

Indonesia Marine Fellows Program - MFP IDENTIFICATION AND DEVELOPMENT STRATEGY OF ALTERNATIVE LIVELIHOODS IN THE CANDIDATE MARINE PROTECTED AREA IN DEPAPRE BAY, JAYAPURA REGENCY, PAPUA

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Indonesia Marine Fellows Program - MFP Applied Economic Research on Fisheries Management and Marine Conservation

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PREFACE

All the praises and thanks to God almighty, with his blessings and favors, the report "IDENTIFICATION AND DEVELOPMENT STRATEGY OF ALTERNATIVE LIVELIHOODS IN THE CANDIDATE MARINE PROTECTED AREA IN DEPAPRE BAY, JAYAPURA REGENCY, PAPUA", has been completed despite a number of operational as well as non-technical problems encountered during the process, causing a delay in the completion. Depapre bay is a relatively challenging location for marine research, due to its remote location in Jayapura Regency, however, it has its own 'charm', because, in addition to the unspoiled natural characters, it also possesses a unique social economy character. This research can be considered *avant-garde* because research in this area is still very thin on the ground, therefore, we would like to break the ground with the hope that research on Papua marine life will flourish in the future and will be able to attract more interest among the scholars of Indonesia.

We would like to convey our deepest gratitude to the following parties for their contribution to this report:

- 1. Dr. Luky Adrianto, as the Dean of the Faculty of Fishery and Marine Science IPB (Bogor Agricultural Institute), who has initiated research grant to attract more research on conservation economy through *"Marine Fellowship Program"* scheme, especially among Indonesia's young researchers
- 2. Dr. Mubariq Ahmad, Director of CSF Indonesia, along with the entire staff of CSF, who have provided "Marine Fellowship Program" research funding, complete with facilitation and assistance. This funding has significant value for us because it has allowed us to initiate research that further explore the long-forgotten region of Papua
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- 4. Fellow colleagues from *Marine Fellowship Program*" as the recipient of this Conservation Strategy Fund (CSF) research fund.

We sincerely apologize if there are still many shortcomings in this report due to our limited capacity. We would welcome any input, recommendations, and critics for future improvement.

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RESEARCH TEAM

CHAPTER 1. INTRODUCTION

1.1. Background

Depapre Bay has considerable potential in marine and fisheries resources, it widely varies, and in fact, it still relatively pristine. With the main ecosystems of 1). mangrove ecosystem in Tablanusu, Waiya, and Bukisi hamlets, which consist of several types of mangroves, such as *Rhizophora apiculata, Sonneratia alba,* and *Nypa fruticans.* 2) Seagrass bed ecosystem of *Cymodocea rotundata, Thallasia hemprichii, Enhalus acoroides* and *Halodule univervis*, can still be found scattered along the Depapre Bay; 3). Coral reef ecosystem, with the type of reef fringing which is dominated by Acropora coral and various types of reef fish (Annual Report of the Maritime Affairs and Fisheries Office of Jayapura Regency, 2015). According to the Jayapura Maritime Affairs and Fisheries Office Report (2014), around 180 species, 79 genera, and 30 reef fish families were found. The average density of reef fish is around 3.39 fish/m2, and the relative abundance of about 33,867 fish/ha. In addition, several marine mammals were also found, including various types of whales, dolphins, and dugongs. Reptiles, including the protected species of *Eretmochelys imbricata, Chelonia mydas,* and *Dermochelys coriacea,* with the nesting area around Cape Tanah Merah (Maritime Affairs and Fisheries Office, Jayapura Regency, 2015).

Depapre Bay, which is located in the 16th Marine Ecoregion (based on the Marine Protected Area network) and or WPP RI 717 (Fisheries Management Area or *Wilayah Pengelolaan Perikanan*), in 2015 has been proposed as a candidate for Marine Protected Areas by the Jayapura District Government. Depapre Bay Area, which is also known as Tanah Merah area, has also been designated as a strategic area to support development in the Papua Province by the Presidential Regulation 65/2011 concerning the Acceleration of Development of the Provinces of Papua and West Papua. Examples of the supporting infrastructure are the passenger port and container port, which construction was started in 2015. The establishment of the strategic area has generated growth in the area. However, the situation has not only affected local communities, but it has also created pressure on the existing resources. The influx of migrants may lead to excessive use of resources, which has the potential to create conflict over the resource, and even lead to the erosion of the local values and weakened the awareness for resource conservation.

Local communities in Depapre Bay have relatively low income that is generated from the minimum use of technology. As Depapre Bay become more open to the outside world, the local communities will be even more marginalized due to their limited technological mastery and their lack of skills in processing the resources they have harvested, this can even push them to use destructive means to harvest/extract the resources. The establishment of the area as the marine protected area is not immediately accepted and carried out properly by the local communities due to the presence of many different interests. The condition can lead to conflict and unhealthy competition in utilizing the resources, which will eventually intensify the damage to the resources. Therefore, it is necessary to create new employment opportunities through the identification of alternative livelihoods to empower local communities. The identification must also take into consideration the sustainability aspect of resources. Once the alternatives are provided, the objective of the establishment of the marine protected area can be achieved, namely to preserve biodiversity by ensuring sustainable provision of environmental service and extraction of natural resources, as well as to improve the well-being of the communities, especially the local communities as the main beneficiaries of the resources.

1.2 Main Problems

In general, the condition of coral reefs in Depapre Bay falls under the category of moderate-very good, with only around 40-78% (Maritime Affairs and Fisheries Office Jayapura Regency, 2015; Paulangan & Munua, 2017). Paulangan & Munua (2017) found that low coral coverage is mostly caused by destructive fishing activities, namely the use of explosives (bombs) and potassium cyanide poison. There are many underlying reasons for destructive fishing practices, such as the limited local-resource-based alternative livelihoods that can be developed by local communities. This research is expected to identify acceptable alternative livelihoods that can be developed by the

local communities to improve their welfare. Thus, shifting the focus of the local communities from fishing activities, especially from destructive fishing methods, and preserve the sustainability of the existing resources.

1.3 Research Objectives

The general objectives of this research are:

- 1) To identify potential natural resources, especially coastal and marine resources;
- To assess the vulnerability of livelihoods and the level of social resilience of communities in Depapre Bay;
- To identify alternative livelihoods that can improve the socio-economic welfare of the local communities, and at the same time can reduce the vulnerability of the conservation areas and the local communities;
- To formulate strategies to ensure the implementation of livelihood programs for the local communities living in the conservation areas and its surrounding, the programs would support the sustainability of the conservation as well as marine resources in Depapre Bay;
- 5) To calculate the economic value of the area as well as the management fee
- 6) Value = the economic cost spent to maintain the system.

1.4 Benefits of the Research

The research aims to serve the following functions:

- 1) Boost sustainable local economic development and create additional employment;
- 2) Utilize local resource in a sustainable manner;
- 3) Create opportunities to meet market demand and supply; and
- 4) Develop new business opportunities that are environmentally friendly by taking into consideration the sustainability of the resources.

1.5 The Expected Results and Dissemination

The development of natural resource-based economic activities for the local communities of Depapre Bay, as well as communities in the coastal areas in Papua in general still rely heavily on the fishery, meanwhile, the cultivation and processing of the fishery products are still very limited. On the other hand, the immigrants generally have better technology mastery in various fields. As a result, there is a wide economic gap between the local community and the immigrant. Therefore, support for local community empowerment, as regulated by Law 21/2001 regarding Special Autonomy for Papua Province, through local community empowerment is highly needed. Results of this study will serve as a recommendation for local community empowerment in Papua, especially in the research locations:

- 1) Availability of livelihoods for the local community;
- 2) Improvement of local community welfare;
- 3) Quality improvement of the local ecosystem and natural resources;
- 4) Promotion of human development to support the local community.

In order to effectively improve the management of the marine protected area through local community empowerment, this report will be presented to stakeholders and policymakers and agencies, especially local governments and ministries responsible for marine conservation, it will also be published in various academic journals. Furthermore, the results of this study will also be presented at scientific meetings and shared with stakeholders in the research area

CHAPTER 2. RESEARCH METHOD

2.1 Time and Location of the Research

In overall, the research took 12 months to be completed. The fieldwork for primary data collection was carried out 2 times for 1 week (6 days), in October 2017 and November 2017. The research was carried out in the Depapre Bay area, namely in Waiya Hamlet, Kendate Hamlet, Tablanusu Hamlet and Tablasupa Hamlet in Depapre District Jayapura Regency (Figure 1). These hamlets (villages) were selected because they had been inhabited for long and represented the existence of tribes in Depapre Bay with relation to traditional communal land rights (Hak Ulayat), and would likely be affected by the establishment of the area as a protected area as well as strategic area for port development.



Figure 1. Research Location

2.2 Data Collection Method

2.2.1 Data Collection

The study uses 3 approaches: literature study, observation, and survey with Participatory Rural Appraisal (PRA). Literature study is needed to collect preliminary data for reference, while the Survey is used to obtain facts from the existing indicators and to find information on institutions, socio-cultural, economic and political (Nazir, 1998). The purpose of using Participatory Rural Appraisal (PRA) is to develop the ability of the community to analyze their own situation as well as to formulate an action plan and implement it. The PRA approach used Focus Group Discussion (FGD) to explore and analyze problems, needs and opportunities, mindset and public awareness regarding the pattern of natural resources utilization, willingness and ability of the community to monitor an activity, and their willingness to take part in as well as their role in the management institutions of the conservation area in Depapre Bay.

2.2.2 Data Source

The data consist of primary and secondary data, with qualitative and quantitative analyses.

2.3. Data Analysis

The methods of analysis are:

- Descriptive Analysis. This analysis is used to describe regional potential and diversities, including the following aspects: environmental quality and status of the conservation area, potential coastal resources, economic conditions of the community and the community's social institutional profile. The team conducted the qualitative and descriptive analysis. The analysis was expected to produce an overview of regional profile and potential, strategic issues in coastal and marine management in the region and economic development in the surrounding area of Depapre Bay.
- Coastal Livelihood System analysis (CLSA). CLSA is an approach and a method to identify and explore feasible livelihoods for coastal communities in the research area (Adrianto, 2005), within the framework of coastal and marine resources management where the aspects of natural systems (ecosystems) and human systems are inseparable.

The CLSA concept is illustrated in Figure 2:



Figure 2. Coastal Livelihood System Analysis scheme (Adopted from Adrianto, 2005)

Rating Scale Analysis. Rating Scale analysis developed based on four technical variables that considered as
 "constraints", namely: public/community interest, availability of raw materials from local natural resources,
 availability of labor, and market opportunities. This variable valuation was done with Rating Scale system
 (Brown and Terry, 1990), by giving a score for each variable. The rating scale was obtained from the total
 score of the assessment component multiplied by its weight. The component and weight of each component
 are the availability of raw materials (40%), community interest (20%), availability of labor (10%), mastery of
 technology (10%) and market availability (20%). Score 4 means 'very good' category, score 3 is 'good', score
 2 is 'fair', and score 1 is 'poor'. The ranking for each type of alternative business was determined by the total
 score and average score (Table 1). Priority alternative livelihoods were selected based on the Total Score
 obtained from the sum of the multiplication scores for each component and its weight.

The range of Total Score	Criteria	Categories	Priorities
>326	Highly potential	Very Good	1
251-325	Potential	Good	2
176-250	Less Potential	Fair	3
100-175	No Potential	Poor	4

Table 1. Prioritization of the Alternative Livelihoods by Total Score

• Business Feasibility Analysis to calculate the economic aspects that can be obtained from each proposed alternative livelihood activity. The analysis was conducted by using *Benefit Cost of Ratio* (BCR), *Return on Investment* (ROI) dan *Payback Period of Capital* (PP):

a. Benefit Cost of Ratio (B/C Ratio or BCR). B/C ratio is the ratio of revenue to total cost: $B/C = \frac{Revenue}{Total Cost}$

The criteria: B/C> 1 (Business is feasible); B/C <1 (Business is not feasible); B/C = 0 (Break Event Point).

b. *Return of Investment* (ROI): ROI I the efficiency in using the investment:

 $\mathsf{ROI} = \frac{Profit}{Investment} x100\%$

Criteria: the bigger the ROI, the more efficient the investment is used, or in another word, one production process can return the ROI investment.

c. Payback Period of Capital (PP): PP shows a profit of investment:

 $\mathsf{PP} = \frac{Investment}{Profit} x1 \text{ year}$

Criteria: The smaller the PP the better, because it means a faster rate of the return of investment in one year.

- Livelihood Vulnerability Analysis This analysis is used to identify what are the variables that strongly influence the livelihood vulnerability level of Depapre Bay community. This livelihood vulnerability analysis was done by constructing Coastal Community Livelihood Vulnerability Matrix, by looking into:
 - Exposure the nature and extent of how the community system is influenced by the occurring changes;
 - Sensitivity the degree to which a community system is negatively affected by changes and shock; and
 - Adaptive capacity the community's capacity to accept changes and anticipate the changes by developing preparing adaptation or mitigation strategies.

To identify the livelihood vulnerability level of the people in Depapre Bay, especially those living at Depapre Bay District, a matrix of Coastal Area Livelihood Vulnerability Indexes was constructed, by adapting the works of Wongbusarakum et al (2011), Duy Can et al (2013) and FAO (2013) and Keshavarz et al (2017). The modified Coastal Community Livelihood Vulnerability Indexes are shown in the following table

	Vulnerability Indicators	Variables of Vulnerability Indicator			
	a.1. Asset Ownership	Percentage of a productive asset to total area (utilization zone)			
		Status and the extent of ownership for the land and means of production			
spect	·	Whether there's a sharing arrangement for the land and means of production (whether the land is common property)			
nomic A	a.2. Means of Production	Availability/sufficiency of the means of production per activity			
		Ownership of the means of production (quantity, price, etc.)			
ЦСС		The number of productions per production period			
Ä	a.3. Production Cost	Source of capital/production cost (whether it is independent or depends on another party)			
		Incentive/subsidy received from the government every year			
		The existence of financing source for production from another			

Table 2. Coastal Communit	v Livelihood Vulner	ability Indexes

	Vulnerability Indicators	Variables of Vulnerability Indicator		
		party/institution		
		Type of the main occupation as a source of income		
		Member of the household have part-time work		
	a.4 Income	An alternative activity that can serve as a source of income when there is disruption to the main livelihood		
		Household per capita income >= RMW		
		The ratio of income : spending		
		Another member of the household who works/held occupation		
	a.5. Market	Availability of reliable market for products		
		Product Price		
		Capacity to save money from every production time/ every time		
	a.o. Savings	An alternative source of funding in time of emergency		
		The condition of the house		
		Level of education		
	b.1 Fulfillment of basic	Capacity building program received by the household		
	liecus	Capacity with regards to generating household income		
ect		Conflict on production asset/land use		
Asp	b.2. Social Network	The presence of loan and savings program among community members		
Social		Availability of social safety net (Villagers collective fund or Village fund, etc.)		
ġ		Solidarity/cooperation to work together in solving problems		
ect		Establishment of a group based on similar profession (e.g. Fishermen Group)		
Aspe		Members of community/household join a social organization		
nal	c.1. Community	Local leadership		
tutio	institutional structure	Availability of financial institution (bank or non-bank)		
Insti		Facilitator agency from the government or non-government		
Ċ		Availability of technical training and facilitation institution		
		Well-structured marketing institution to sell community products		
		The number of potential resources		
		Area/land/marine area that can produce all the time (seasonal)		
	d.1. Land Resource	Land productivity per land area		
		Area/land/marine area with the assurance that it can be used		
		Alteration of land use for other use, e.g. conservation, special economic area		
pect		The plan to change production land, by the community		
ıl As	d.2. Food/Consumption	Availability of food at all time		
/sice		Availability of main staple food all year long		
/Ph/		Incident of staple supply scarcity		
Ecology		Availability of local food products as alternatives for the main staple food (rice, meat etc.)		
Ū.		Average consumption (amount of food/day) or per capita (rice, fish, meat,		

	Vulnerability Indicators	Variables of Vulnerability Indicator		
		etc.)		
		Household food consumption that meets the government standard dietary (4 sehat lima sempurna)		
		Easy access to clean water		
		Availability of accessible health facilities		
		Life expectancy rate		
	d.3. Health	Mortality rate per 100,000 births		
		Diseases that regularly appear, repetitive, or chronic and epidemic		
		The number of permanent houses with good sanitation		
		Household with the standard sanitary facility (MCK)		
	d.4. Disaster Risk	Incidents of harvest failure/the fish caught do not meet the target		
		Types of disturbance/disaster that pose as a threat to the community		
		Number of days without a natural disaster		
		Availability of work safety instruments in water or on land		
		The community has ways/techniques for mitigation of disaster		
		Emergency plan/evacuation plan		

Source: Adapted from Wongbusarakum et al (2011), Duy Can et al (2013) and FAO (2013) and Keshavarz et al (2017).

