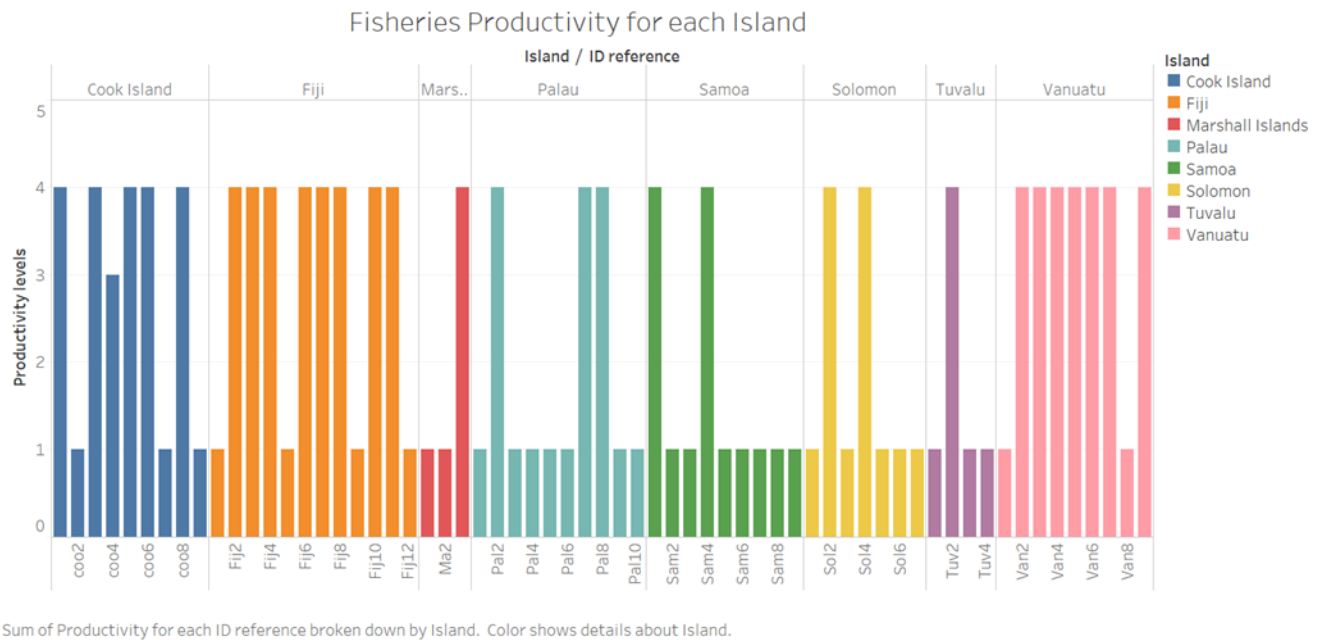


Figure 3 shows graph representing the conservation outcomes for each island shown or analyzed from the articles. The x-axis shows us how many articles are used for each island and the y-axis displays the fisheries productivity (N/A (not mentioned in the text) = 1, productivity decreasing = 2, No change in productivity = 3 & productivity increasing = 4)

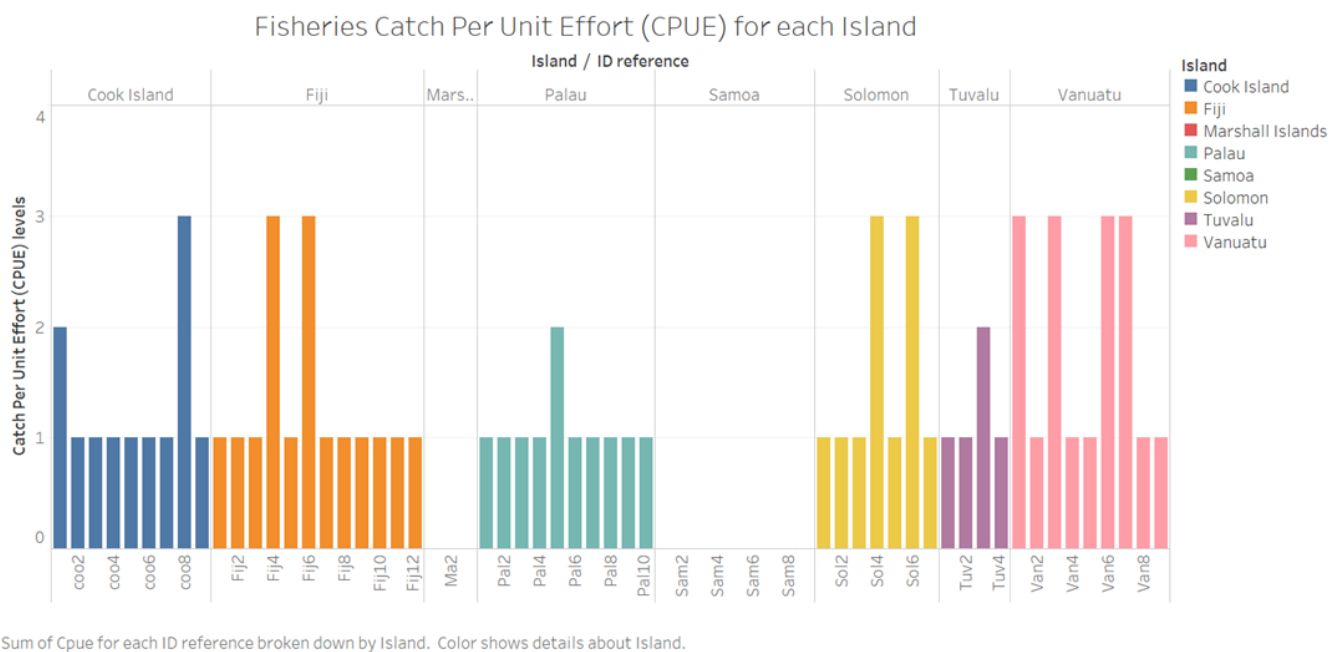


Figure 4 identifies fisheries catch per unit effort (CPUE) for each island; (N/A not shown in the article = 1, CPUE no change = 2 and CPUE Increasing =3)