The indicators of Coastal Area Livelihood Vulnerability include 4 (four) aspects, namely economic (6 variables), social (2 variables), institutional (1 variable), and ecology/Physical (4 variables), in total, there are 59 measurable indicators.

Each indicator is assessed with the guidance of a questionnaire, arranged in a matrix, and tabulated based on the conditions/answers of each respondent. The value of each indicator is given a score of 0-5, with 0 is the most vulnerable (the lowest) and 5 is the most resilient (the strongest). The final value of the vulnerability would then categorized into 3 categories:

(a) 0-1,66	= very vulnerable;
------------	--------------------

(b) 0,67-3,33 = vulnerable; and

(c) > 3,34 = Invulnerable.

• Social Resilience Analysis. This analysis calculates the capacity of the community to overcome shock and stress/pressure. It is done by examining how much "shock/pressure" happens to the community, the result would indicate the level of resilience of the community, and allow the researcher to estimate the capacity of the community to survive, and what intervention is needed to maintain or to achieve the ideal level of resilience

In order to identify the social resilience status of the community in Depapre Bay, especially those who live in Depapre Bay District, which is the area surrounding the candidate marine protected area (MPA networks), a *coastal community resiliency* matrix is developed, the matrix is adapted from Abesamis *et al* (2006), with four (4) social resilience components: Leadership and adaptability, diversities and re-organization, the community's learning and knowledge system, and the community's self-organization capacity, each component consist of the following indicators:

No	Resilience Components	No	Indicators	
I	I Adaptability & leadership			
			Strong leadership	
		2	Layered/Tiered Leadership	
I.A		3	Collegial Leadership	
		4	Leadership that support environmental preservation	
	Local leadership and vision	5	Leadership on Conservation Area networks	
1.B	Demographic Change	1	Positive demographic dynamics	
		1	Livelihood diversities	
		2	Community income	
		3	Dependency on natural resources	
		4	Traditional mechanism for marine resources (Sumber Daya Alam Laut/SDAL) utilization	
		5	The history and utilization pattern of natural resources (Sumber Daya Alam/SDA)	
	Diversities ⁹ re organization	6	The main market for marine products	
11	Diversities & re-organization	7	A multi-level network of the conservation area	
		8	Level of connectivity among stakeholders	
		9	Stakeholder's trust in the existing leadership	
		10	Perception on disturbance due to corruption	
			The relationships in the community/among members of the	
		11	community	
		12	ne connection between a local community member and	
		12		
Ш	Local Learning and Knowledge Svs	stem		
		1	Local management system (limited)	
			Local system to complement Conservation Area management	
3.1		2	model	
5.1		3	Local social convention for marine resource conversion	
		4	Customary land allocated for conservation area	
		5	Community land allocated for conservation area	
2.0	Transformational learning	1	Level of awareness on the importance of the conservation	
3.Z		2	Willingness to release the land for conservation land	
		2		
			The group that support the management of the conservation	
	Participatory planning	1	area	
		2	Community representation	
3.3		3	Instruments of cooperation among groups	
		4	Activities to promote conservation area	
			Stakeholders involvement in the conservation area	
	6	Connectivity among stakeholders		

Table 3. Coastal Community Resilience Indexes

No	Resilience Components	No	Indicators
			Stakeholders' trust in the leaders with regards to marine
		7	resource management
		8	Closeness/relationship among members of the community
IV	Self Organization		
		1	Type of decision-making process of the marine resource management
4.1	Management and accountability	2	Management of the KKPD
		3	Multiparty partnership
		4	Local organization involvement
		5	Local accountability mechanism
		6	Minority rights/acknowledgment of customary groups
		7	Sustainability mechanism of natural resource management
		1	The main source of conflict
4.2	Conflict resolution mechanism	2	Conflict resolution mechanism
		3	Conflict resolution institution
		1	Opportunity for capacity improvement
4.3	Capacity improvement	2	Type of training provided
		3	Sufficiency of resource to manage the conservation area
		1	The presence of monitoring group/institution
		2	Area of monitoring
		2	Law enforcement institution
		3	Law enforcement system
		4	Types of law enforcement system
		5	Specific rules in the conservation area
		6	The complexity of regulations/procedures of the conservation area
4.4	Monitoring/feedback	7	Acceptance of rules by the stakeholders
		8	Socialization of regulations and procedures to stakeholders
		9	Clarity of boundaries of the conservation area
		10	KKPD is recognized by the academic community
		11	Knowledge about KKPD from stakeholders
		12	Involvement of data collection of the conservation area
			Availability of assembly forum, information, and networking
		13	about the conservation area
		14	Data management of the conservation area

Source: Adapted from Abisamis et al (2006)

Each component and indicator is assessed with the guidance of a questionnaire and tabulated for analysis. The value of each indicator is given a score 0-10, with the score of 0 means the real condition of the indicator does not exist, for Score 1, the quantity and quality is there but at minimum, and so on up to Score 10, which means the quantity is highly sufficient or the quality is exceptional. The final value of the resilience level would be then categorized into 3 categories:

- (a) > 6,67-10 = *Resilient* / Strong;
- (b) 3,34-6,66 = Moderate Resilient (Moderate); and
- (c) 0-3,33 = Not Resilient (Weak).

Lastly, to complete the process, the status of social resilience is followed up with institutional economic analysis of the scenario of intervention adaptation by calculating transaction costs. Transaction cost referred to costs to carry out activities to ensure that the system keeps running (Williamson, 2005 in Menard et al 2005) or to increase resilience until the ideal level or *Tiaitiki* institution remain operational.

Components Cost that needs to be taken into consideration for this analysis are:

- a. Strong leadership cost, consist of the cost to run customary rituals/ceremonies to strengthen the local customary system
- b. The cost of missing income when a member of the community leave their work to attend customary activities
- c. Meeting/Assembly cost
- d. Transportation cost
- e. Training/technical facilitation cost
- f. Data and information cost
- g. Other social costs.

Total cost, by taking into consideration discount rate, become the applicable transaction costs.

Institutional Economic Analysis on The Area Management Strategy

Management Cost of the Marine Protected Area

The institutional economic transaction cost of the Marine Protected Area defined as all the costs spent to ensure that the marine protected area could provide optimum benefit for the beneficiaries (government, private sectors, and community) in Jayapura District in a sustainable way. In simple calculation:

$$TTC = \sum_{i=1}^{n} C_i$$

With *TTC* as total institutional economic transaction cost of the MPA's. C_i as *i*- cost component that describes transaction costs of the MPA, such as the establishment and implementation process of the MPA management. The establishment cost of the MPA covers various costs for (i) provisioning, (ii) determining, and (iii) formulating the zoning plan, management plan, and technical management plan of the MPA. Implementation cost the MPA covers (i) establishment of institutions that will manage the MPA (Regional Service Agency/BLUD), (ii) operational costs of the BLUD (HR costs, program, and infrastructure costs), (iii) monitoring costs, and (iv) evaluation costs.

The benefit of MPA Management

In addition to the institutional economic transaction cost of the MPA, we also calculate the economic value of service of the MPA, that includes all economic value of ecosystem service in the MPA. With four ecosystems in the MPA, the calculation of the total economic value of the ecosystem service of Jayapura's MPA is as follow:

$$TEVoMPA = \sum_{i=1}^{n} \sum_{j=1}^{m} Eco_{ij}$$

TEVoMPA refers to the total economic value of the MPA, *Eco_i* is the *i*- ecosystem component, namely (1) mangrove, (2) Seagrass, (3) coral, and (4) water. *Eco_j* refers to *j*- ecosystem service component, namely (1) provision service, (2) regulating service, (3) cultural service, and (4) habitat supporting service.

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According to Biology-Online Dictionary, quoted in Wahyudin *et al* (2016), ecosystem is a system that includes all living organisms (biotic factors) in an area as well as its physical environment (abiotic factors) functioning together as a unit. There has been an extensive and ever-evolving definition of Ecosystem Service, to describe direct and indirect ways an ecosystem can benefit the community, to meet their needs and wellbeing (Wahyudin *et al*, 2016). The following table listed some of the definitions used by prominent researchers and institutions.

No	Definition	Reference
1	The benefits people obtain from the ecosystem, these include provisioning services regulating services, cultural services, and supporting services.	United Nations Environment Programme (1993)
2	The services of ecological systems and the natural capital stocks that produce goods and services that are critical to the functioning of Earth's life support system.	Costanza et al (1997); de Groot et all (2000)
3	Crucial benefits generated from the ecosystem, that can support people's lives and livelihoods. These services classified into (i) provisioning services, (ii) regulating services, (iii) cultural services, also (iv) supporting services.	Dictionary (1995) Wikimedia Foundation (2001) The Free Dictionary by Farlex (2003); <i>Greenfacts</i> (Selliers, 2001)
4	The benefits that humankind obtains from an ecosystem.	Earth Economics (Batker, 2003)
5	Ecosystem services are the benefits people obtain from ecosystems. These include (i) provisioning services (ii) regulating services (iii) cultural services, and (iv) supporting Services.	Millenium Ecosystem Assessment (2003)
6	Various categories of ecosystem services that benefit humankind, and often grouped into 4 (four) ecosystem services, namely: (i) provisioning/production services, (ii) regulating services, (iii) supporting services, and (iv) cultural services.	The Economic of Ecosystem and Biodiversity (TEEB) (UNEP, 2008)

Table 4. Definitions on Ecosystem Service

Source: Wahyudin et al. (2016)

Table 5. Category of Service and Type of Product for Ecosystem Service

No	Category of Service	Product	Available for Coastal and Marine Ecosystem
1	Provisioning	Food	Yes
	Service	Material	Yes
		Fuel	Yes
		Genetic Resource	Yes
		Biochemicals Resource	Yes
		Ornamental Resource	Yes
		Fresh Water	No
2	Regulating	Management of Air Quality	Yes
	Service	Management of Climate	Yes
		Management of Water	Yes
		Management of Erosion	Yes
		Water Purifying and Waste Management	Yes
		Disease Control	Yes
		Pest Regulation	Yes
		Crop Pollination	Yes

No	Category of Service	Product	Available for Coastal and Marine Ecosystem
		Regulation on Natural Hazard	Yes
3	Cultural/	Cultural Diversities	Yes
	Information	Religious and Spiritual Values	Yes
	Service	Knowledge System (traditional and formal)	Yes
		Education Values	Yes
		Inspirations	Yes
		Aesthetics Values	Yes
		Social Relations	Yes
		Sense of Place	Yes
		Cultural Heritage Values	Yes
		Recreation and Ecotourism	Yes
4	Habitat	Land Formation	Yes
	/Support	Photosynthesis	Yes
	Service	Primary Productions	Yes
	Γ	Land Nutrient Cycle	Yes
		Water Cycle	Yes

Source: Wahyudin (2017)

For this study, all management and ecosystem services costs are obtained by using Project Based Cost Approach (PBCA) and Benefit Transfer Method (BTM). The values of PBCA and BTM are estimated by calculating areas and ecological diversities that can be represented by the proximity of the regions in eastern Indonesia, such as Wakatobi and Raja Ampat. In addition, to provide a correction factor for PBCA and BTM values due to the value of money against time and current economic factors, a comparison between Consumer Price Index (CPI) in combination with People's Purchasing Power of Jayapura towards the value of People's Purchasing Power at the study location. The equation for determining the value is as follow:

$$V_{i} = V_{j} \left(\frac{IHK_{jk}}{IHK_{jl}} \right) \left(\frac{IDB_{i}}{IDB_{j}} \right)$$

with *Vi* as the value sought in the region *-i*, *Vj* as the value referred in the *j* region, *IHKjk* is the value of Consumer Price Index in *j* region in year *k*, *IHKjl* is the value of Consumer Price Index in *-j* region in year *l*, *IDBi* is the value of Purchasing Power Index in region *-i*, *IDBj* is the value of Purchasing Power index in *-j* region.

Payment for Ecosystem Services

PES (*payments for ecosystem services*) is mean to collect the fund/endowment to support the sustainable management of the MPA. Wahyudin (2017) theorized that the amount of the basic levy for PES can adopt the Use Value on Cultural Services approach with the following equation:

$$BPES = \frac{CSV}{CC}$$

With BPES as the basic levy per person, *CSV* as the Cultural Services value of the protected area, and *CC* as a maximum number of users that can utilize the area in accordance to the carrying capacity and environmental capacity of the area.

 Analysis of Management and Adaptation Strategies. This analysis is an adaptive strategy to address the problems of livelihood, social vulnerability, and social resilience, by employing an institutional economic

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approach. This strategy will be further promoted as an intervention program to equally increase environmental conservation and at the same time improve the welfare of the people of Depapre Bay. Gap analysis of problems, vulnerabilities, and resilience is used to formulate the Adaptation Strategy.

CHAPTER 3. GENERAL PROFILE

3.1 Geographic, Administration, and Geomorphologic Profiles

Depapre District covers the area of 404.3 km2 (2.31% of Jayapura Regency) and is in the Development Area II (Wilayah Pembangunan II). It is bordered by the Pacific Ocean to the north, Ravenirara District to the east, West Sentani District to the south, and the Pacific Ocean and Yokari District on the west. Geographically, the population in the Depapre District area mostly occupies the coastline bordering the Pacific Ocean. Administratively Depapre District consists of 8 villages, namely Waiya Village (District Capital), Entiyebo (Tablanusu), Kendate, Tablasupa, Yepase, Wambena, Yewena and Doromena (Jayapura in Figures, 2016)

Depapre District is an area of topographic contrast, which is shown by the slope conditions ranging from 1 km² of flat area, 28.41 km² of gentle steep area, 45.28 km² of steep area, and 16.99 km² of very steep area. In term of altitude, 41.75 km² of the area is located at the altitude of lower than 100 m above sea level (MASL), 26.64 km² at 100-500 MASL, 34.40 km² at 500-1000 MASL, and 5.30 km² at the altitude higher than 1000 MASL (Mining and Energy Office of Jayapura Regency, 2009). In term of physiography, the waters of Depapre Bay (Depapre District) are open to the influence of wind, especially the Northwest wind to North which causes high ocean waves and impacts on geomorphological processes along the coast (Jayapura Regency Maritime Affairs and Fisheries Office, 2014).

3.1.1 Waiya Village

Waiya Village is the Capital of Depapre District, it lies in 140°22'4.4" E. longitude and 2°27'48.3" S. latitude, at the altitude of 22 MASL with an elevation around 10-20° of gentle slope. The morphology of Kampung Waiya is mountainous with mafic and ultramafic igneous rocks with strong structures. The land use is mainly for settlements, markets, schools, offices, fields, forests and ports (Jayapura Regency Mining and Energy Office, 2009).

3.1.2 Entiyebo (Tablanusu) Village

Entiyebo or Tablanusu Village lies in 140°22'48,7" Longitude and 2°27'46" S. Latitude, at the altitude above 12 MASL, with the elevation of 5-20° with the slope condition of moderate slope. The morphology of Entiyebo Village is mostly flat to mountainous with pyroclastic stones and limestones. Land use in Entiyebo Village is mostly for settlements, fields, forests, coastal tourism and port (Jayapura Regency Mining and Energy Office, 2009).

3.1.3 Tablasupa Village

Tablasupa Village lies in 140°22'27,4" Longitude and 2°25'19,9" S Latitude. The village is located at the altitude of 40 MASL, with an elevation of 15-20° with moderate slopes. The morphology of Tablasupa Village is mostly mountainous with mafic and ulta mafic igneous rocks with a strong structure. The land use is mostly for settlements, fields, forests, and coastal tourism (Jayapura Regency Mining and Energy Office, 2009).

3.1.4 Kendate Village

Kendate Village lies in 140°22'48,7" E. longitude and 2°27'46" S. latitude, at the altitude of 10 MASL with the elevation of 15-30° and moderate slope. The morphology of Kendate Village varies from flat to mountainous with a strong structure of pyroclastic stones and limestones. The land use is mostly for settlements, fields, and forests (Jayapura Regency Mining and Energy Office, 2009).

3.2. Environmental Profile

3.2.1 Oceanographic Profile

Types of Tides

The type of tides in the Depapre Bay is mixed tides with double dominance, the area has two episodes of high water and two episodes of low water in one day, with tide heights vary during one tidal cycle (Jayapura Regency Maritime Affairs and Fisheries Office, 2015), and the average height of the high water is around 1.760 m (Jayapura Regency Transportation Office, 2016).