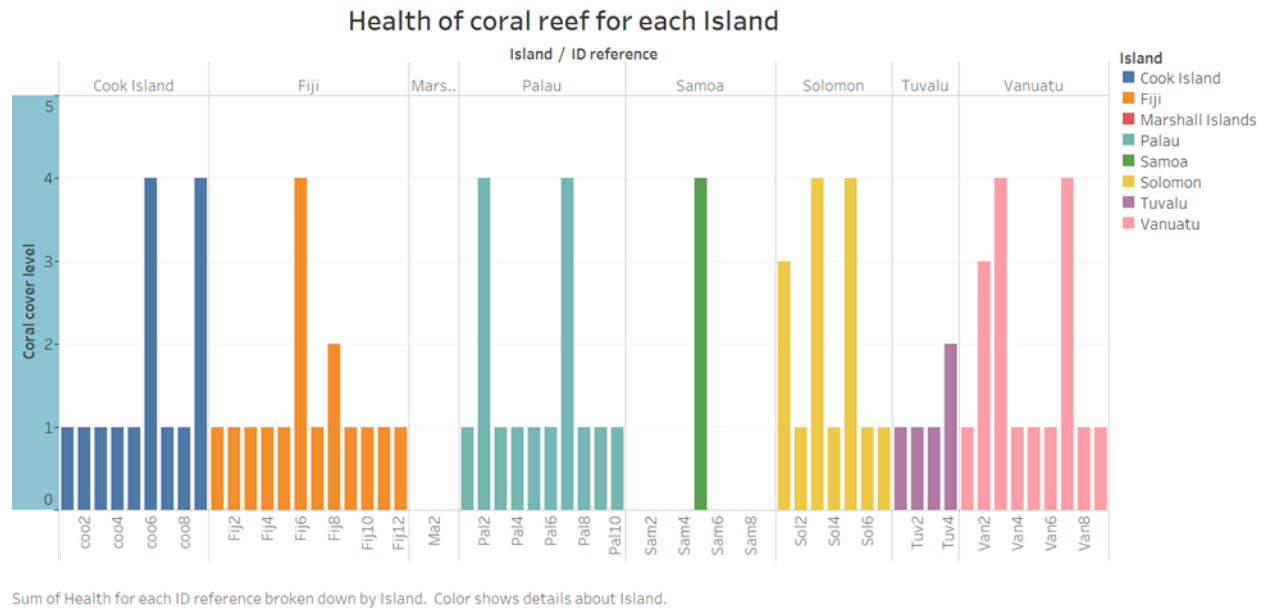


Figure 5 Health of coral reef in relation to coral cover across each Island; (N/A = 1, Decrease coral cover = 2, No change in coral cover = 3 & coral cover increasing = 4)