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Brightness Temperature

The Maritime Affairs and Fisheries office (2015) conducted brightness temperature observation by observing the euphotic depth of the water based on the image data from MODIS-AQUA satellite from November 2013-Oktober 2014, their observation shows that the monthly average of euphotic depth spread of Depapre District water is highly varied. The highest euphotic depth usually found around July-September. In July, euphotic depth ranges between 58.62-97.41 m with the average of 87.63 ± 8.68 m, in August, it ranges between 67.73-106.71 m with the average of 95.17 ± 11.04 m, and in September, it ranges between 78.00-95.88 m with the average of 85.85 ± 5.71 m. the lowest euphotic depth usually happens during west monsoon season, that is January and February. In January, the euphotic depth ranges from 27.92-44.57 with the average of 37.53 ± 5.27 m while in February it ranges between 36.23-53.03 m with the average of 48.46 ± 3.42 m. Therefore, the intensity of sunlight that penetrates the water is significantly higher during July-September compared to January and February.

Wave Patterns

Waves in the water of Depapre District is wind wave (variety of *sea* and *swell*), which is mainly generated by wind. The wave pressure in this area is quite intensive, especially during the west monsoon season. During the east monsoon, the condition of coastal waters is relatively calm because the wind trajectory is directly obstructed by land topography. The Jayapura Regency Transportation Office (2016) has obtained wave characteristics with a 10-year forecast, through wave analysis by using the SMB (Svedrup, Munk, and Bretschneider) method. The forecast shows a significant wave height of 1,256 m, significant wave period of 6.9 seconds and dominant direction of the waves from the west and northwest with an average wave height of 0.67 m

Temperature

In November 2014, observation by using Conductivity Temperature Depth (CTD) showed that in Depapre Bay of Depapre District, for the surface waters (0-5m) the water temperature ranged from 29.98-30.27°C with an average of 30.17 ± 0.08°C. On the surface, the water temperature in Bote Bay tends to be lower than other stations. Whereas the vertical distribution of temperature in the waters of the Depapre District shows a different pattern between stations, except the Harlem observation station and the Old Tablanusu Village. The pattern of temperature distribution vertically to a depth of 20 m shows no stratification of the mass of water but the distribution pattern shows the characteristics of different water masses. Dormena area which is more open to the high seas has cooler water temperature data based on the Modis-Aqua Image data, the distribution of Depapre District's sea surface temperature throughout the year ranges from 28.67-31.82°C. The temperature distribution pattern shows variations on monthly basis, the lowest average temperature is found in February-April while the highest temperature range is found in October-December. During February-April the average sea surface temperature is less than 30°C while in October-December, the range of water temperature is 30.19-31.82°C.

Salinity

Data from the Maritime Affairs and Fisheries Office (2015) shows that water salinity in Depapre Bay of Depapre District for the surface waters (0-5m) ranges between 32.27-33.67 with the average of 33.53 ± 0.29 , the information was obtained by using CTD. From the spatial salinity distribution, we can see that water mass in Bote has lower salinity for the surface water (with the average of 32.27), while the Old Tablanusa Village has higher salinity with surface salinity value of 33.61. Based on vertical salinity distribution from the surface to the depth of 20 m, Old Tablanussu Village has higher salinity compared to other observation stations.

Wind Condition (Season)

In general, the wind pattern in Depapre Bay and the surrounding area can be divided into 4 patterns by season, namely West Monsoon (December, January, February), Transition Season I (March, April, May), East Monsoon (June, July, August) and Transition Season (September, October, November).

3.2.2 Ecosystem, Marine and Coastal Resources

Coastal Vegetation

The coastal land cover in Depapre Bay area consists of secondary forest, shrubs and reeds, fields/moor, fields of mixed vegetations, empty/barren land and settlements. The coastal vegetations are scattered along the coastline in a narrow group of forests, growing in the area around the bay which has flat topography. The coastal forest vegetation formation consists of two main types, the first type consists of bayhops (*Ipomea pescaprae*) formation and the Barringtonia formation (25-50 m), that grow on the sloping coastal area and tend to decrease in size if the beach is steep and rocky. The second type, Pescaprae Formation consists of plants that grow low and consist mostly of herbaceous species, with some of the climber/vine plants. The most common types are bayhops (*Ipomoea pescaprae*) and Squarrosus seeds (*Spinifex squarrosus*). The Barringtonia Formation consists of poison-fish tree (*Barringtonia asiatica*) or in local also known as *keben*, beach Calophyllum (*Calophyllum inophyllum*) or the locals call it *nyamplung*, sea-almond (*Terminalia catappa*) or what the locals call *ketapang*, pandan (*Pandanus tectorius*), coconut (*Cocos nucifera*), and other plants (Jayapura Regency Marine and Fisheries Service, 2015)

Mangrove

Mangrove ecosystem in Depapre District is only found in Waiya Village, Kendate Village, Tablasufa Village and Tablanusu (Entiyebo), even there, the ecosystem is not extensive with very sparse vegetation. In Entiyebo village, the mangrove forest can be found at the back of the village (particularly in the lake) and consists of *Rhizophora apiculata*, *Sonneratia alba*, and *Nypa fruticans*. While in Waiya, the mangrove located on the right side of the village. In Kendate, the mangrove forest can be found in front of the village, it consists of *Rhizophora apiculata*, *Sonneratia alba*, and *Nypa fruticans*.



Figure 3. Mangrove Ecosystem condition (a) Waiya Village, (b) Tablanusu Village

Seagrass

Seagrass ecosystems are commonly found in Depapre Bay. Particularly in the research locations, there are around 5 types of seagrass: *Cymodocea rotundata*, *Thalassia hemprichii*, *Enhalus acroides*, *Halodule uninervis*, and *Halophila ovalis* (Table 6). An extensive seagrass field can be found in the waters of Tablasufa Village.

	Waiya		Tabla (Enty	inusu (ebo)	Ken	date	Tablasupa	
Туре	Density	Percent	Density	Percent	Density	Percent	Density	Percent
51-5	(teg/m2)	of	(teg/m2)	of	(teg/m2)	of	(teg/m2)	of
		coverage		coverage		coverage		coverage
		(%)		(%)		(%)		(%)
Cymodocea rotundata	10.75	13	17.60	16	7.25	9	ND	ND
Thalassia hemprichii	13.25	18	5.60	6	9.65	12	ND	ND
Enhalus acroides	15.55	24	9.40	9	11.15	18	ND	ND
Halodule uninervis	6.15	6	24.15	18	TD	ND	ND	ND
Halophila ovalis	TD	TD	11.10	10	TD	ND	ND	ND
Total Percent of Cove	rage	61		59		39		

Table 6. Density and Percent of Coverage of Seagrass in the Research Locations

Note: TD (Not Found); ND (No Data)

Source: Jayapura Regency Maritime Affairs and Fisheries Office, 2014.

Coral Reef (Coral and Coral Fish)

Coral reef ecosystem is commonly found in the District of Depapre (Depapre Bay). The type of coral reef in the area is mostly fringing reef. Coral coverage in some of the waters in the research locations is shown in Table 7:

Location	Percent of co Cate	overage (%) & gory	Description		
Location	Depth 3-5 m	Depth 10- 13 m	Description		
Old Village in Pulau Tiga	32-48	46-52	<i>Customary rights</i> of the people of Tablanusu Village and a <i>Tiaitiki</i> location		
Sarebo Cape	40-56	60-62	<i>Customary rights</i> of the people of Tablasupa Village (Tefraa/Tabla tribe) and a <i>Tiaitiki</i> location		
Tanah Merah Cape	52-58	60-64	<i>Customary rights</i> of Tablasupa Village and fishing ground for Tefraa/Tabla tribe, a <i>Tiaitiki</i> location		
Amayepa	38-48	58-78	Customary rights of the people of Amayepa Village and not a Tiaitiki location		

Table 7.	Coral Coverage	in the	Research	Locations
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Note: Hak Ulayat is Communal Land Rights; Tiaitiki is a local term for marine and coastal management and conservation. Source: Paulangan & Munua, 2017.

Data from the Maritime Affairs and Fisheries Office (2015) shows less coral coverage, based on 8 sampling points by using *Rapid Resources Inventory* (RRI) method, only around 39.09%. Meanwhile, according to Paulangan & Munua (2017), coral coverage in Tablanusu Village is around 40.67% at the depth of 3-5 m and around 50.00% at the depth of 10-13 m. In Sarebo Cape, Tablasupa Village around 48.67% at the depth of 3-5m and around 60.67% at the depth of 10-13 m. Coral reef in some of the areas in Depapre District is mostly Acropora corals, both, the table-shaped (*Acropora Tabulate*) and the branch-shaped (*Acropora Branching*). Based on the visual observation, there are a significantly large number of foliose coral as well as massive coral. The low coral coverage percentage in Depapre District is mostly due to the coral destruction caused by the destructive fishing method of bomb and poison (*potassium cyanide*) as well as tuba root (Figure 4 and Figure 5).



Figure 4. The coral destruction caused by fishing bomb



Figure 5. Coral Bleaching caused by Tuba Root (Seido)

The 2015 report from the Maritime Affairs and Fisheries Office listed 97 species of reef fish, *Pomacentridae* family has the highest number of species of 19 species, followed by the family of *Chaetodontidae* with 15 species, and the family of *Labridae* with 12 species. Meanwhile, 17 other families have less than 10 species, in fact, 6 families of fish

consist of 1 species. The *Chaetodon* genus has the highest number of species of 11 species, followed by *Chromis* with 6 species, *Lutjanus* and *Pomacentrus* each of 4 species. The other 46 genera have less or only 3 species, of which 26 genera only consist of one species and 14 genera only consist of two species. According to Paulangan et al (2017), in total, there are 101 species of reef fish found in several dive points in Depapre Bay, consisting of *Pomacanthidae* family of 3 species, *Pomacentridae* 29 species, *Chaetodontidae* 13 species, *Caesionidae* 2 species, *Scaridae* 2 species, *Amphiprionidae* 1 species, *Monacanthidae* 2 species, *Balistidae* 4 species, *Scorpaenidae* 1 species, *Mullidae* 2 species, *Zanclidae* 1 species, *Tetradontidae* 1 species, *Acanthuridae* 9 species, *Lathrinidae* 2 species, *Serranidae* 1 species, *Cirrhitidae* 1 species, *Holocentridae* 2 species, *Ostraciidae* 1 species, *Nemipteridae* 1 species, *Haemullidae* 1 species, *Blennidae* 1 species, and *Labridae* 14 species.

Based on the study by the Maritime Affairs and Fisheries Office (2015), the sustainable potential (MSY) of reef fish in Depapre Bay is around 168,341 individuals, consisting of 88,982 individuals of Consumable Fish, and 79,358 individuals of Ornamental Fish. Based on that estimation, and by referring to Minister of Agriculture Decree 995/1999, the Total Allowable Catches (TAC) in Depapre District is 134,672 individuals. The Maritime Affairs and Fisheries Office (2015) has converted the big data for sources/supply of the TAC, using the value of constants from the National Commission for Stock Assessment of Indonesian Marine Resources, which is for the Depapre District is 44.5 tons, the Potential for Sustainability (PoS) amounting to 22.2 tons with the Total Allowable Catches (TAC) of 17.8 tons/year.

Pelagic and Demersal Fish

The relatively calm condition of Depapre Bay has made it a perfect spawning ground, nursery ground and feeding ground for a wide range of fish species, especially pelagic fish and demersal fish and other tradeable biotas. This can be seen by finding small pelagic fish resources, such as anchovies (*Stolephorus spp*), mackerel scads (*Decapterus spp*), short mackerel (*Rastrelliger spp*), and big-eyes scads (*Selar spp*) and large pelagic fish such as tuna (*Thunus spp*), skipjack tuna (*Katsuwonus pelamis*), mackerel (*Scomberomorus sp*), and sailfish. In addition to small pelagic fish, demersal fishes such as garfish, jackfish, big snapper, garfish, humpback grouper, and lobster are also common in the area. Small pelagic fish (anchovies, mackerel scads, short mackerel, and big-eyes scads) are found in large populations in March-May and in August and November. Large pelagic fish (tuna and skipjack), predominantly caught in August-November). Pelagic fish of bubara and garfish, are the species that are often caught throughout the year with distribution patterns relatively close to coastal waters. While for demersal fish such as red snapper, grouper and lobster are available almost all year round.

Reptilian Species

The 2015 report from Jayapura Regency Maritime Affairs and Fisheries Office mentions that there are three types of sea turtles in Depapre Bay, the Hawksbill Turtles (*Eretmochelys imbricata*), Green Turtle (*Chelonia mydas*), and Leatherback Turtles (*Dermochelys coriacea*). Those are protected marine species, because, in the wild, their number has dropped dramatically as a result of being hunted by humans for various reasons, either for different needs as well as for traditional rituals. The turtle nesting ground includes the northern part of Cape Tanah Merah.

Mammals

The 2015 report from Jayapura Regency Maritime Affairs and Fisheries Office mentions that Depapre Bay sea and coastal area are crossed by 6-7 species of whales, namely *Megaptera Novaeangliae* (Humpback whale), *Balaenoplera borealis* (Sei whale), *Balaenoplera musculatus* (Blue whale), *Balaenoplera physalis* (Fin whale), *Physeter catodon* (Sperm whale), *Physeter sp.*, And *Orcinus orca* (Killer whale). The presence of blue whales, sperm whales and killer whales in these waters is quite specific, and it is believed that the area is the migration route of the blue whale and Sei whale from the Pacific Ocean to the Indonesian Ocean and/or vice versa, they cross Depapre Bay sea and coastal waters. In addition to the whale, there are at least five types of dolphins spotted in Depapre Bay sea and coastal waters, namely *Globicephala macrorhynchus*, *Pseudorca crassidens*, *Delphinus delphis*, and *D. capensis* (long-beaked common dolphin), and *Tursiops truncatus* (bottlenose dolphin). Observation in the field shows that the types of dolphins commonly found in the area are the common dolphin and bottlenose dolphin, they both migrate all the way to shallow waters. These dolphins are also classified as protected marine mammals. Another type of marine mammal that is quite important and generally makes an appearance in the coast of Depapre Bay with its relatively shallow waters, is dugong (Dugong dugon).

3.3 Socio-Economic, and Cultural Profile

3.3.1 Demography

According to Jayapura in Figures 2016, the total population of Depapre District is 4,127 people with a density of 10.21 people/km². The number of inhabitants of the 4 research locations based on data from the Jayapura Regency Population and Civil Registry Office as per December 31, 2015, is presented in Table 4.

No	Villago	Hausshalds	Population					
INO.	village	nousenoius	Male	Female	Total			
1	Waiya Village	288	647	616	1.263			
2	Tablanusu Village	165	381	329	710			
3	Tablasupa Village	269	634	605	1,239			
4	Kendate Village	146	328	339	667			
Total in the 4 research locations		868	1,990	1,889	3,879			

Table 8. Population of Jayapura Regency Per 31 December 2015 by Village

Source: Jayapura Regency Population and Civil Registry Office (2016)

In term of composition, according to Jayapura in Figures 2016, by ethnicities, there are 640 people of non-Jayapura tribes and 469 non-Papuan tribes (migrants).

3.3.2 Cultural Profile

Depapre Bay has now become a heterogeneous area. Different ethnic groups make this region their home, not only the indigenous Papuans, but there are already quite a number of immigrants from Java, Sulawesi, Sumatra, Maluku and other regions in Indonesia. According to the history, Tefraa tribe is the native inhabitants of Depapre Bay, they were the pioneer for the current occupants of Depapre Bay.

The language spoken by the indigenous people of Depapre Bay is Tefra language (interview with the Head of Tablasupa Village, 2017), or others refer to it as the *Tabla* language, it is spoken in 6 villages, of which 3 villages are in the surrounding of Depapre, namely Tablasupa, Tablanusu and Waiya (also known as Tablawauna) and 3 other villages located on the north coast of Papua facing the Pacific Ocean. According to Yarisetou (2009), the *Tefra/Tabla* language has similarities to the language of the Yakari tribe, the Yongsu tribe, and the Yawena tribe. As in other village communities across Papua, the cultural system adopted in Depapre Bay is based on the local cultural system. One of the basic cultural system in the structure of Depapre Bay society is a strongly-entrenched system of *adat* power, with the *Ondowafi* system ".

Ondowafi serves as the customary leader in each village, where the leadership structure is legitimized based on the patrilineal hierarchy of the clans/tribes, ensuring that position in this *adat* structure will only be passed down to the successors from the same tribe, it will not be handed over to other tribes unless the patrilineal line of that particular tribe ends. In exercising his power, *Ondowafi* is assisted by two people whose position is also based on lineage, namely the deputy or the right hand of *Ondowafi* (Yarona), and the general or the head of war (Perai), as well as certain tasks inherent in the tribe. Figure 6 illustrates the structure of Indigenous Leadership in Tablanusu and Tablasupa Villages.



Figure 6. Structure of Indigenous Leadership in Tablanusu and Tablasupa (Yarisetou, 2009).

The structure presented in Figure 6 suggests that there is a distribution of power/authority over particular functions, such as territorial security, economics, management of certain geographical areas (i.e. maritime/sea, forest, agriculture/ land, and water/rivers). The management of each function is assigned to a certain tribe (clans/yarise). For example, in Tablasupa village, marine management falls under the authority of the Esuwei tribe as a tribe that has customary rights (hak ulayat) over the sea, even though there are other tribes who are more dominant as fishermen, such as the Seibu and Soronto, and this mechanism to manage the sea/waters functions, there is local wisdom called *Tiatiki* (Interview with the head of Tablasupa Village and Chief of Soronto Tribe, 2017).

3.3.3 Community Livelihoods

The types of livelihoods of the people in Depapre District are quite diverse, including fishermen, farmers, entrepreneurs, private employees, village officials, civil servants (PNS), and retired civil servants. However, in general, people in Depapre District work as fishermen. The coastal topography of the Depapre District, also due to the low education level, mostly elementary school graduates (without any specific skills), are the main reasons why most heads of household choose to work as fishermen.

For the people in Tablanusu, fishing and farming are the most common livelihoods. For farming in general, the scale is still at subsistence or small/gurem. For the people who earn their living as fishermen, their income highly depends on the amount of fish they manage to catch, and it is very much influenced by natural conditions (sea). The number of catches depends on the season, during the calm/low season, which happens during part of the east monsoon season, the number of catches is higher than the high season.

Season and Fish Availability	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Short mackerel (Rastrelliger spp)												
Jack fish (Carangoides)												
Anchovies (Stelophorus sp)								\checkmark			\checkmark	
Big-eyes scads (Selar spp)												
Grouper (Chepalopholis sp)												
Garfish (Thylosorus spp)					\checkmark						\checkmark	\checkmark
Mackerel scads (Decapterus spp)											\checkmark	
Skipjack Tuna (Katsuwonus											\checkmark	
pelamis)												
Red snapper (Lutjanus												
argentimaclathus)												
Spanish mackerel (Scomberomorus												

Table 9. Fish Season in Depapre Bay

Season and Fish Availability	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
spp)												
High Season	\checkmark							\checkmark	\checkmark	\checkmark	\checkmark	\checkmark
Low Season												
West Monsoon												
East Monsoon							\checkmark	\checkmark				
Transition Season I												
Transition Season II									\checkmark	\checkmark		

As for farming, most farmers still cultivate the communal land. In Depapre, a land distribution based on communal land right (hak ulayat) is still strongly enforced, the size of allocated land depends on the decision of *Ondoafi*. However, it is worth noticing that only small parcel of the communal land has been cultivated as productive lands, such as farm or field, the rest is still forested area.

3.3.4 The Institutional of Village Governance

In regulating and managing village or hamlet/kampung government (Regulations on village designation as hamlet/kampung and district as sub-district/kecamatan regulated in Law 21/2001 on Special Autonomy for Papua), the village government is given the authority to execute the role of the government as expected by the government through Law 32/2004. The structure of village administration in the four villages in Depapre District is illustrated in Figure 7:



Figure 7. Structure of Village Governance in the 4 Villages in Depapre District

3.3.5 Health Facility

The available health facilities are: 1 community health center (Pusat Kesehatan Masyarakat/Puskesmas) in Waiya Village, 1 auxiliary health center (Puskemas Pembantu/Pustu) in Yewena Village, 4 village health clinics (Poliklinik Desa/Polindes) in Entiyebo, Kendate, Tablasupa dan Dormena, 4 units of water mobile health center (Puskesmas Keliling Air) and 2 units of land mobile health center (Puskesmas Keliling Darat).

3.3.6 Education Facility

Education facilities in Depapre District include 8 elementary schools (consisting of 3 state elementary schools and 5 private schools), 2 middle schools or *Sekolah Lanjutan Tingkat Pertama* (SLTP), consisting of 1 state junior high school and 1 state vocational junior high school (Jayapura Regency in Figures, 2016).

3.3.7 Worship Facilities

There are churches in all 4 villages, 1 church in Waiya, 1 church in Tablanusu, 1 church in Kendate, and 2 churches in Tablasupa. As for mosque, there is only one mosque found, it is located in Waiya.

3.3.8 Transportation Facilities

Land transportation facilities can only be found in Waiya, Tablanusu, and Tablasupa. Whereas Kendate can only be reached by sea transportation. Depapre District is about 2 hours from Jayapura City by car and motorcycle. Public ports as a means of transportation facilities to connect villages are sufficiently available in each village.

3.3.9 Fishmarket/auction

The fish auction and port in Depapre was built by the Ministry of Marine and Fisheries, to facilitate fishermen in selling their catches. It is located on the east coast of Waiya, unfortunately, is has not optimally serve its purpose.

3.3.10 Electricity and Communication Network

Electricity supply for Depapre District comes from Sentani City, managed by State Electricity Company or *Perusahaan Listrik Negara* (PLN). Telecommunication access is available in the form of cellular telecommunication, through 1 BTS tower provided by PT. Telkomsel.

Chapter 4. Findings and Discussion

4.1 Respondent Profile

Some of the parameters used to identify the characteristics and profile of the community are age, gender, main and secondary occupation, education, number of household dependents, and income. The age distribution of the respondent is shown in the figure below: 4% of respondent is at the age group of age of 23-31 years, 15% at the age group of 32-40 years, 30% at the age group of 41-49 years, 33% at the age group of 50-58 years, and 18% at the age group of 59-67 years. The distribution shows that most of the respondents belongs in the productive age group.



Figure 8. Respondent Age Distribution

Distribution of respondents by education attainment is shown in Figure 9, where elementary school comprise of 26% of total, junior high school 29%, high school and equivalent 41%, and college/postsecondary 4%. Education attainment of the local community is relatively low, with the highest percentage of high school graduated or lower. According to Wasaraka (2011), the reasons for the low education attainment in Depapre are economic reason and transportation constraint, with access to transportation that connects villages to city or places where the higher education facility is located, insufficient land and water transportation facilities, and lack of support from parents.



Figure 9. Respondents' Education Level

Distribution of respondents according to type of main occupation is 85% work as fishermen, and 15% non-fishermen, they work as civil servants, police officers and village officers (Figure 10.a). Furthermore, 67% of respondent have secondary occupation and 33% has no secondary occupation (Figure 10.b)



Figure 10. Comparison of Main Occupation

Distribution of respondents by income group is a follow: IDR 1,500,000 - IDR 2,500,000 (26%), >IDR 2,500,000 - IDR 3,500,000 - IDR 3,500,000 - IDR 4,500,000 (18%), >IDR 4,500,000 - IDR 6,500,000 (11%), and >IDR 6,500,000 (4%). Average income of respondents is relatively high.



Figure 11. Distribution of Income

Average household dependents are as follow: 1-3 people (11%), 4-6 people (56%), 7-9 people (26%), and \geq 10 people 7% (Figure 12). The chart shows that on average, the number of household dependents is relatively high.



Figure 12. Percentage of Household Dependents

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4.2 Socio-ecological System of Depapre Bay

The social-ecological system links human and nature/environment, it emphasizes that humans are part of, and not external to, nature (Berkes and Folke, 1998). The local coastal and marine resources management in Depapre Bay, Depapre District, especially in the research locations, adheres to local knowledge system, known as *Tiaitiki* system. For the people of Depapre Bay, the coast and sea are highly valuable, just like prime quality land with a very high selling price (Yarisetou, 2009). Based on this perspective, all marine resources are managed and preserved by using customary norms. Furthermore, the people also view the sea and all the potential within as the creation of God Almighty, gifted to human to be managed and preserved. People of Depapre Bay refers to the sea as mama/mother/lady or in *Tefraa/Tabla* they call it *kalume*, thus it must be treated wisely and with the utmost respect.

4.2.1 Social System and Ecological System

From a human ecology perspective, ecological systems (ecosystems) is interrelated with the social system. The flow of mass, energy, and information connects ecosystems with social systems. Thus, the quality of ecosystems is influenced by social systems and/or vice versa. Any change that occurs in one system can affect the sustainability of the other systems. The social-ecological system is a biological/ecosystem system intricately linked with and affected by one or more social systems, in a way that it forms cooperative and interdependent relationships with others which include an ecosystem unit such as coastal area, mangrove ecosystem, lake, coral reefs, beaches that are associated with social structures and processes within (Anderies et al., 2004). This integration is known as the paradigm of the Social-Ecological System (SES) in the management of coastal and marine areas (Adrianto and Aziz, 2006). This SES approach is expected to be able to increase resilience through several actions both within the local as well as national framework system.

Ecological System

Depapre Bay has a complex system of natural resources; it occupies a narrow sea in the northern part of Papua Island. This socio-ecological system consists of semi-enclosed waters within which interactions of waters and ecosystems of coral reefs, sea grasses and mangroves and small islands take place.

According to Yarisetou (2009) also interview with Tablasupa Head of Tribe for marine functions (2017), in this ecological system, the people of Depapre Bay has adopted several marine divisions based on bathymetry, depth and certain characteristics of the sea:

- a. Akadame, part of the shallow sea, starting from the peak of the highest tide to 12 meters deep, and usually in the form of reefs and sea grass beds, where some of the areas are visible and dry during low tide.
- *b. Kia-kia,* part of the sea with a depth of 12-25 meters. The sea floor is still visible and during the lowest tide, it is still submerged. Some parts are still in the form of coral.
- *c.* Nou Koti, part of the sea with the depth of 25-100 meters, the sea floor is no longer visible from the surface, and the color of the water is a darker blue.
- *d.* Beta nau, part of the sea with the depth more than 100 meters all the way to the open ocean towards the direction of Pacific Ocean, in general, this area is no longer part of Depapre Bay.

Social System

Teluk Depapre has a relatively complex social-ecological system. A wide range of activities to utilize the local resource have existed, and influenced each other, both in social system and ecology. The land use in Depapre Bay includes marine aquaculture in Kendate and Tablanusu, construction of port (ongoing) in Tablanusu, floating village residential in Tablasupa and residential area in Kendate, Tablanusu, Waiya, and Tablasupa, also development area for education, trade, government and economic in Waiya, as well as transportation and recreational aquatic ecosystem services, and beach tourism in Cape Harlem, Cape Tanah Merah, Cape Pistol, Amay Village, Tablanusu Village, and Tablasufa Village.



Figure 13. Land and water area utilization in Depapre

If we refer to the distribution of sea in the social system of Depapre community, the land and water utilization completely refers to the customary communal system; with the parts of the sea included into the customary system (sea tribe) are the *akadame*, *kia-kia*, and *nou koti*. The control over those three sea areas by the customary system is considered strategic because it is an area that affects the reproductive cycle of the marine life; the areas serve as spawning, nurturing, and living grounds for the biota. meanwhile, *beta nau* is excluded from the area of customary communal system because it is open ocean zone and it does not intersect with customary interest.

In the customary system called *Tiaitiki*, the parts in which the *Tiatiki* applied are *akadame* and *kia-kia*. In term of ecology sustainability, those areas are parts of the sea that need to be protected, because, with the relatively calm currents, abundant nutrients, and plentiful shelters, those areas provide a source of food and serve as breeding places for the marine biota.

4.2.2 Flowchart Connectivity of Socio-ecological System in Depapre

In short, the complexities of the socio-ecological system in Depapre Bay are illustrated in Figure 14.



Figure 14. Complex System of Depapre Bay

4.3 Strategic Issue Approach for Coastal Management of Depapre Bay

From the perspective of the relationship between social and ecological systems, there is a very close interrelation between social and ecological systems. Likewise, in defining key problems in Depapre Bay, the approach centralized on the linkages between social, economic and ecological systems. Based on information gathering on the issues considered as strategic issues, which then structured into 3 aspects (ecological, economic and socio-institutional), the strategic issues identified in Depapre Bay are shown in Table 10.

Table 10	Ctrotogia loguas	and Drahlama	hanad an Car	via analaninal C	votom Annroach
Table TU	Sinaleoic issues	and Problems	0aseo on 500	CIO-ECOIOOICAL 5	vsiem Addioach
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	-		
Aspects	Issues and Problems	Location	Scale
Ecological	1. Destruction of coral and <i>fishing ground</i> (within	Tablanusu	High
	the area of <i>Haltiki)</i> resulting from the backfilling		
	2. Turbidity and destruction of coral and sea grass caused by sedimentation	Waiya	Medium
	3. The on-going practice of destructive fishing, and using tooba root (sap from a local tree)	All villages	Medium
	1. Low work ethic (from the number of days spent	All villages	Very High
Economic	at the sea to fish or at the field to farm)	-	
	2. The insufficient market for the products	All villages,	Medium
		except Waiya	
	3. Accessibility (village transportation, speedboat)	Kendate,	Medium
		Tablasupa	
	4. Insufficient technological mastery	All villages	High
	5. Dependency on nature in catching fish	All villages	High

Aspects	Issues and Problems	Location	Scale
	The mountainous and rocky terrain makes it difficult to farm	All villages	Medium
	7. The scale of fishing and farming that is still too small (subsistence)	All villages	High
	 Lack of guidance, technical assistance, and facilitation to develop their livelihoods 	All villages	High
Socio-institutional	 The conflict between the community and government regarding port construction area (Court process) 	Tablanusu and Waiya	High
	 Conflicts within the community (Tabla/Tefraa vs. Moi Tribes) regarding port construction area (Court process) 	Tablaa/Tefraa and Moi Tribes	Medium
	3. Insufficient education facilities	All villages	Medium
	 Uncertainty in the establishment of Depapre Bay Marine Protected Area (Regency vs. provincial authority) 	The entire bay	Medium
	 The rights of the local community in the management of the bay area 	All villages, which consist of 2 tribes (Tefraa/Tabla and Moi	Medium
	6. Lack of socialization and community involvement in development planning, including the plan for the Port construction and the establishment of the Marine Protected Area	All villages	High

Source: Processed from Interview and FGD (2017).

The strategic issues that directly related to the conservation of Depapre Bay are Aspect 1 (Ecology) and Aspect 3 (social). There are three issues under the ecology aspect that are related to the existence of Depapre bay as the candidate for Marine Protected Area:

- a) Destruction of coral and *fishing ground* (within the area of *Tiaitiki*) resulting from the backfilling of Depapre port, which lead to a conflict between the contractor responsible for the construction of the port and the fishermen and community, especially the villagers of Tablanusu, Waiya and Kendate. Unfortunately, in the Environmental Impact Assessment or *Analisis Mengenai Dampak Lingkungan* (AMDAL) document (Bupati of Jayapura Decree 13/2006) regarding economic feasibility of the AMDAL, the issue was not considered significant, whereas the impact is long-term and affects the ecological quality of the entire waters of Depapre Bay and the lives of the people, especially fishermen. The AMDAL mainly concern about the impact on water quality. Even though the assessment has estimated economic losses on water quality, fish/marine biota and coral reefs due to port development (pp. V-64, 65 and 67).
- b) Turbidity and destruction of coral and sea grass caused by sedimentation. The construction of Depapre's port has impeded fishermen in 3 villages (Waiyai, Tablanusu, and Tablasupa) from going to their fishing ground because the fishing ground is now covered/backfilled by the port construction.
- c) The on-going practice of destructive fishing and using tooba root (sap from a local tree). If these activities are not immediately restricted, the damage to the coral reef will be even more severe and will affect the ecological quality of the bay, it will also impact the fish stock, in the end, the fishermen are the one who will be harmed because the number of the catches will decrease.

From social aspect, there are also several strategic issues related to the development plan of the protected area in Depapre Bay:

- e. Uncertainty in the establishment of Depapre Bay Marine Protected Area, resulting from the shift of authority in marine management from regency office to provincial office, however, the proposal for the establishment of the protected area actually came from regency office (Jayapura Maritime Affairs and Fisheries Office). On the other hand, the blueprint of the port development, which refers to the Port Work scope Map or *Peta Daerah Lingkungan Kerja Pelabuhan*, (DLKPr and DLKPk) includes the entire Depapre Bay area. This overlap might lead to a conflict
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of authority and zoning conflict for the marine area.

f. Lack of socialization and community involvement in development planning, including the plan for the Port construction and the establishment of the Marine Protected Area, which seems to be planned in the same area.