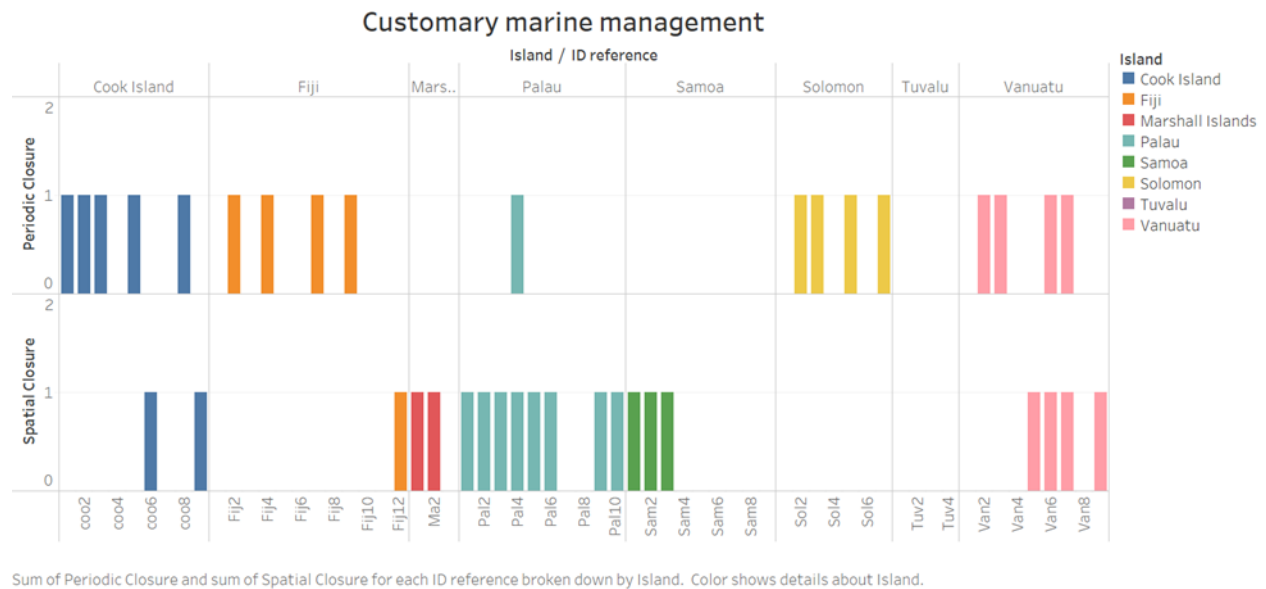
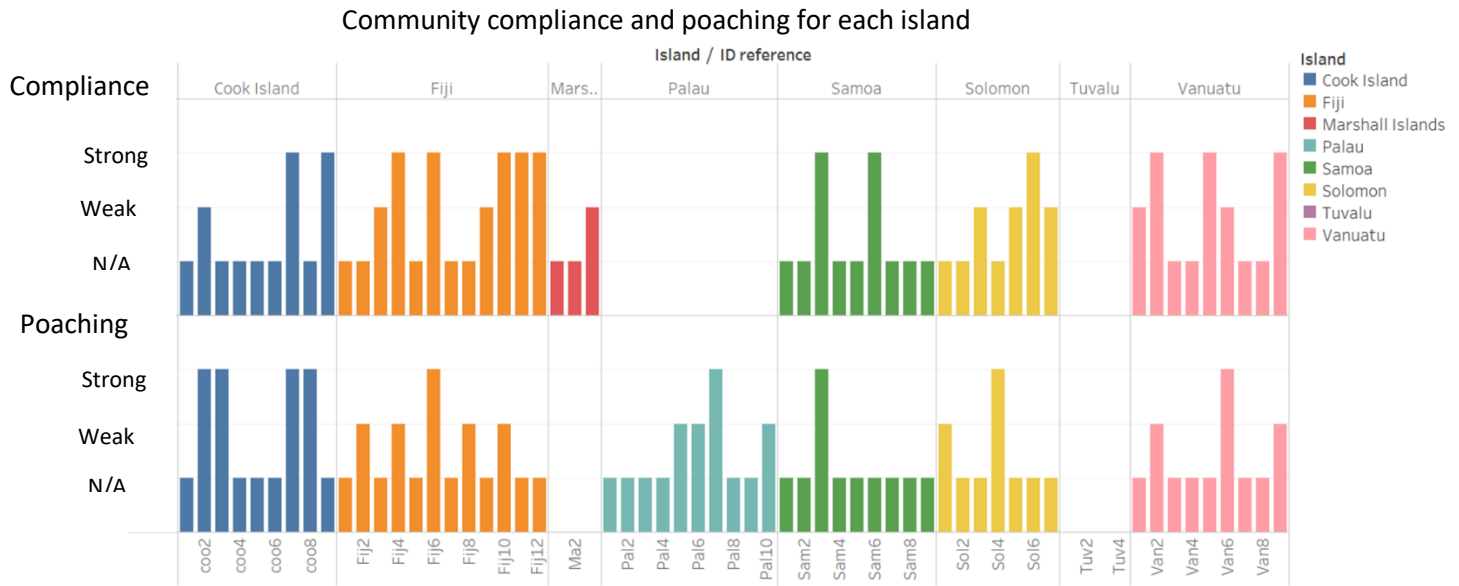


Figure 6 illustrates the graph for traditional methods applied in LMMAs for each Island. These methods include spatial, seasonal and periodic closure; (NO = 0, YES = 1).



Sum of Compliance and sum of Poaching for each ID reference broken down by Island. Color shows details about Island.

Figure 7 depicts the graph for community compliance and poaching for each island; measuring how strong and weak the compliance and poaching for each island with LMMA regulations.

Table 2: types of governance structure used within LMMAs		
Islands	Governance	Examples
Fiji	Chief-community	Liston, Clark & Alexander (2013), Berthold (2016)
Solomon Islands	Chief-community/National	Aswani & Hamilton (2004)
Vanuatu	Chief-community	Govan (2009)
Palau	National	Cinner et al (2007)
Cook Islands	National	Hoffman (2002) Vierros et al. (2010)
Samoa	National	Johannes (2002), Mascia & Mills (2018)
Tuvalu	National	Govan et al. (2009), Johannes (2002)

Marshall Islands	National	Baker et al. (2011), Reimaan National Team (2008)
------------------	----------	---

The example column determines the articles or sources that mention which Islands govern and are driven by chiefly/community or national governance.

9. Discussion

LMMAs are used across the South Pacific, however, this Capstone Project focuses on eight Islands: Fiji, Vanuatu, Solomon Islands, Cook Islands, Samoa, Palau, Tuvalu and the Marshall Islands. The following indicators were used to determine the strength of each island's conservation outcomes: fishery productivity, fishery Catch per unit effort (CPUE) and health of coral reefs.

In figure 1, more than 50% of articles/ sources claimed that Vanuatu and Fiji had increased fishery productivity within their LMMAs. For instance, within the boundaries of LMMAs in Navakau and Waitabu the biomass of fishes increased by 40% (Hastings et al., 2015). As well as in Ngula-pele that improved abundance and biomass of fish/ invertebrate species spill over from LMMAs (Govan et al., 2009). The Cook Islands are also considered to have high productivity whereas the rest of islands (Samoa, Palau, Tuvalu, Solomon Islands and the Marshall Islands). Most of these studies indicate that there is a higher percentage of fisheries productivity across the islands within their LMMAs.