4.4 Alternative Livelihoods

4.4.1 Potential Alternative Livelihoods of Depapre Bay

In accordance with its initial objective, this study aims to identify and analyze alternative livelihoods that can be developed as an alternative socio-economic development for the communities in Depapre Bay, to serve as a solution for the on-going ecological and economic pressures. Potential alternative livelihoods that can be developed for the community of Depapre Bay include:

a. Marine Tourism

The marine tourism that currently operated in Depapre Bay is classified as a relatively small-scale business. The supporting facilities and infrastructure are mainly cottage and boat rentals for tourists. Diving tourism still not yet managed locally by the community. There has been growing interest in diving activities from local tourists who came from Jayapura City; however, the facilities and the infrastructure (diving equipment) are still not available in the research locations/villages. Fishing tourism seems to have the potential to be managed locally by the community; there has been an influx of fishing tourists, especially on holidays

b. Aquaculture

Fish cultivation activities in Papua in general, and in Depapre Bay in particular, are still very limited. Commodities that have started to be developed include milkfish and tilapia farming in Tablanusu Village. Some of the constraints for aquaculture in Papua, especially in Depapre Bay, are insufficient technological mastery and motivation of the (local) community, availability of seed, high production costs, and limited market. In addition, seaweed cultivation and sea cucumber farming in the submersible cage also present an opportunity to be developed.

c. Improvement of Fishing Activities

In general, fishermen in Depapre Bay are traditional fishermen, who only use fishing rods, nets and spears to catch their fish. In addition, floating trap and FAD (Fish Aggregating Device) has started to be developed. The FAD is a fishing device installed by the government and businessmen from Jayapura.

d. Horticulture for Areca Nut and Betel

In general, the fields in Depapre Bay are mixed fields, where people grow horticultural crops such as sweet potatoes, cassava, taro, areca nut, and betel. Plants such as yams, cassava, and taro have a very high potential to be promoted, not only because they are the staple food for the local community, but also because the available fields can still be planted and developed for these plants.

e. Processing Industry of Marine products to Support the Port

Processing industry of marine products such as fresh or dried fish products is very potential to be developed, considering that the operation of the port will absorb a large number of workers. It is also expected that the labor demand would absorb local labors as a form of community empowerment.

f. Culinary Business to Meet the Need of the Passengers/Workers from the Port

This culinary activity will present business opportunities because there is a strong indication of an increasing number of people who will come to Depapre Bay for many different purposes, they would require food and drink.

4.4.2 Selection of Alternative Livelihoods

The results of scoring and weighting of alternative livelihoods based on interviews and field observations are presented in Table 11 below:

	Pusiness Type 8	Т	echnical-Non-To	echnical Cons	sideration & Weig	jh	Wojah
No	Dusiness Type &	Availability	Community's	Labor	Technological	Market	weign
		of Material	Interest	Availability	Mastery	Availability	A Score
	Alternative	(40%)	(20%)	(10%)	(10%)	(20%)	00010
А	Marine Tourism						
1	Development and &	4	3	3	3	3	340*
	Management of						
	cottage/bungalow						
В	Capture Fishery						
2	Promotion of FADs	3	4	4	2	4	340*
С	Aquaculture						
3	Milkfish farming in	2	2	2	1	3	210
	floating fish cage						
4	Tilapia farming in	2	2	2	1	3	210
	floating fish cage						
5	Seaweed cultivation	3	2	3	3	2	260
6	Sea cucumber	2	2	2	2	3	220
	farming in						
	submersible cage						
D	Plantation						
7	Betel & Areca	3	2	3	3	3	280
8	Taro & Yam	3	2	3	3	3	280
Е	Processing of Marine						
	Products						
9	Dried fish processing	3	3	3	3	3	300
10	Fish ball processing	4	2	2	2	2	280
11	Smoked fish	4	3	3	3	3	340*
	processing						
F	Culinary business						
12	Food stalls	4	2	3	3	2	300

Table 11. Scoring and Weighing of Livelihoods

Note: range of scores 100-175 (poor); 176-250 (good); 251-325 (fair); and 326-400 (very good). Star mark (*) to be analyzed further as the candidate of alternative livelihoods

The potential alternative livelihoods with very good criteria are then analyzed based on business feasibility. Based on Table 11 above, the selected ones are the development & rental of cottage/bungalow for tourist, smoked fish processing and promotion of FADs for fishing.

4.4.3 Feasibility of Selected Alternative Livelihoods

The feasibility analysis aims to identify whether the business conducted by the communities in the research locations are feasible to be developed or not. In order to measure this feasibility, the BCR, ROI, and PP parameters are used as shown in the business financial analysis table.

Smoked Fish Processing

The smoked fish business is one of the high potential businesses based on social, market and technical feasibility. The raw materials are plentiful, Depapre Bay fishermen can easily get a plentiful supply of skipjack tuna and mackerel tuna, this business can even be a solution to maintain the economic value of the fish when the supply is abundant and the price fall and plenty got wasted. This business is also expected to be a source of alternative income for the people of Depapre Bay, especially for fishermen when fishing in the bay is no longer possible due to the activities of the port of Depapre. Based on the financial analysis of business feasibility, this business is also financially feasible, as shown in Table 12.

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No.	Type of Investment	Quantity /Volume	Unit	Price (IDR)	Original Value (Rp)	Economic Life (Yrs.)	Depreciation /year
Α.	Fix Cost						
1	Smoking Furnace/Oven	1	Unit	450,000	450,000	10	45,000
2	Knife	3	Unit	10,000	10,000	3	10,000
3	Basin	2	Unit	20,000	20,000	2	20,000
4	Cutting board	1	Piece	25,000	25,000	3	8,333
5	Medium-size bucket	1	Piece	50,000	50,000	3	16,667
6	Plastic basket	4	Piece	50,000	50,000	6	33,333
7	Cool box	1	Piece	300,000	300,000	6	50,000
8	Water reservoir	1	Piece	1,000,000	1,000,000	10	100,000
9	Freezer	1	Piece	2,500,000	2,500,000	10	250,000
	Total of I	Fix Cost		4.595.000			533,333
В.	Variable						
No.	Variable Cost	Quantity /	Unit	Price	Total Price	Productio n	Total Production /vear
_		Volume	2	050.000		(Year)	.,
1	Firewood	24	m ³	250,000	6,000,000	1	6,000,000
2	Kerosene	1500	Liter	2,500	3,750,000	1	3,750,000
3	Fresh skipjack tuna	12000	Fish	10,000	120,000,000	1	120,000,000
4	Vinegar	1500	Bottle	7,000	10,500,000	1	10,500,000
5	Salt	2400	Package	2,000	4,800,000	1	4,800,000
6	Ice block	4500	Kg	500	2,250,000	1	2,250,000
7	Bamboo skewer	2400	Bundle	5,000	12,000,000	1	12,000,000
8	Fuel (premium)	2100	Liter	6,500	13,650,000	1	13,650,000
9	Packaging	24	Pile	5,000	120,000	1	120,000
10	Electricity	1	Year	500,000	500,000	1	500,000
12	Labor fee	2	OB (Person)	2,000,000	4,000,000	1	4,000,000
	T	otal Variable	e Cost		177,570,000		177,570,000
C.	Selling price						
No	Smoked fish	Volume	Unit	Price	Income	Income/	
					/ Month	year	
1	Skipjack Tuna	12000	Fish	35,000	35,000,000	420,000,00 0	
			Total Selling	1			420,000,000
			Net Income				198,516,667
		Inc	ome per mo	nth			12,407,292
Net B	/C Net						3.70
ROI							90%
PP							0.04

Table 12. Fix Cost and Variable Cost of Smoked Fish Business

Source: Processed Data (2018)

Table 12 describes that smoked fish business is economically feasible, because Net B / C> 1 (3.70), with net income, can be up to IDR 198,516,667 per year, or IDR 12,407,292 per month. Return of investment in this business is also relatively fast, the payback period is only 0.04.

Cottage/Bungalow Rental

Rental business for tourist lodgings, with the assumption of 3 cottages equipped with 2 units of bath and sanitation facilities. The cottage can be built on communal land (lahan hak ulayat); thus, there is no need to rent a place/land. The cottage rental business is one of the more promising business alternatives, in term of social, market and technical feasibility, because natural tourism objects are quite abundant, this business can even serve as a solution to maintain the sustainability of the coastal resources, with an effective management. This business is also expected to be an alternative source of income for the people of Depapre Bay when fishermen can no longer catch their fish in the bay due to the port activities. Financially, this business has also feasible, based on business feasibility that has been conducted; the description can be seen in the following Table 13.

No.	Investment	Quantity/ Volume	Unit	Price (IDR)	Original Value (IDR)	Economic Life (Year)	Depreciation / Year
Α.	Fix Cost						
Ι.	Construction of the	e Cottage					
1	Ironwood Beams	50	Beam	120,000	6,000,000	10	600,000
	size 10x5 cm						
2	Ironwood Beams size 5x5 cm	18	Beam	60,000	1,080,000	10	108,000
3	Ironwood plank size 20x3 cm	36	Sheet	120,000	4,300,000	10	432,000
4	Tin roof	48	Sheet	60,000	2,880,000	10	288,000
5	Tin plate size 30x800 cm	3	Sheet	96,000	288,000	10	28,800
6	Nail size 10 cm	6	Kg	12,000	72,000	10	7,200
7	Nail size 7 cm	6	Kg	10,000	60,000	10	6,000
8	Nail size 5 cm	6	Kg	8,000	48,000	10	4,800
9	Tin Nail	6	Kg	10,000	60,000	10	6,000
10	Tin roof paint, medium size	4	Can	100,000	400,000	5	80,000
11	Varnish paint	6	Can	65,000	390,000	5	78,000
12	Labor fee	1	Packag e	15,000,000	-	-	-
II.	Construction of Ba	ath and sanit	ation facilit	ies			·
1	Ironwood Beams size 10x5 cm	6	Beam	120,000	720,000	10	72,000
2	Ironwood Beams size 5x5 cm	4	Beam	60,000	240,000	10	24,000
3	Tin roof	12	Sheet	60,000	720,000	10	72,000
4	Brick	200	Piece	2,500	500,000	10	50,000
5	Cement	10	Sack	120,000	1,200,000	10	120,000
6	Septic tank	1	Set	5,000,000	5,000,000	10	500,000
7	Pipe (3 inch)	1	Piece	120,000	120,000	10	12,000
8	Squat lavatory	2	Piece	450,000	900,000	10	90,000
9	Water faucet	2	Piece	25,000	50,000	10	5,000
10	Labor fee	1	Packag	8,000,000	8,000,000		
			е				
	Αποι	int	I		49,048,000		
No.	Variable Cost	Quantity / Volume	Unit	Price (IDR)	Original Value (IDR)	Economic Life (year)	Depreciation /year
1	Firewood/coal	5	Sack	150,000	750,000	1	750,000

Table 13. Business Feasibility Analysis for Cottage Rental Business

No.	Investment	Quantity/ Volume	Unit	Price (IDR)	Original Value (IDR)	Economic Life (Year)	Depreciation / Year
	from coconut shell						
2	Kerosene	10	Liter	2,500	25,000	1	25,000
3	Cottage maintenance	12	Month	100,000	120,000	1	1,200,000
4	Worker salary	12	OB (person)	8,000,000	9,600,000	1	9,600,000
	•	Total		•			11,575,000
C.	Assumption on re	sult from cott	age rental/	production			
No.	Rental	Volume	Unit	Price	Total Price	Production/ye	Total
						ar	
1	Rental of 3 cottages	3	Day	150,000	450,000	1	54,000,000
		То	tal Selling	l			54,000,000
		N	et Income				39,741,200
		Incon	ne per Mo	nth			3,311,767
Net B	/C Net						2.64
ROI							85%
PP							2.17

Source: Processed Data (2018)

Table 13 describes that cottage rental business is economically feasible, because Net B / C> 1 (2.64), with net income can be up to IDR 39,741,200 per year, or IDR 3,311,767 per month. Unfortunately, the return of investment for tourist lodgings is relatively slow, with the payback period is only 2.17, however the risk for this business is relatively small.

Promotion of FAD for Fishing

Capture fishery is the main livelihood that has been carried out by the people of Depapre Bay for generations. The fishermen use simple fishing gear such as fishing rods and nets and spears. Most of them use rowing boats, and some already use Johnson machines boat.

No.	Туре	Quantity/	Unit	Price	Productio	Quantity	Unit	Total
	Investment	Volume		(IDR)	n /year			(IDR)
Α.	Fix cost							
1	Boat	8	Times/ye	1,250,00	-	Times	Maintena	10,000,000
	maintenance		ar	0			nce	
2	FAD	8	Times/ye	200,000	-	Times	Maintena	1,600,000
	maintenance		ar				nce	
3	Fishing net	3	Times/ye	200,000	-	Times	Maintena	7,200,000
	maintenance		ar				nce	
	Jun	nlah						18,800,000
	richle Cost							
в. va	nable Cost							
		Quantity/	Unit	Price	lotal	Productio	Producti	l otal
No.	Description	Volume		(IDR)	Price	n /month	on /year	
					(IDR)			
1	Solar (fuel)	120	Liter	7,000	840.000	6 times	60 times	50,400,00
2	Motor oil	4	Liter	35,000	140.000	6 times	60 times	8,000,000
3	Kerosene	10	Liter	5,000	50.000	6 times	60 times	3,000,000

Table 14. Business Feasibility Analysis for Promotion of FAD for Fishing

4	Ice block	100	Block	1,000	100.00	0	6 times	60 times	6,000,000
5	Rice	15	Kg	10,000	150.00	0	6 times	60 times	9,000,000
6	Coffee	6	Package	6,000	36.00	0	6 times	60 times	2,160,000
7	Sugar	6	Package	15,000	90.00	0	6 times	60 times	5,400,000
8	Gallon water	6	Gallon	6,000	36.00	0	6 times	60 times	2,160,000
9	Labor fee	6	Person	200,000	1.200.00	0	6 times	60 times	72,000,000
		Total							158,520,000
C.	With the assump	tion of produ	iction/selling	from 6 FAD)s				
							Selling	Income	
No.	De	scription		Volume	Unit		price	/month	Income /year
							(IDR/kg)	/montin	
1	Yellow Fin Tuna	(Thunnus al	bacares)	30	Kg	5	50,000	1,500,000	15,000,000
2	Big eye Tuna (T	hunnus obes	us)	30	Kg	6	60,000	10,800,000	108,000,000
3	Albacore (Thunn	us alalunga)		50	Kg	1	8,000	900,000	9,000,000
4	Skipjack Tuna (<i>k</i>	Katsuwonus j	pelamis)	1000	Kg	1	0,000	10,000,000	100,000,000
5	Mackerel Tuna (Euthynnus a	ffinis)	1000	Kg	1	5,000	15,000,000	150,000,000
6	Other fish			50	Kg	8	3,000	400,000	4,000,000
		-	Total Selling					38,600,000	386,000,000
			Net I	ncome					156,230,000
			Income	per month					9,764,375
B/C N	let								1.62
ROI									5.826
PP									2.32

Source: Processed Data (2018)

Table 14 describes that catching fish with FADs is economically feasible, because the Net B/C > 1 (1,62), with net income up to IDR 156,230,000 per year, or IDR 9,764,375 per month. Unfortunately, the return of investment for FAD fishing is relatively slow, the Payback period is only 2.32 with a relatively high risk.

4.5 Local Institutional Structure in the Management of Marine Resource in Depapre Bay

Management of marine resources in Depapre Bay falls under the authority of Provincial Government, in accordance to Law 23/2015; the management of marine area from the highest tide point to 12 nautical miles is the authority of Provincial Government. This transition in authority still causes problems in the implementation, because management by the province still not yet completely in place, while the district no longer has the authority for the functions. However, in a different context, the existence and the rights of indigenous people or traditional communities are also acknowledged and guaranteed under Article 18B of the 1945 Constitution (paragraph 2), which states that the State recognizes and respects customary law communities and their traditional rights as long as they exist and in accordance with the development of society and the principle of the Unitary State of the Republic of Indonesia, as regulated by the law. Likewise, their traditional identity and rights are also protected under the Article 381 paragraph (3), stating that cultural identity and the rights of traditional communities are respected in line with the development of the times and civilizations. Furthermore, Article 32 paragraph (1) states that the State promotes Indonesian national culture amidst global civilization by ensuring the freedom of the people in maintaining and developing their cultural values. Thus, the freedom for indigenous peoples to practice their traditional resource management systems are recognized and protected by the state.

The people of Depapre Bay have had a long-standing local knowledge about marine management. For them, the sea (or in Tefraa/Tabla language also known as *Nau*) is highly valuable, just like prime quality land with a very high selling price (Yarisetou, 2009). Based on this perspective, all marine resources are managed and preserved by using customary norms. The people also view the sea and all the potential within as the creation of God Almighty, gifted to human to be managed and preserved. People of Depapre Bay refers to the sea as mama/mother/lady or in *Tefraa/Tabla* they call it *kalume*, thus it must be treated wisely and with the utmost respect

For many generations, the people of Depapre Bay have developed a coastal and marine management system called "*Tiaitiki*". In local language of the Tefra and Yokari, *Tiaitiki* means "to close". According to Yarisetou (2009), in a broader sense, *Tiatiki* means "the knowledge to regulate; manage, utilize and preserve marine and coastal

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resources within the local context...." This definition implies the presence of rules and boundaries, and the violations of these rules and boundaries would result in physical and non-physical (spiritual/magical) sanctions.

Tiaitiki is a local wisdom in the form of scheduling system (opening and closing areas for a certain period) (Yarisetou, 2009; Paulangan et al., 2017). In practice, the opening and closing of an area within the *Tiaitiki* have a certain geographical dimension and time (certain period), which is decided through a customary meeting/assembly, the closing and opening of the *Tiaitiki* area is performed by an *Ondowafi* through a special ceremony. Referring to Ruddle (2000), the institutional system for managing *Tiaitiki* is quite complete in terms of institutional elements, where the boundaries system, rights system, sanctions system and monitoring and evaluation mechanisms exist but not yet defined as written and formalized institutional rules, they are still informal rules or norms. However, every member of the community in Depapre Bay understand perfectly these customary rules, it has been passed down from one generation to the next, even the migrants have understood and obeyed this rule. We can safely say that *Tiaitiki* has been carried out effectively.

Summary of *Tiaitiki* institutional system, by referring to Ruddle (2000) is presented in Table 15.

Institutional Elements	Boundaries of the Institutional Elements
Territorial System Boundary	 The management of the territorial boundaries is the customary rights of the 3 tribes (Esuae, Serontou and Okoserai); the boundary is all the waters within Tanah Merah (Depapre) Bay, and out of the bay as far as the eye can see. The location of <i>Tiaitiki</i> will be set in <i>Akadame</i> and <i>Kia-kia</i> sea area, the waters with a depth of 25 meters with coral reefs and sea grass ecosystems. The boundaries of the <i>Tiaitiki</i> are determined by each village and treated as a conservation area or a closed area, the boundaries are in the form of natural boundaries in the coral reef area with an average distance of 50 meters from the coast, and usually marked with wood embedded in the reef, without any written sign.
Rules system	 The rules apply for all member of the community, the local people as well as the migrants In the area that has been declared as <i>Tiaitiki</i>, nobody can catch any biota from the sea (fish, shrimp, crustaceans, mammals) Passing the area with a boat, or doing snorkeling and diving is allowed during the <i>Tiaitiki</i> period.
Rights system	The rights over the marine management or the customary rights of the sea area belong to Esuae, Soronto and Okoserai tribes, who are entitled to reap the benefit (catching fish) from the sea. The leadership of the <i>Tiaitiki</i> are in the hand of Esuai tribe, the other tribes including those with customary rights over the land, can only take something from the sea when <i>Tiaitiki</i> is opened. <i>Tiaitiki</i> is enforced throughout the year and can be opened for the benefit of village development or mutual interests. The opening of <i>Tiaitiki</i> usually led by the <i>Ondoafi</i> in the village and preceded with traditional rituals.
Sanctions system	 The sanction system has been established with the <i>adat</i> or customary system. The consequences for violating <i>Tiaitiki</i> are: The sanction is given based on the severity of the violation. The violation can be based on a report from witness (active) or confession from the perpetrator (passive) Customary sanction: sacrifice a pig and feed the entire village with the pork meat during a traditional ceremony. Spiritual Sanction: If the perpetrator denies the accusation or committing the violation without being caught, he/she would suffer

Table 15. Marine Management Institutional System based on Tiaitiki

Institutional Elements	Boundaries of the Institutional Elements
	illness or even death. It means you violate the Tiaitiki at your own risk.
Monitoring and Evaluation System	The responsibility for monitoring <i>Tiaitiki</i> is basically the authority of the chief of the tribe who has customary rights over the marine management, especially the Esuwei, Soronto and Seibu tribes. However, every member of the community, whether tribe members or not, have the right to monitor and have the right to report to the Chief of the Tribe. The duty to enforce the customary law is the responsibility of the Chief of the Tribe theough the Ondewofi

Source: Interview with the Chief of Soronto Tribe (2017)

In details, the *Tiatiki* institutional mechanism can be explained as follow:

a. Territorial System Boundary

The boundaries of *Tiaitiki* zone are set to be within *Akadame* and *Kia-kia* sea area (Yarisetou, 2009), and are determined by each village. *Tiaitiki* is another word for a certain area, which is treated as a conservation area or a closed area with natural boundaries of coral reef area with an average distance of 50 meters from the coast. The boundaries are usually natural landmark such as cape or man-made marking such as woods embedded into the ground that can easily be recognized by the people, without any written mark. In order to make the management easier, the community has agreed upon the location of *Tiaitiki* based on participatory mapping and it is drawn into a map with a particular scale. The area of *Tiaitiki* does not cover the entire sea, but the only certain location and will only be disclosed to the community just before it goes into practice.

The zoning of *Tiaitiki*, which usually on the reef area, is based on the control/ownership of the reef in each village, and the control of reef area in each village is listed as follow (Yarisetou 2009 and interview with the Chief of Esuai sea tribe, 2017):

- a. Tablanusu village has the *Akadame* in: reef Senedia, reef Keser Bukoy, reef Numlai Tum, reef Bitiai yo, reef Atablay skare, reef Elife Skare, reef Sensou skare, reef Buka skare.
- b. Tablasupa village has the Akademe in: Reef Cape Tanah Merah, reef Amai, reef Klimpong.
- c. Wayai village, because it used to be part of Tablasupa village, by customary law, it does not has its own *Akadame* area, instead, it follows the Akademe of the Tablasupa village as their main village.



PETA KAWASAN TIAITIKI DAN KAWASAN PENANGKAPAN TRADISIONAL MASYARAKAT LOKAL DI TELUK DEPAPRE

Figure 15. Map of *Tiatiki* and Traditional Fishing Ground for the people of Depapre Bay

The figure above confirmed that each village has their own boundaries in the area where it is prohibited to catch any biota from the sea; it is usually located at the edge of the cape, marked with black lines on the map.

b. Rules System

The rules of *Tiaitiki* are not yet clearly defined, based on an interview with the Chief of Esuai tribe, the main points of those rules are:

- The rules apply for all member of the community, the local people as well as the migrants
- In the area that has been declared as *Tiaitiki*, nobody can catch any biota from the sea (fish, shrimp, crustaceans, mammals)
- Passing the area with a boat, or doing snorkeling and diving is allowed during the *Tiaitiki* period, as long as the
 activities do not involve catching any biota from the sea, only enjoying the scenery.

However, those rules are not yet legalized as written rules.

c. Rights System

The rights over marine management belong to the tribes who have customary rights of the sea area. The rights belong to Esuai, Soronto and Seibu tribes, who are entitled to reap the benefit (catching fish) from the sea. The leadership of the *Tiaitiki* are in the hand of Esuai tribe, the other tribes including those with customary rights over the land, can only take something from the sea when *Tiaitiki* is opened.

Basically, *Tiatiki* is enforced throughout the year, however, it can be temporarily open based on the proposal from local/customary leaders for and only for the purpose that serves the community's interest or community's development, such as to finance village development, road construction, church renovation, and other similar needs. Thus, the *Tiaitiki* can be proposed to be temporarily open. The opening of *Tiaitiki* usually led by the *Ondoafi* in the village, and preceded with traditional rituals.

d. Sanctions system

The sanction system has been established with the *adat* or customary system, it has become local knowledge and all member of the community is aware of this system. The consequences for violating *Tiaitiki* are:

- The violation can be based on a report from witness (active) or confession from the perpetrator (passive)
- Customary sanction: sacrifice a pig and feed the entire village with the pork meat during a traditional ceremony.
- Spiritual Sanction: If the perpetrator denies the accusation or committing the violation without being caught, he/she would suffer illness or even death. It means you violate the *Tiaitiki* at your own risk.

e. Monitoring and Evaluation System

The monitoring system in *Tiaitiki* is not based in a formal regulation, it is more of customary rules, the responsibility for monitoring *Tiaitiki* is basically the authority of the chief of the tribe who has customary rights over the marine management, especially the Esuwei, Serontou and Seibu tribes. However, every member of the community, have the right to monitor and have the right to report to the chief of the tribe. The duty to enforce the customary law is the responsibility of the Chief of the Tribe through the *Ondowafi*.

f. Authority for Tiaitiki Management

In term of *Tiaitiki* management, the highest authority for *Tiaitiki* belongs to the chief of the tribe(s) that have customary rights on marine management for generations, especially Esuwei, Soronto and Seibu tribes, this structure has been agreed upon by all parties.

4.6 Livelihood Vulnerability of Depapre Community

Communities that are dependent on natural resources are highly vulnerable to environmental changes and shock; the adverse effects on the natural system are already evident. For marine and coastal systems, the direct impact of environmental changes such as ecosystem damages, abrasion, and climate change, can be seen from the increase in ocean temperatures, the rise of sea levels, the shifts in strength and time of currents, the alarming increase in tropical storm frequency, and ocean acidification, these changes will be strongly impacting the community livelihood. This change will have a ripple effect on the ecosystem, which in the end, will affect nature's capacity to provide goods and services in which the community depends their livelihood on. Social systems and sectors that depend on marine resources must adapt by changing, following the slightest change in environment, including changes in the distribution and productivity of important fishery species, potential losses in tourism (recreation and aesthetics) from important marine ecosystems such as coral reefs and coasts, also reducing the effects will also have a strong impact on the quality of social and cultural life of the community. Adaptation will be needed to mitigate the direct impacts such as changes in the availability of drinking water, coastal erosion, seawater intrusion also flooding on agricultural and settlement areas, as well as groundwater sources (FAO 2013).

Furthermore, FAO (2013) also explained that to understand and to map the linkages between social and ecological systems is complicated, however, understanding the underlying ground and cause of social vulnerability can provide substantive information for the future planning on coastal and marine resources management. Conventional vulnerability assessment has been primarily focusing on biological, physical and environmental aspects. However, the relationship between humans affected by the physical environment and ecosystems and their capacity to cope with and adapt to new situations plays an important role in the extent of vulnerability. In other words, people with different capacities to respond to changes will likely have different levels of vulnerability. Therefore, it is important to understand social vulnerability by conducting integrated biophysical and socio-economic assessments that complement each other.

The following section will discuss approaches that can be used to get the synoptic view about the level of vulnerability in term of community's livelihoods, and their adaptive capacity, also the implications for the management of Depapre Bay. Four aspects of livelihood are used to assess the level of vulnerability, namely: economic, social, institutional and ecological/physical aspects.

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The data collected from the field by using questionnaire were then tabulated and analyzed based on Coastal Community Livelihood Vulnerability Index, by adapting the works of Wongbusarakum et al (2011), Duy Can et al (2013) and FAO (2013) and Keshavarz et al (2017). The results of the analysis of the Coastal Community Livelihood Vulnerability Indexes are shown in Table 16 below.

a.1. Asset Ownership Whether there's a sharing arrangement for the land Image: Status and the extent of ownership for the land	Value of Aspects
a.1. Asset Ownership Ownership Owner	
a.1. Asset Ownership Whether there's a sharing arrangement for the land and means of production (whether the land	
Whether there's a sharing arrangement for the	
land and means of production (whether the land	
Is common property) 4.10	
production per activity 2.10	
a.2. Means of Ownership of the means of production (quantity, 2.00 2.07	
The number of productions per production	
period 2.10	
Source of capital/production cost (whether it is	
independent or depends on another party) 2.20	
a.3. Production Incentive/subsidy received from the government 1.90	
The existence of financing source for production	
from another party/institution 1.20 2	2.05
Type of the main occupation as a source of	
A Member of the household have part-time work 3 00	
An alternative activity that can serve as a source	
of income when there is disruption to the main	
a.4 Income livelihood 2.20 2.57	
Household per capita income >= RMW 3.20	
The ratio of income : spending 2.40	
Other members of the household who	
works/held occupation 3.10	
a.5. Market 2.65	
Product Price 4.00	
Capacity to save money from every production time/ every time 2.10	
An alternative source of funding in time of	
emergency 1.00	
The condition of the house 3.00	
Level of education 3.00	
b.1 Fulfillment of household 0.50 1.94 1	1.52
Capacity with regards to generating household	
Conflict on production asset/land use 1 20	

Table 1	6. Anal	vsis of	Coastal	Community	/ Livelihood	Vulnerability	/ Indexes	Depapre	Bav
	0.70101	y 515 01	oouolui	Communit		vaniorability	mackes	Dopupio	Duy

Aspects	Livelihood Variables	Indicators	Score of Indicators (1-5)	Score of Variable	Value of Aspects
		The presence of loan and savings program	(10)		
		among community members	0.40		
	b.2. Social	Availability of social safety net (Villagers		1 10	
	Network	collective fund or Village fund, etc.)	0.90	1.10	
		Solidarity/cooperation to work together in solving problems	2.00		
		Establishment of group based on similar profession (e.g. Fishermen Group)	3.00		
		Members of community/household join a social			
ect		organization	4.00		
Asp		Local leadership	4.20		
nal	c.1. Community	Availability of financial institution (bank or non-			
Itio	institutional	bank)	3.00	2.36	2.36
stitu	structure	Facilitator agency from the government or non-	4.40		
L L		government	1.40		
0		Availability of technical training and facilitation institution	0.50		
		Well-structured marketing institution to sell	0.40		
		The number of potential resources	0.40		
			5.00		2.36
	d.1. Land Resource	Area/land/marine area that can produce all the	F 00		
		time (seasonal)	5.00	3.10	
			2.00		
		Area/land/marine area with the assurance that it can be used	2.00 3.10	3.10	
		Alteration of land use for other use, e.g. conservation, special economic area	4 00		
		The plan to change production land, by the	1.00		
		community	0.60		
		Availability of food at all time	4.00		
		Availability of main staple food all year long	3 50		
		Incident of staple supply scarcity	0.50		
		Availability of local food products as alternatives	0.00		2.65
	d.2.	for the main staple food (rice, meat etc.)	5.00		2.00
	Food/Consumptio	Average consumption (amount of food/day) or		3.14	
	n	per capita (rice, fish, meat, etc.)	3.00		
		Household food consumption that meets the			
		government standard dietary (4 sehat lima			
		sempurna)	2.00		
ect		Easy access to clean water	4.00		
Asc		Availability of accessible health facilities	5.00		
sical		Life expectancy rate	4.00		
hys		Mortality rate per 100,000 births	2 00		
g//Ę	d.3. Health	Diseases that regularly appear, repetitive, or	2.00	3.17	
		chronic and epidemic	2.00		
с Ш		The number of permanent houses with good			
Ō		sanitation	3.00		

Aspects	Livelihood Variables	Indicators	Score of Indicators (1-5)	Score of Variable s	Value of Aspects
		Household with the standard sanitary facility	3.00		
		Incidents of harvest failure/the fish caught do not meet the target	1.50		
		Types of disturbance/disaster that pose a threat to the community			
	d 4. Disector Diele	Number of days without a natural disaster	4.00	1 01	
	d.4. Disaster Risk	Availability of work safety instruments in water or on land	0.00	1.21	
		The community has ways/techniques for mitigation of disaster			
		Emergency plan/evacuation plan	0.00		
	Меа	ns of Vulnerability Level			2.44

Note:

> 0.1-1.66 : very vulnerable;

1.67-3.33	: vulnerable

3.34-5 : invulnerable

The analysis on Table 16 shows that vulnerability level of Depapre Bay community can be classified as **VULNERABLE**, with the score of 2.44 or < 3.34 as the lowest point for the INVULNERABLE category. The most vulnerable aspect is social aspect, with the index score of 1.52, meanwhile, the physical aspect is the strongest one, even though the score is still below 3.34, thus, to low to be classified as invulnerable. Figure 17 illustrates the vulnerability index for each aspect.



Figure 16. Livelihood Vulnerability Index Depapre Bay Community

In term of vulnerability variable, the variables with the relatively high score are land resources, food/consumption, health and asset ownership, with an index score above 3, although it is still quite vulnerable because the score is still below 3.34. The other variables are still very low, for example Disaster variables, social networks, savings, production costs and means of production, and fulfillment of basic needs, which have the score lower or equal 2. Comparison of indexes of each vulnerability variable is shown in Figure 17.