Catch per unit effort in fisheries is very essential in determining the success of LMMAs within the island. Since most local people depend on seafood as their main supply of food and main source of income; it is estimated that 80% of fisheries catch are for subsistence purposes (Clements et al., 2012). In this case, CPUE in fisheries are considered as fisheries catch for subsistence only and are assessed how to increase and decrease of CPUE that the LMMAs communities had obtained throughout the articles. As shown in figure 2, Vanuatu is one island with increased CPUE, since LMMAs were established. In Vanuatu, small closures prevent population declines of invertebrates and fishes' biomass which in turn, also benefit local livelihoods by increasing CPUE of fishers (Jupiter et al., 2014).

In this research, coral cover is considered to determine the health of coral reef within the LMMAs. There are a number of scientific reports and findings on the coral cover within LMMAs concluding that coral covers are increasing; determining that the health of coral reef are improving and that the ecosystem in managed areas are well-balanced (Bonito et al., 2014). Coral cover was measured and valued as in 1 for N/A, 2 for coral cover decreasing, 3 for no changes occurred in coral cover and 4 indicating the increase of coral cover. In light of figure 3, across each Island, there are some articles report on a rise in coral cover took place in protected areas (Boland et al., 2017; Johannes, 2002; Cohen & Foale, 2013 & Govan et al.,

2009). The graph in figure 3 shows us indeed that most articles mentioned that coral cover is growing and increasing within the LMMAs boundaries.

Figure 4 represents the type of customary marine management used across the eight islands as a marine management tool for LMMAs regulations. There are a number of customary marine management methods; however, in this research, there are only three types considered (1) seasonal or periodic closure and (2) spatial closure. Spatial closures generally refer to temporary closure whereas specific areas are closed from fishing and harvesting, due to the special occasions such as wedding or special events for chief. They are generally marine reserves or "fish bank" (Polum, 1984; McClanhan et al. 1997 & Johannes, 2002). Traditionally, periodic or seasonal closure are described as areas closed from fishing and harvesting in certain times or season due to fish spawning or aggregation (Thornburn, 2001 & Cohen et al., 2004). In figure 4, the four islands (Cook Is, Fiji, Vanuatu, and Palau) had shown that they both used spatial and periodic/ seasonal closure as their customary marine management as their LMMAs tool; except for the Marshall Islands, Samoa and Solomon Islands.

(1) Does an LMMA design process that integrates traditional conservation methods results in more favorable conservation outcomes that one does not?

By figure 2, 3, 4 & 5, the design process that integrates traditional conservation methods results in more favorable conservation outcomes than a design process that does not. In response to this research question, the results clearly state that Cook Island, Fiji, and Vanuatu results in more higher productivity, CPUE and have healthier coral reefs within their LMMAs boundaries. For Palau's case, they also have higher productivity; however, lower CPUE since most marine waters are entirely closed and protected from commercial and even subsistence fishing. From the papers, articles, and reports, this research collected stated that Marshall Island, Tuvalu, Samoa, and Solomon Island are not resulting in more favorable conservation. They all have one characteristic in common: their customary marine management, since they only applied either one of the spatial or seasonal closure. Thus, the results clearly show that islands which used traditional methods have a higher increased percentage in fisheries productivity, coral reef health and CPUE, which definitely determines that an LMMA design process that integrated traditional methods results in more favorable conservation outcomes than one that does not.

To determine and assess how capable the governance structure is, this research focused on "Governance" as an indicator regarding compliance within the LMMAs and evidence of poaching reported in the papers. For this research study, community compliance is measured as how strong and weak the people comply to the LMMAs regulations, while the evidence of poaching is determined based on how strong and weak of poaching cases reported throughout the sources/ articles. Both community compliance and evidence of poaching can reflect the effect of governance used by each Island.

Community compliance shown in figure 6 illustrates that out of the 60 articles or sources analyzed, some of them determined that there is strong compliance performed by the

communities across the Islands. In Samoa, reserves are managed by communities with direct interest and compliance with a ban on fishing is increased (Idechong & Graham, 1998). The other articles indicate that there is poor compliance exercised by the communities in some places. According to the results, Fiji has a high value stronger compliance exerted by the communities within the village. Referring to Jupiter et al., (2014), Hastings et al., (2015) and Fiji LMMA (2009), most LMMAs communities are complying with LMMAs regulation, since they are given authorities to report on activities that might breach the rules.

Implementing and managing LMMAs within the context of each island can be complicated and controversial as poaching is a huge issue (Hastings et al., 2015). The effects of poaching have led community members to lose faith in the sustainable management as they fail to reap the rewards of their efforts (UNDP, 2012). Figure 7 represents the evidence of poaching level found throughout the articles for each island. The study sites were all experiencing evidence of poaching internally but mostly, externally from outside of their community or village. As such, Cook Island have the most reliable evidence of poaching in their LMMAs. Cook Islands traditional marine tenure are being ignored by most people, contributing to poaching issues as it would encourage other neighboring areas to breach LMMAs rules and regulations (Hoffmann, 2002 & Drumm, 2002).

Table 2 laid out the types of governance structure; chief-community driven or national driven. Chief-community is a more bottom-up structure in which decision-making, management plans, regulations and enforcement are developed by the community (Aswani & Hamilton, 2001); Fiji, Solomon Islands, and Vanuatu engaged in this type of governance. On the other hand, National governance is a top-down structure, in which the decisions, regulations, management, and Government officials make enforcement and bonded by legal laws (Mascia & Mills, 2018); as such in Palau, Cook Islands, Samoa, Tuvalu and the Marshall Islands in which the government drives most LMMAs.