Figure 17. Vulnerability Index for each livelihood variable

The figure shows that the most vulnerable variables on the livelihood vulnerability assessment for the Depapre Bay community are: (a) disaster risk, (b) social networks, (c) savings, (d) production cost, (e) means of production, and (f) fulfillment of basic needs, these aspects need to be strengthened and treated as priority in management and development program interventions. Some of the weak variables, especially those with the very low score of indicators, which need to be prioritized in the intervention programs are as follow:

Livelihood Variables	The Weak Indicators
	Incomplete means of production
Means of production	Insufficient ownership of means of production
	The amount of production is not optimal
	Insufficient access to capital/finance
Production cost	Insufficient incentive/subsidy
	Insufficient third-party source of finance for production
	Poor housing conditions
	Low education attainment
Fulfillment of basic needs	Insufficient capacity development program
	Insufficient management and technical skills to improve livelihood
	The occurrence of production asset/land use conflict
	Ineffective community loan and savings
Social network	Ineffective social safety network
	Lack of solidarity/cooperation to solve problems (low solidarity)
	Many incidents of harvest failure/the fish catch do not meet the target
Disaster Risk	The frequent occurrence of disturbance/disaster that poses a threat to the community
	Frequent days without a natural disaster, weather uncertainty or sea conditions
	Insufficient availability of work safety instruments in water or on land
	Insufficient knowledge/mechanism about disaster mitigation
	The absence of emergency plan/evacuation plan

Table 17	. The Weak	Vulnerability	Indicators
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Source: Analysis, 2018

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4.7 Social Resilience of the People of Depapre

Resilience has been widely placed as an important aspect in natural resources and environment management, including marine and small island resources management, according to Shaleh M et al (2014) the value or level of socio-economic resilience is a vital attribute that characterizes the capacity of a system to deal with pressure. However, it is not easy to promote resilience, especially in the context of Common Pool Resources (CPRs), which tend to be open access and highly contested among many non-standard interests and valuations. Studying socio-economic resilience in the context of managing marine protected area networks is important, because resource utilization activities have become increasingly massive in scale, under the pressure to fulfill the needs of humankind that tends to be exploitative. On the other hand, the absence of effective management has resulted in unlimited use of resources, and this will further damage the resources and put more pressure on the coastal environment, it would eventually result in a decrease of productivity, and will have the potential to threaten the resilience of the ecological-social systems within the area (Gowing et al., 2006).

According to Abesamis et al (2006), social resilience was initially defined as "capacity of a social system, involving multiple levels of government, communities and users, to embrace uncertainty and change in the advent of political, social or economic disturbances by building knowledge and understanding of resource and ecosystem dynamics". The previous definition of social resilience has been developed and defined by Adger (2000) as "the ability of groups or communities to cope with external stresses and disturbances as a result of social, political and environmental change". This definition highlights the fact that social security has economic, spatial and social dimensions and thus requires interdisciplinary understanding and analysis at different levels. "It differs fundamentally from ecological resilience by having the added capacity of humans to anticipate and plan for the future" (Moberg and Galaz 2005).

In the context of the relationship between communities and ecological resources, resilience is defined as the ability of an ecological system or a particular ecological-social system to withstand interference by absorbing and directing the changes to the variables within the system remain undisturbed (Holling, 1973; Folke, 2006).

This study identifies the concept of social resilience through key questions regarding the conditions of social resilience in Depapre Bay, what are the influencing factors, and what is needed to improve the social resilience in a community where MPA networks exist or will be established. The results of this study will be used as the basis for developing resilience strategy for human and ecological systems, which many experts believe as an effective way to cope with environmental changes, which is filled with unknown shocks and risks. The key principle is to involve adaptive capacity development and self-regulating abilities of the social-ecological system (SES). Referring to Abesamis et al (2006) concept regarding the main principles for building resilience and contextual variables and using it to analyze the data on social resilience in Depapre Bay, we can see that in overall, social resilience level of Depapre Bay community can be classified as moderate (score 6.19), with the weakest score at the self organization factor.





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In detail, the performance of each factor that influences Depapre Bay social resilience level, referring to the main principles to develop resilience and contextual variables from Abesamis et al (2006) can be explained as follows.

Factor 1. Learn to Live with Change and Uncertainty (Adaptability)

This factor illustrates how the community, and their social system, accepting change or crisis and living with uncertainty and risks. To enhance resilience, strategies for social-ecological management should take advantage of change and crisis and turn it into an opportunity for development. This approach is known as adaptive management. The Depapre community's performance on this factor, from the score 0-10, is **good**, with a relatively strong local leadership and vision (score 8.8 out of 10), by implementing traditional leadership of *Ondoafi* system, which is quite common in Papua. In this system, *Ondoafi* as the head of the tribe has the highest leadership, it means that the *Ondoafi* decision is the highest authority, and power is not given to other clans. However, the decision-making process is not authoritative and absolute, it is done by layer/tier, there is a division of authority between *Ondoafi* and his assistants (deputies) who come from tribes (clans) in the community, the relationship between the *Ondoafi* and the deputies also the chief of the tribes (clans) is actually collegial leadership (score 9).

Social resilience for people living in and around marine conservation areas can be defined as "their ability to cope with changes or stress brought about by MPA establishment and management without losing their critical functions as a community concerning social relations, economic prosperity and political stability" (Abisamis et al 2006). Looking at the Ondoafi leadership in Teluk Depapre, there will be no difficulties in acquiring the capacity to adapt and to build social capital; all the traditional leaders in the four villages have shown their support for the sea management (score 9). This is proven by the presence of a customary marine management system of "*Tiaitiki*" and "*Kendik Baip*" in every village, the system is basically mean as a prohibition to take sea products. This visionary local leadership is the proof for the strong potential for adaptation; another proof is the lack of negative influence from the demographic diversities in Depapre region. The area has started to be demographically heterogeneous, with the influx of residents from many other regions, but this demographic change does not cause negative influence, members of community have mutual respect and cooperation (Multi-level social networks) due to the enforcement of strong norms and customary rules, in fact, it produces positive influence on work ethic and education (score 9).

The level of performance for the factors that are key to leadership in facing changes and adaptation as the social resilience variable is shown in Figure 20.



Figure 19. Performance of Social Resilience Level of Depapre Bay for Leadership in Depapre Bay (Score 0-10)

Factor 2. Nurturing diversity for reorganization and renewal

This factor explains the level of resilience of the people of Depapre Bay in nurturing diversity for resilience, recognizing that diversity is insurance to uncertainty and shock. The diversity of knowledge, institutions and human

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opportunity and diversity of economic options all contribute to sustainability and adaptive opportunity of the people of Depapre Bay. The score for this factor, in overall, falls under the category '**Fair**' (6.02 of 10), and performance of each variable is highly varied, as illustrates in the following figure.



Figure 20. Performance of Social Resilience Level of Depapre Bay for Diversity and Renewal Capacity Factor (Score 0-10)

From Figure 20 we can see that there are different conditions for each variable that describe the level of performance of resilience for the factor of resilience in addressing the diversity of choices and the opportunity to ensure the sustainability of people's live. In term of the diversity of livelihoods, the Depapre area seems to have relatively homogeneous livelihoods, which means that there are not many livelihood options in the region (Diversity of livelihood is scored 3, or **low**). It is worth noting that there are only 3-4 developed livelihoods that based on natural resources namely fishermen, fish farming, marine tourism and transportation. Whereas trade and industry-based livelihoods have not yet developed. Dependence on fishing relatively dominates the livelihood, up to 67% of the population in 4 villages depends on fisheries resources (Resource dependency scored 3), and with Esuwae Tablasupa village has the highest percentage, while in Waaiya the lowest. However, in term of the diversity of the products, mostly only come as the primary production, which is fresh fish for consumption, and most only by providing ice for preservation. The range of sales is also only in the local sub-district of Depapre, even if some of the products are sold outside, usually it is by collectors from Sentani or Jayapura.

The tourism sector still not yet developed (only in Tablanusu Village), and Social Networking (scored 2) in Depapre Bay is almost homogeneous, because the dominant livelihood is fishing or based on fishing activities, where there is a relatively large number of fishermen. On average there are 85 fishermen per village, the merchant only consists less than 1% of the population, and tourism only operated by 2% of the population in Tablanusu, Tablasupa, and Waiyai with tourism activities in the form of marine tourism (beach tourism with tourist lodges) and fishing tours. This illustrates the vulnerability of the people in the face of changes or shocks. However, in term of income, the earning is relatively good, between IDR 1,500,000 million to IDR 7,000,000 per month (scored 6, **Fair**).

In term of a mechanism for natural resource utilization in Depapre Bay, the community has adopted a pattern of traditional mechanisms to regulate, control or manage the use of natural resources (Scored 9); it takes form in local knowledge called *Tiaitiki* (Tablasupa, Waiyai, and Tabanusu) and *Kendik Baip* (in Kendate). This local regulatory mechanism is based on the customary rights of indigenous peoples over the sea, where the boundaries are a natural landmark, such as cape (reef). Unfortunately, customary rights-based marine management is still very local and has not become a larger scale force for massive marine conservation management, although in almost all villages there are customary mechanisms. This suggests that multilevel networks for conservation are still very weak (scored 3) due to the weak connectivity between conservation stakeholders (scored 2). The scale is only local, or up to Regency (Kabupaten) level at the most, thus it is not yet a joint movement. This could be a missing

opportunity because the level of trust from the stakeholders towards local leadership is very high (scored 9.5), this potential can be mobilized to organize Depapre Bay clean marine conservation movement, given that the community would have a strong feeling and would be very disturbed by the potential of disruption to the conservation due to corruption (scored 9), in addition, the relationship between community members is relatively strong (scored 9). Diversity also comes in the form of social heterogeneity, where the composition of the population of Depapre Bay is still dominated by indigenous people with a composition of > 87.5%, however, there is no negative attitude towards the migrants (scored 8.7).

Factor 3. Learning and Knowledge

This factor examines the extent of knowledge, experience and understanding of the community about complex ecosystems, their inclusion in management systems and their complementarity to conventional management. The experience of local communities and traditional communities in managing their resources can enrich our understanding of complex adaptive systems and ecosystem management. Combining different ways of knowing and learning will allow different stakeholders to work together, even with much uncertainty and limited information. Much like in the second principle of resilience, social memory is critical for building knowledge and learning because it links past experiences with present and future policies. Based on the identification, the variables that affect the level of resilience in the learning and local knowledge system factor is shown below.



Figure 21. Performance of Social Resilience Level of Depapre Bay for Learning and Local Knowledge (Score 0-10)

Figure 21 suggests that this factor has a very high score; the only uneven variable is in the variable for community's ownership at sea (scored 0), because the customary rights do not grant personal ownership but communal ownership with the quasi-open access system (semi-open). The local management system that based local customary law called *Tiaitiki* and *Kendik Baip*, are the only mechanisms to regulate community's access to marine resources in Depapre Bay. However, because the area that is the object of management is limited to a stretch of coral reef and not permanent, this system is considered incomplete (scored 4)

However, in principle, the local system does not contradict the modern MPA system (Scored 10), only the Depapre Bay customary system does not necessarily agree if this local system is incorporated directly into the modern management system. The community believes that local social conventions for environmental protection in the form of *Tiaitiki* and *Kendik Baip* (scored 9.5) can be used and applied for the protection of the Depapre Bay Sea under customary control and management with the supervision of the chief of tribe who owned the customary rights over the sea (scored 10).

In the process of collaborative management (co-management), successful transformational learning is towards adaptive governance. This type of learning emphasizes on learning as people use and manage resources,

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monitoring and accumulating knowledge on the way, and constantly adjusting the rules that shape their behavior to match the dynamics and uncertainty inherent in the system (Folke et al. 2002). In the context of Depapre Bay, the score for transformational learning is still quite low (scored 6.5), this closely linked to awareness of the importance of conservation for their region. There is a difference of awareness in Tablasupa and Waiyai with Kendate and Tablanusu. Tablasupa and Waiyai have a more positive perception toward the benefits of marine protection (scored 7). In other variables related to willingness to hand over land/resources, where not all parties voluntarily hand over the management rights to the management institutions, except fishermen and village government will give to the government. The tourism sector will object, as does aquaculture business, while fishermen will willingly hand over (scored 6).

Unfortunately, for the variable Collaborative Planning and Participation, the score is still low (scored 4.75), where community still have not been much involved in all stages of conservation area management (starting from creating the design of the MPA, implementation, monitoring and evaluation), whereas collaboration and participation are very important to ensure higher efficiency of the management. Participation from stakeholders/community builds trust, enhances the legitimacy of rules and regulations and ensures the sustainability of MPA implementation plans by giving stakeholders a sense of ownership or responsibility for the MPA and its management arrangements (Tompkins and Adger 2004). In the case of Depapre Bay, public participation is still absent from the management, and there has never been a communication mechanism to promote the MPA (scored 1, **very poor**). The *Ondoafi* as the customary leader is considered as a representative of the entire community, thus, the voice of Ondoafi represents the community, and fortunately the *ondoafi* has always supported the marine management efforts (scored 8).

Unfortunately, in Depapre Bay there has still no instrument of collaboration between groups or between villages in managing their sea, in of conserving Depapre Bay (scored 0), including no collaboration between villages that have customary *Tiaitiki* and *Kendik Baip* laws. This might be due to the lack of activity/program that promotes marine conservation to the general public, either through workshops, consultations, or public forums and meetings (Scored 0). Stakeholder involvement in marine conservation activities is still limited as well (scored 3). However, for other matters related to development, the relationship between stakeholders in this region is relatively good (scored 8), this suggest that the level of trust in local leaders, either formal (village head, sub-district head, etc.) or informal (customary leader, *Ondoafi*) in regional management is well established (scored 10). This is also supported by the close relationship between community members (value 8).

Customary leadership which is considered absolute, gives the impression to other parties, especially the government, that they only need to invite these customary leaders to discuss matters related to conservation, this is evident from the fact that member of the community apart from these leaders have never received socialization or have been invited to discussion regarding conservation of Depapre Bay. However, at the village stakeholders level (village and customary leaders), connectivity between stakeholders has been well established with a very high level of trust (scored 10), as well as the close relationship between communities is relatively strong, even with migrants (scored 8.5).

Factor 4. Creating Opportunity for Self-organization

This factor examines the capacity of a system (community) to self organize (self-organization), The ability to selforganize is important in systems of adaptive co-management and is an essential element of adaptive capacity (Abisamis et al. 2006), this process would support the establishment of adaptive *co-management*, in which the process by which institutional arrangements and ecological knowledge are tested and revised in a dynamic, ongoing self-organized process of learning-by-doing (Folke et al. 2002). Abesamis et al (2006) suggest that selforganization is key to social resilience, and requires capacity assurance on:

a. Multilevel polycentric governance and accountability

This builds social resilience by sharing and distributing power and by encouraging cross-level interactions and cooperation among stakeholders or institutions. An advantage of polycentric arrangements for MPA network management is that it provides an institutionally rich environment that improves the prospects of resolving complex problems; it can encourage innovation and experimentation by allowing individuals and organizations to explore

different ideas about solving problems; creates a variety of feedback loops at different scales and contributes to scale matching of social-ecological dynamics (Olsson 2003).

b. Conflict Resolution Mechanism

For a community to be resilient to interpersonal and inter-stakeholder conflicts, these should not be addressed on an ad-hoc basis or ignored until they reach a crisis stage.

c. Capacity

This variable focuses on capacity-building activities can range from broad environmental education, MPA planning and management, monitoring and research, enforcement and surveillance to help community learn from the process, internal conflict resolution, participatory evaluation and feedback, and providing capacity development and financial management for self-organization management, to avoid dependency toward external donor, and to encourage transparent and accountable management.

d. Monitoring and Feedback Loops

Sharing of information and feedback also allow appropriate adjustments in human behavior and management actions to match current environmental or social changes (Abesamis et al 2006). If we examine all the variables in this factor, this seems to be the weakest factor and there seems to be inconsistency in Depapre Bay, with the total score of this factor is only 3.19. This result suggests that in term of self-organization, that involves a wide range of stakeholders, is still problematic. Performance of the variables can be seen in the following figure.