(2)How do two models of social hierarchy (such as chiefly /community governance or national governance) impact compliance with LMMA rules?

LMMAs which are driven by chief/ community, the bottom-up governance structure is showing stronger community compliance, as such Fiji, Solomon Islands, and Vanuatu. These three islands are implementing, managing and enforcing their LMMAs through their customary marine tenure; in fact, most of the South Pacific Islands used to have it. The way they respect their leaders and elders is the same way they comply with LMMAs rules; since marine reserves are not only for an ecological system, economic benefits, but also cultural values. During, the pre-contact with Europeans, some customary marine was demolished and never practiced. This caused controversy among the people as most sacred and protected areas are open-access since the law-leading does not recognize customary marine tenure to a higher number of poaching and weak compliance towards LMMAs rules. Therefore, Social hierarchy (chiefly/ community and national governance) can impact compliance with LMMA rules. Chiefly

governance results in stronger compliance and weak poaching, while national governance results in weak or poor compliance with higher poaching.

9.1 LMMA marine customary in the South Pacific

FIJI

Fiji is known as an archipelagic state comprised of more than 300 islands located in the South Pacific (UNDP, 2009). The largest Islands are Viti Levu, Vanua Levu, Kadavu and Taveuni; with a population of approximately of 911,668. It has a total of 1,293,035 square kilometers of marine area, whereas the Fiji Locally Managed Marine Areas of more than 200 sites cover approximately 11,959 square kilometers (IUCN, 2009). Fiji's marine and coastal ecosystems provide significant physical, economic, social and cultural benefits to its people (UNDP, 2009). Over decades, the Fijian people managed their own marine resources through 'qoliqoli' (traditional fishing ground area); which regulates who and where people legally and culturally can fish (Jupiter & Egli, 2010). There are 385 qoliqoli in the Fiji waters which are generally managed by the chiefs at the village level (Govan et al., 2008 & Hastings et al., 2015). The qoliqoli system creates 'tabu' areas along the coast where they can only be governed by the Chief and village councils in the interest of the local people (Jupiter, 2017). Today, these traditional marine management methods are still exercised throughout the Fiji Islands.

SOLOMON ISLANDS

Solomon Islands have a total marine area of 1,604, 757 square kilometers of which the LMMAs protected areas cover a total of 1,900 square kilometers (Johannes, 2002). Solomon Islands communities have a customary tenure and governance system, where tribes and clans have ownership of the land and sea and communities and are governed by tribal chiefs or community leaders (Foale et al., 2011). It is a common practice to declare a taboo on a clan reef as a mark of respect for the death of a prominent clan member, to protect sacred sites, or to prepare for a feast by allowing for the short-term replenishment of fish (Foale et al., 2011 & Albernethy et al., 2014). Secret sites are automatically protected sites (tabu), and certain areas are protected seasonally for the preservation of sacred species (Vierros et al., 2010).

VANUATU

The Republic of Vanuatu, an archipelago of 84 islands in the South-West Pacific, has a population of over 220,000 people, of which 77% engage in small-scale fisheries (UNDP, 2012). Access to marine resources is typically allowed for subsistence or small-scale commercial needs. Traditional 'tabu' declarations prohibit harvesting within defined community marine access areas, and may last for weeks, years, or indefinitely (Govan, 2009). Some of these 'tabu' periods incorporate short-term harvests dictated by economic, social or cultural processes; they have traditionally declared marine closures most often for resource conservation and sustainable harvesting purposes (Hickey & Johannes, 2002). Reserve implementation, regulation enforcement, size, type, and location are typically governed by the local community (Hickey,

2006). A namele palm leaf tied to a stake is the most commonly employed marker, though large white stones, pig jaws and painted signs are also used (UNDP, 2012).

COOK ISLANDS

The concept of ra'ui, is put in place by a person of high birth rank or chief. The area is reserved and protected for weddings and feasts or when fish stock is depleted (Saywood et al., 2002). Closing an area is done by series of processes; planning and informing the villages about the area, purpose of closure and period of closure (Sauni & Fay-Sauni, 2005). Recently, traditional owners, Island councils, land owners, communities and government have all played roles in establishing and managing protected areas (Vieros et al., 2010). However, ra'ui' (customary marine tenure) is not recognized in their legislation, imposing complications in maintaining ra'ui throughout the Cook Islands (Vieros et al., 2010).

PALAU

Palau is an island located on the western Pacific Ocean; it lies east of Mindanao Philippines, and north of Irian Jaya, Indonesia (Cinner et al., 2007). The Republic of Palau is known as a group of 12 inhabited islands with more than 700 islets stretching 700 km from northeast to southeast. (Donaldson, 1996). For over decades, the people of Palau have had a profound connection with the ocean which extends from reliance on ocean resources for food and livelihood to deeply rooted cultural practices (Cinner et al., 2007). Historically, they managed their marine resources by practicing the 'bul' (fishing moratorium); in which the island chief acted and prohibited fishing activities in certain waters to protect the local waters as well as specific fish and reef species (Morris, 2004). The 'bul' traditional conservation mechanisms include no-take areas, marine reserve areas, and seasonal closures for spawning sites (Govan, 2009). However, the 'bul' traditional conservation tool had been integrated with modern conservation tools; whereas scientific, management and financial approaches are also applied to this customary law of Palau (Morris, 2004).

SAMOA

The independent Samoa is a country comprising the westernmost group of the Samoan Islands in Polynesia. The Islands include Upolu, home of Samoa's population, and Savai'i, one of the largest islands in the South Pacific (Govan, 2009). The total marine area for Samoa is 132,306 square kilometers, where 115 square kilometers are covered as protected areas. Similarly, Samoa has its own marine management, which known to them as 'Sa' - marine closure areas (Idechong & Graham, 1998). The concept of Sa (customary fishing tenure) is generally controlled by the chiefs whereas enforcement of custom-based fishing regulations is carried out by village authorities (Johannes, 2002). Nevertheless, in contrast, Samoa's LMMA implementation was driven by the government (Mascia & Mills, 2018).

MARSHALL ISLANDS

Marshall Islands consist of twenty-nine low lying coral atolls and five Islands. Each atoll has a local government and Mo (tapu/taboo/tambu/kapu) (Vieros et al., 2010). The concept of Mo has to do with human-environment relations, institution and ideology of chief authority, and the existing interpretation of taboo in Oceania. Today, the concept of Mo still employed, however it is very weak and lacking; since the institutions and laws are changing (Aswani et al., 2017).

TUVALU

Tuvalu, in the South Pacific is comprised of nine islands of small, thinly populated atolls and reef islands (Kaly et al., 1999). With a total of 731,900 square kilometers of marine area, there are only 62 square kilometers which are covered as 6 LMMAs in Tuvalu. There are six marine conservation areas belonging to the Island Councils (Community groups) and there are three conservation areas. Tapu (sacred) areas are permanent areas for whom Island councils decide when harvest and fishing take place (Cinner & Aswani, 2007). In earlier years, Tuvalu was colonized by the British Government; however, their customary marine systems are being demolished and becoming more western-centered these days.

10. Recommendations- lesson learned

Failure (less success of LMMA)

-  This research identifies that 'National governance' could not be not working in some LMMAs for various reasons. In national governance, the ideas and plans come from people in seminar rooms and board tables that are universally trained from a western perspective. In this case, we do not have traditional people sitting in those tables and most of the times, the plans and rules are very biased toward the local people.
-  Lack of participation or collaborative work from the local communities can also occur, when local communities are not included in some plans and rules developed.
-  Higher evidence of poaching depicts that there is a lower compliance from the communities.
-  Miscommunication can lead to unsuccessful LMMAs, as some rules and plans might not work and somehow the local communities might not understand and comply to them

Successful LMMA

-  LMMAs are more successful and effective, if local communities are involved in every way from planning, making decisions, implementation, managing and enforcing.
-  One of the most important components of LMMAs is having traditional conservation methods. LMMAs are built on local and traditional strength.
-  Continuing the use of marine tenure as a management unit is very essential, so that the inappropriate use of tools can be avoided.



Having a chiefly or community governance means bringing more people to participate and work together as communities under the guidance of a traditional chief.

Conclusion

To conclude, locally managed marine areas is one of the most effective and successful in managing marine resources. This management includes many variety of traditional marine management as such, periodic closure, spatial closure, gear restrictions and so forth. The research focuses on whether the changing in governance or institutions might impact the conservation goals or outcomes of LMMA. The results of this research show that it is very essential to integrate traditional methods into LMMA design in order to obtain and achieve conservation outcomes. Islands which integrated their LMMA design with traditional methods have increasing fisheries productivity, increased of coral cover determining of coral reef health as well as stable fisheries catch per unit. Furthermore, in terms of governance, LMMAs are more effective when they are driven or governed by chief or community governance. In this case, there is a stronger compliance from local people as they are mostly involve in the process of LMMAs, rather than national governance. Although, national governance can be very effective in LMMA if local people are involved in making decisions, plans and rules. Foremost, Integration of customary management into the modern conservation context can be a way forward for implementing and establishing more effective LMMAs across the South pacific islands.

References

- Aswani, S. (1999). Common property models of sea tenure: a case study from the Roviana and Vonavona Lagoons, New Georgia, Solomon Islands. *Human Ecology*, 27(3), 417-453.
- Aswani, S., & Hamilton, R. (2004). The value of many small v. few large marine protected areas in the Western Solomon Islands. *Traditional marine resource management and knowledge information bulletin*, 16, 3-14.
- Aswani, S., & Hamilton, R. J. (2004). Integrating indigenous ecological knowledge and customary sea tenure with marine and social science for conservation of bumphead parrotfish (*Bolbometopon muricatum*) in the Roviana Lagoon, Solomon Islands. *Environmental conservation*, 31(1), 69-83.
- Aswani, S., Albert, S., & Love, M. (2017). One size does not fit all: critical insights for effective community-based resource management in Melanesia. *Marine Policy*, 81, 381-391
- Aswari et al, 2007
- Baker, N., Beger, M., McClennen, C., Ishoda, A., & Edwards, F. (2011). Reimaanlok: a national framework for conservation area planning in the Marshall Islands. *Journal of Marine Biology*, 2011
- Baker, Nicole, Maria Beger, Caleb McClennen, Albon Ishoda, and Florence Edwards. "Reimaanlok: a national framework for conservation area planning in the Marshall Islands." *Journal of Marine Biology* 2011 (2011).
- Berthold, S. (2016). *The Fiji locally-managed marine area network: structure, strengths and scope for future developments* (Doctoral dissertation).
- Birkeland, C. (2017). Working with, not against, coral-reef fisheries. *Coral Reefs*, 36(1), 1-11.
- Bonaldo, R. M., Pires, M. M., Junior, P. R. G., Hoey, A. S., & Hay, M. E. (2017). Small marine protected areas in Fiji provide refuge for reef fish assemblages, feeding groups, and corals. *PloS one*, 12(1), e0170638.
- Bonito, V., Simpson, R., & Waqairagata, F. *Evaluating the performance of LMMAs in the districts of Korolevu-i-wai, Dawasamu, and Nakorotubu*. NOAA Technical Report NA09NOS4630017. 2014. Available from: http://data.nodc.noaa.gov/coris/library/NOAA/CRCP/other/grants/International_FY09_Products/Final_Report_NA09NOS4630017.pdf.
- Boso, D., Paul, C., Hilly, Z., & Pita, J. (2010). Lessons learned in Community based Adaptive Marine resource management. WorldFish Center, Honiara, Solomon Islands. 2010.
- Brodie, G., Pikacha, P., & Tuiwawa, M. (2013). Biodiversity and Conservation in the Pacific Islands: Why Are We Not Succeeding?. *Conservation Biology: Voices from the Tropics*, 181-187.
- Cinner, J. E. (2007). Designing marine reserves to reflect local socioeconomic conditions: lessons from long-enduring customary management systems. *Coral Reefs*, 26(4), 1035-1045.

- Cinner, J. E., & Aswani, S. (2007). Integrating customary management into marine conservation. *Biological Conservation*, 140(3-4), 201-216.
- Clarke, P., & Jupiter, S. D. (2010). Law, custom and community-based natural resource management in Kubulau District (Fiji). *Environmental Conservation*, 37(1), 98-106.
- Clements, C., Bonito, V., Grober-Dunsmore, R., & Sobey, M. (2012). Effects of small, Fijian community-based marine protected areas on exploited reef fishes. *Marine Ecology Progress Series*, 449, 233-243.
- Cohen, P. J., & Foale, S. J. (2013). Sustaining small-scale fisheries with periodically harvested marine reserves. *Marine Policy*, 37, 278-287.
- Cohen, P. J., & Foale, S. J. (2013). Sustaining small-scale fisheries with periodically harvested marine reserves. *Marine Policy*, 37, 278-287.
- Cohen, P. J., Jupiter, S. D., Weeks, R., Tawake, A., & Govan, H. (2014). Is community-based fisheries management realizing multiple objectives? Examining evidence from the literature. *SPC Traditional Marine Resource Management and Knowledge information Bulletin*, 34, 3-12.
- Delisle, A., Namakin, B., Uriam, T., Campbell, B., & Hanich, Q. (2016). Participatory diagnosis of coastal fisheries for North Tarawa and Butaritari island communities in the Republic of Kiribati.
- Donaldson, T. J. (1996). Fishes of the remote southwest Palau Islands: a zoogeographic perspective.
- Drumm, D. J. (2005). *Habitats and macroinvertebrate fauna of the reef-top of Rarotonga, Cook Islands: implications for fisheries and conservation management* (Doctoral dissertation, University of Otago).
- Foale, S., Cohen, P., Januchowski-Hartley, S., Wenger, A., & Macintyre, M. (2011). Tenure and taboos: origins and implications for fisheries in the Pacific. *Fish and Fisheries*, 12(4), 357-369.
- Govan, H. (2009). Status and potential of locally-managed marine areas in the Pacific Island Region: meeting nature conservation and sustainable livelihood targets through wide-spread implementation of LMMAs.
- Govan, H., Aalbersberg, W., Tawake, A., & Parks, J. (2008). Locally managed marine areas: A guide to supporting community-based adaptive management.
- Govan, H., Aalbersberg, W., Tawake, A., & Parks, J. (2008). Locally managed marine areas: A guide to supporting community-based adaptive management.
- Govan, H., Tawake, A., Tabunakawai, K., Jenkins, A., Lasgorceix, A., Schwarz, A. M., ... & Afzal, D. (2009). Status and Potential of Locally-managed Marine Areas in the South Pacific: Meeting Nature Conservation and Sustainable Livelihood Targets Through Wide-spread Implementation of LMMAs: Study Report.
- Harris, M., & Weisler, M. (2018). Two millennia of mollusc foraging on Ebon Atoll, Marshall Islands: Sustained marine resource use on a Pacific atoll. *Archaeology in Oceania*, 53(1), 41-57.
- Hastings, J. G., Orbach, M. K., Karrer, L. B., & Kaufman, L. (2015). MMAS in Fiji. *Coastal Management*, 43(2), 155-171.
- Hickey, F. R. (2006). Traditional marine resource management in Vanuatu: Acknowledging, supporting and strengthening indigenous management systems. *SPC Traditional Marine Resource Management and Knowledge Information Bulletin*, 20(11), 11-23.

- Hickey, F. R., & Johannes, R. E. (2002). Recent evolution of village-based marine resource management in Vanuatu. *SPC traditional marine resource management and knowledge information bulletin*, 14, 8-21.
- Hoffmann, T. C. (2002). Coral reef health and effects of socio-economic factors in Fiji and Cook Islands. *Marine pollution bulletin*, 44(11), 1281-1293.
- Hoffmann, T. C. (2002). The reimplementation of the Ra'ui: Coral reef management in Rarotonga, Cook Islands. *Coastal Management*, 30(4), 401-418.
- Hviding, E., & Baines, G. B. (1994). Community-based fisheries management, tradition and the challenges of development in Marovo, Solomon Islands. *Development and Change*, 25(1), 13-39.
- Idechong, N. T., & Graham, T. (1998). The Ngerukewid Islands of Palau: 40 years of managing a marine protected area. *Parks*, 8(2), 17-22.
- Islands 2007-2012*. Published by: N. Baker: Melbourne
- IUCN, (2008). Protected Areas definition. Retrieved from <https://www.iucn.org/theme/protected-areas/about>
- IUCN. (2009). Navakavu Locally Managed Marine Area, Viti Levu Island, Fiji. Retrieved from https://www.iucn.org/downloads/marine_protected_areas_navakavu.pdf
- Johannes, R. E. (1991). *Some suggested management initiatives in Palau's nearshore fisheries, and the relevance of traditional management*. South Pacific Commission.
- Johannes, R. E. (2002). The renaissance of community-based marine resource management in Oceania. *Annual Review of Ecology and Systematics*, 33(1), 317-340.
- Jupiter, S. (2017). Culture, kastom and conservation in Melanesia: what happens when worldviews collide?. *Pacific Conservation Biology*, 23(2), 139-145.
- Jupiter, S. D., & Egli, D. P. (2011). Ecosystem-based management in Fiji: successes and challenges after five years of implementation. *Journal of Marine Biology*, 2011
- Jupiter, S. D., Cohen, P. J., Weeks, R., Tawake, A., & Govan, H. (2014). Locally-managed marine areas: multiple objectives and diverse strategies. *Pacific Conservation Biology*, 20(2), 165-179.
- Kaly, U. L., Alefaio, T. M., Ludescher, C. M., Talakatoa, K., & Alefaio, S. (1999). Second Marine Survey of Funafuti Conservation Area, Tuvalu. *South Pacific Regional Environment Program/Funafuti Town Council*.
- Le Cornu, E., Doerr, A. N., Finkbeiner, E. M., Gourlie, D., & Crowder, L. B. (2017). Spatial management in small-scale fisheries: A potential approach for climate change adaptation in Pacific Islands. *Marine Policy*.
- Liston, J., Clark, G., & Alexander, D. (2013). Pacific Island Heritage: Archaeology, Identity & Community (Terra Australis 35).
- Lovell, E., Sykes, H., Deiye, M. A. R. G. O., Wantiez, L., Garrigue, C., Virly, S., ... & Sabetian, A. R. M. A. G. A. N. (2004). Status of Coral Reefs in the South West Pacific: Fiji, Nauru, New Caledonia, Samoa, Solomon Islands, Tuvalu and Vanuatu. *Status of coral reefs of the world*, 2, 337-362

Mascia, M. B., & Mills, M. (2018). When conservation goes viral: The diffusion of innovative biodiversity conservation policies and practices. *Conservation Letters*, e12442.

McClanahan, T. R., & Cinner, J. E. (2008). A framework for adaptive gear and ecosystem-based management in the artisanal coral reef fishery of Papua New Guinea. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 18(5), 493-507.

Navakau LMMA, 2009

Orbach, M. K., & Karrer, L. B. (2010). *Marine managed areas: what, why, and where*. Conservation International, Science and Knowledge Division.

Pascal, N. (2011). Cost-Benefit analysis of community-based marine protected areas: 5 case studies in Vanuatu. *CRISP, SOC, New Caledonia*, available online at: http://cmsdata.iucn.org/downloads/nicolas_pascal_2011_cba_mma_spc.Pdf

Polunin, N. V. (1984). Do traditional marine "reserves" conserve? A view of Indonesian and New Guinean evidence. *Senri Ethnological Studies*, 17, 267-283.

Ridep Morris, A. (2004). Traditional management of marine resources in Palau. *International Marine Project Activities Centre Limited (IMPAC) Traditional Law and the Environment, for Countries and States of the Melanesian Spearhead Group, IMPAC (supported by the World Bank, The CEC Reef Research Centre, Australian Government, Christenson Fund)*.

Sauni, S., & Fay-Sauni, L. (2005). Vulnerability and dependence: The nearshore fisheries of Tuvalu. *Pacific Voices: Equity and Sustainability in Pacific Island Fisheries*. University of the South Pacific, Suva, Fiji, 11-26.

Saywood, A., Turua, T., & Makikiriti, N. (2002). 3rd monitoring survey of the Rarotonga Ra'ui. *Ministry of Marine Resources, Government of the Cook Islands, Rarotonga*

Secretariat of Pacific Communities. (2010). <http://www.spc.int/>

Tawake, A., Parks, J., Radikedike, P., Aalbersberg, B., Vuki, V., & Salafsky, N. (2001). Harvesting clams and data involving local communities in monitoring can lead to conservation success in all sorts of unanticipated ways: a case in Fiji. *Conservation in Practice*, 2(4), 32-35.

Thorburn, C. (2001). The house that poison built: customary marine property rights and the live food fish trade in the Kei Islands, Southeast Maluku. *Development and Change*, 32(1), 151-180.

Tiraa, A. (2006). Ra'ui in the Cook Islands- today's context in Rarotonga. *Traditional marine resource management and knowledge information bulletin*, (19), 11-15.

United Nations Development Programme. 2012. Fiji Locally-Managed Marine Area Network, Fiji. Equator Initiative Case Study Series. New York, NY

Vierros, M., Tawake, A., Hickey, F., Tiraa, A., & Noa, R. (2010). Traditional marine management areas of the Pacific in the context of national and international law and policy. *United Nations University, Traditional Knowledge Initiative, Darwin, Australia*