Figure 22. Performance of Social Resilience Level of Depapre Bay for Self-Organization (Score 0-10)

Figure 22 suggests that most variables are still very weak. Only the variables of conflict resolution mechanism, readiness to accept rules and rules that are simple and understandable, the scores are sufficient. For other variables, such as the aspects of governance and accountability, capacity, and monitoring are still very weak; in fact, there are many that are still not in place (Scored 0). Governance and accountability of MPA management is still very far from sufficient (Scored only 2), meanwhile decision-making arrangements is not yet in place except those that have become customary law (scored 2), and cooperation in implementing the management is limited to general relations without a shared agenda (scored 2) and local mechanisms to ensure the accountability of the

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MPA has not been elaborated further (scored 0). The score for governance and accountability in managing Depapre Bay is also still very low since the management is still based entirely on customary law, which is hereditary, relying on the leader's charisma and verbal rules. Very rarely formal legal instruments adopted, to signify that the customary law still works properly, although customary law has been quite effective so far, in fact, it has been proven that the customary system that applies to everyone (including people from outside the customary system, such as immigrants) is quite successful (scored 10). Traditional and informal customary-based management mechanisms that can guarantee the sustainability of a proper management are still highly insufficient, the mechanisms need to be elaborated further to ensure the sustainability of the management of Depapre Bay for future generations. Conflict resolution in Depapre Bay is relatively effective (scored 8). The conflicts that commonly occur have been defined relatively well (scored 7), which is mostly Clan conflict (family/tribal conflict) related to production land or residence, and a customary legal mechanism to resolve such conflicts has been in place, it is very rare for the conflict to escalates further into a bigger conflict. The community has established a mechanism for resolving conflicts with the customary institutions serve as facilitating institution to resolve the conflicts (scored 8). *Ondoafi*, as protectors of the community, acts as the judge for conflict in the community, including for conflict over natural resources (scored 9).

However, in term of capacity development for the community, there is still very little opportunity to obtain capacity building on marine management for fishermen or customary leaders, since there is no communication channel for conservation area management (scored 0.2 = very poor), the opportunity improve local capacity has not been opened as well. As a result, there is no effective resource management mechanism in Depapre Bay, because there has been no training or capacity building to strengthen the MPA network (scored 2).

Monitoring for the Gulf Depapre community is considered not necessary for broader management, only as a customary task, and there has been no institution that specializes in regional supervision, except on land (by the Nature Conservancy Agency of Papua Province or Balai Konservasi Sumber Daya Alam/BKSDA), and the existing monitoring only for monitoring *Tiaitiki* and limited within the system/customary territory (scored 0.1), the monitoring is not directed towards monitoring of wider area (scored 0.2).

Even though customary law is predominantly in place (the type of regulation is still entirely customary and local (scored 4), the existing regulation enforcement system is actually a combination of customary law and formal law, because there is already BKSDA intervention in enforcement of the regulation, especially in the area of land ecosystems (forest) (scored 4), because the customary rules are considered not specific enough in defining the rules. However, 75% of the community considers that customary rules regarding marine management are easily understood; only in Kendate the rules are considered complicated (scored 7.5). The formal rules are acceptable by customary law, and not considered contradictory to the customary rules (scored 9).

Knowledge about MPA management is still insufficient, people mostly understand the customary rules with *Tiaitiki* boundaries, which are established based on traditional rules, and in the form of cape or reef flat (scored 2). Knowledge about the area as a candidate for MPA is not yet widely understood by the community (scored 1), this situation is also related to the lack of involvement from the scholar community (academics, researchers and activists), thus, support from the scientific area is still very lacking (scored 3). Moreover, traditional leaders' involvement in data inventory and marine protection (MPA) in Depapre Bay only limited to some of the customary leaders/elders (scored 1), as is the case with the involvement of religious leaders (scored 1). We can consider that the data collecting process for Depapre Bay MPA is less participatory because it does not involve any village (scored 0), involvement in the planning process is also low, because there was no village invited to the deliberate planning meeting for the MPA (scored 0). As a result, the data is weak because the data collection and data administration processes are also weak, in addition to the low awareness in all villages in term of data (scored 0).

We can hereby conclude that social resilience level of Depapre Bay community can be classified as MODERATE, with the strongest resilient factor is leadership, and the weakest resilient factor is self-organizing.

4.8 Institutional Economic of Conservation Management of Depapre Area

4.8.1 Institutional Economic Analysis of Jayapura Marine Protection Area Management

The presence of marine protected area in Depapre Bay, Jayapura Regency, at least provides benefits in the form of provisioning services, such as fish, shrimp, crab commodities and a wide range of products that are produced directly from the ecosystems associated with the MPA. In addition, the MPA also provide regulating services, such as climate regulation, abrasion restraints, flood control, and many more. The MPA also provides cultural services such as recreation, education, and research, besides, of course, habitat services, in which the MPA serves as breeding grounds for marine biota, nurturing areas and provision of nutrients/marine biota food. All benefits from the marine protection area strongly suggest that the management of the ecosystem function is highly importance, given its role as the source of welfare for the local community.

The local wisdom of the local community is also one of the things that need to be considered in the MPA management. The presence of local wisdom in natural resource and environmental management suggests that the local community have acknowledged and understood their dependence on coastal and marine resources, thus, the sustainability of resources becomes something that needs to be maintained and preserved, so that the future generation could still reap at least the same amount of resource that the present generation gets. Based on the data, Depapre Bay protected area, Jayapura, is 5,747.66 hectares, consisting of 172.43 hectares of mangrove ecosystems, 14.37 hectares of sea grass beds, 86.21 hectares of coral reefs and 5,489.02 hectares of waters. Based on the economic value generated from various references, the value of the marine conservation area can be estimated to be around IDR 1.62 trillion per year, which in brief, can be seen in the following table.

No	Consequence	Value (IDR	Area (ha)	Total Value (IDR
NO	oonsequence	million/ha/year)		billion/year)
1	Economic Value of Mangrove Ecosystem	4535,72	172,43	782,09
	- Provisioning/production Services	70,13		
	- Regulating Services	4012,21		
	- Cultural/Information Services	51,31		
	- Habitat/Support Services	402,06		
2	Economic Value of Sea grass Bed Ecosystem	1623,16	14,37	23,32
	- Provisioning/production Services	394,51		
	- Regulating Services	101,39		
	- Cultural/Information Services	198,33		
	- Habitat/Support Services	928,92		
3	Economic Value of Coral Reef Ecosystem	8520,54	86,21	734,60
	- Provisioning/production Services	1290,27		
	- Regulating Services	3309,73		
	- Cultural/Information Services	3564,43		
	- Habitat/Support Services	356,10		
4	Economic Value of Open Water Ecosystem	15,29	5489,02	83,93
	- Provisioning/production Services	2,03		
	- Regulating Services	3,42		
	- Cultural/Information Services	3,12		
	- Habitat/Support Services	6,71		
	Total Nilai Kawasan Konservasi Perairan			1623,95

Table 18. Estimation of Economic Value of MPA Resource	ces in Depapre Bay-Jayapura Regency
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Source: Wahyudin (2017, 2018)

According to WWF literature, the management fund for one hectare of protected area is USD 35-150, or with reference to rupiah exchange rate to US dollars of IDR 14,000/USD, the transaction costs for marine protected area can reach at least IDR 0.49 million per hectare per year, the maximum cost would be IDR 2.1 million per hectare per year. Thus, for an area of 5,747.66 hectares, the total management cost for Jayapura marine protected area can reach IDR 2.82-12.07 billion per year. We can safely say that the management of the protected area of Depapre Bay, Jayapura, is economically feasible because the benefit of managing the area is far greater than the transaction costs that must be spent annually.

PES (payment for ecosystem services) is an instrument to obtain the grants needed to manage the marine protected area. According to the theory developed by Wahyudin (2017), we can apply the following formula to

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determine the basic levies for the payment for ecosystem services:

$$BPES = \frac{CSV}{CC}....(1)$$

With BPES as the basic levy per person, *CSV* as the Cultural Services value of the protected area, and *CC* as the maximum number of users that can utilize the area in accordance to the carrying capacity and environmental capacity of the area. The value of cultural/information services from protected area is IDR 3765.89 million/ha/year, thus, with a maximum capacity of 200 people per hectare per day, or as many as 73 thousand per year, the value of the basic levy is IDR 51,587.52 per person per visit. Payment of these fees can be done by integrating the payment system with payment of support services, such as accommodation, transportation and or equipment rental

4.8.2 Policy Recommendations through the Implementation of Payment for Ecosystem Services on the MPA

A sustainable management of marine protected area is needed; in order for the protected area to serve their functions as an area that provides sustainable ecological, socio-cultural and economic benefits (Wahyudin et al, 2018). Ecosystem-based management approach is the best approach to ensure that the ecosystem service and functions can be maintained, and it can serve as a sustainable source of fund that is beneficial to the people's welfare through the promotion of payments for ecosystem services.

Payments for ecosystem services are incentives offered to preserve the ecosystems in order for them to sustainably provide goods and services that can benefit humankind. According to Hanley and White (2014), payments for ecosystem services are intended to provide financial incentives for resource owners, or managers, to protect biodiversity within their area and ensure that the community can still utilize the ecosystem services optimally and sustainably. Meanwhile, according to Wunder (2005), Payments for Ecosystem Services (PES) can be defined as: (i) A voluntary transaction, (ii) payment given for a well-defined environmental service (ES) (or a land-use likely to secure that service), (iii) is being 'bought' by ES buyer, (iv) the payment is paid to a manager or ES provider (v) the payment is offered to the ES manager or provider to ensure the sustainability of services provided by an ecosystem services. Payments for ecosystem services are real financial incentives that can be given to maintaining the sustainability of biodiversity conservation activities, especially in a marine conservation area (OECD, 2010).

Payments for ecosystem services (PES) is a key instrument that needs to be developed to provide a sustainable financial source for the management of the conservation area. Iterative study of all existing documents, both directly and indirectly, so that they can be a reference in implementing the PES that will to create a source of funds for the management of MPAs in the future, thus expressing the benefit of the existence of the MPA in the monetary term. ES is designed based on ecological values, economic values and social values of the four ecosystem services provided by coastal, marine, and terrestrial resources. These four ecosystem services have provided great benefits to humankind through social and ecological connectivity system, either in the "tangible" and "intangible" forms. The "tangible" value refers to the existence of goods as a result from the existence of ecosystems in an area (supply/production services), while the "intangible" value refers to the benefit that may not be directly felt through services such as (i) regulating services (coral reef services as breakwaters, mangrove services as abrasion restraints, etc.); (ii) cultural services that can be obtained from the existence of enjoyable aesthetic values, also as a place to conduct research and gaining knowledge; and (iii) support services, from the existence of mangroves as breeding ground, nutrient cycles and primary production.

The basic levy of the PES is IDR 51,587.52 per person per visit. The payment can be done by integrating the payment system with payment of the support services in that area, such as accommodation, transportation and or equipment rental. This levy is an effort to maintain the sustainability of the management program and in turn would be able to promote resources sustainability Jayapura Marine Protected Area.

Wahyudin (2017) states that the management of the ecosystem services levies should be institutionalized as a public service body or *Badan Layanan Umum* (BLU). This BLU is very suitable to be used as an institutional model for managing the funds, because it has been implemented in several regions and relatively effective and

successful. One success story that can be used as a reference and/or institutional comparative study model is BLUD in the Raja Ampat Regency.

Furthermore, Wahyudin (2017) states that since ecosystem service is a gift from God, and the benefit of the ecosystem service must be able to meet the principle of social justice for every citizen if Indonesia, especially the people of Jayapura. Therefore, the revenue sharing system from the ecosystem service levy must also adhere to the principles of justice and equity. The proportion of distribution of the levies is as follows:

- 30 percent belongs to the people of Jayapura as a whole, and the distribution is based on the proportion of the coastal and marine ecosystems area, the number of visitors/tourists visiting the sub-district, and the proportion of the regional budget spent for the environmental management of that area
- 70 percent belongs to the local MPA management, in which the utilization is also shared proportionally based on the need of the MPA management.

Wahyudin (2017) emphasized that the utilization of the shared revenue from the levy can be divided to 3 (three) parts, namely operational fund, rehabilitation fund, and development fund for village/urban village. The proportion of the shared revenue is as follow:

- 50 percent for ecosystem rehabilitation/restoration;
- 20 percent for an operational fund for management/maintenance of the ecosystem; and
- 30 percent for development fund for the village/urban village, that should be proportionally shared based on the area of coastal and marine protected area managed by the hamlet, the number of visitors/tourist visiting the respective village/urban village and share of village budget spent for the environmental management.

CHAPTER 5. ADAPTATION STRATEGY FOR DEVELOPMENT OF LIVELIHOODS AND CONSERVATION FOR THE PEOPLE OF DEPAPRE BAY AND THE SURROUNDING AREA

Based on the livelihood vulnerability analysis, the most vulnerable variables on the livelihood vulnerability assessment for the Depapre Bay community are: (a) disaster risk, (b) social networks, (c) savings, (d) production cost, (e) means of production, and (f) fulfillment of basic needs, these aspects need to be strengthened and treated as priority in management and development program interventions. Some of the weak variables, especially those with the very low score of indicators, which need to be prioritized in the intervention programs are as follow:

Vulnerability Variables	Indicators that need to be Strengthened
	Incomplete means of production
Means of production	Insufficient ownership of means of production
	The amount of production is not optimal
	Insufficient access to capital/finance
Production cost	Insufficient incentive/subsidy
	Insufficient third-party source of finance for production
	Poor housing conditions
	Low education attainment
Fulfillment of basic needs	Insufficient capacity development program
	Technical and management capabilities for improving low-income livelihoods
	The occurrence of production asset/land use conflict
	Ineffective community loan and savings
Social network	Ineffective social safety network
	Lack of solidarity/cooperation to solve problems (low solidarity)
	Many incidents of harvest failure/the fish catch do not meet target
Disaster Risk	Frequent occurrence of disturbance/disaster that pose a threat to community
	Frequent days without natural disaster, weather uncertainty or sea conditions
	Insufficient availability of work safety instruments in water or on land
	Insufficient knowledge/mechanism about disaster mitigation
	The absence of emergency plan/evacuation plan

Table 19. Vulnerable Livelihood Indicators that need to be strengthened

Source: Analysis, 2018.

The strategy is carefully formulated by using gap analysis method and focused differentiation approach. This means maintaining the stronger aspects and focusing on the weakest point of the organizational system (in this case the people of Depapre Bay), with reversal techniques, which means the strategy is focusing on reversing the negative (weak) indicators to positive (strong). The strategy aims to balance the level of livelihood vulnerability and the resilience level to be in a more balanced position for each factor, variable and indicator.

Table 20	. Intervention	to	Strengthen	Livelihood	Indicators
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Variable	Intervention Strategy
	Provision of means of production on each household
Means of production	Ensuring ownership of means of production
	Improving productivity through capacity development and improvement of technological skill
	Provision of financing scheme with simple/flexible access to capital/financing
Production cost	Promotion of incentive/subsidy for productive business
	Encourage the establishment of productive financial institution
	Promotion of healthy and proper housing
	Improvement of access to education, through scholarship and subsidy scheme, at least up to high school level
Fulfillment of basic needs	Capacity development program that oriented to management skills/technical
	Facilitation and training on technical and managerial of the existing livelihoods
	Conflict management for the utilization of customary lands as production asset through harmonization with customary elders/leaders
Casial natural	Promotion of social safety net based on local wisdom such as community savings and loans
Social network	Solidarity/cooperation program for small-scale neighborhood, such as <i>Dasawisma</i> (Women Neighborhood Group) or tribe
Minimizing the Risk/Disaster Risk	Anticipate harvest failure or lack of fish catch by using anticipative/predictive technology
	Promotion of disaster risk awareness through disaster mitigation workshop
	Establishment of disaster-ready community workgroup (trained and skilled)
	Provision of safety kit for work especially in the sea (floating device, GPS and Emergency Kit)
	Facilitation/training on disaster anticipation and response for the community
	Mapping of disaster-prone area and formulation of Emergency plan/evacuation plan, especially for coastal community (who lives in coastal area)

5.1. Strategy for Improving Social Economic Resilience

5.1.1. Strengthening and Development of Livelihoods Strategy

The strategy to improve the livelihoods of the people of Depapre Bay, is to anticipate the shortcomings that still have not exist and to strengthen the weak aspects. Referring to the vulnerability analysis of Depapre community, livelihoods vulnerability is in the aspects of means of production, insufficient financing for production activities, lack of capacity building programs, insufficient economic cooperation networks, and weak disaster mitigation. The strategies to improve the livelihoods are as follow:

- a. Improvement of proficiency with regards to production aspects, which includes provision of infrastructures and facilities, and mastery of production technology
- b. Facilitation of financing for productive activities, and not for consumptive, for economic actors, through incentive system to attract the existing entrepreneur to intensify their business
- c. Encourage new entrepreneurs through facilitation of means of production and capital as incentives
- d. Intensification of capacity building programs for entrepreneurs and for youth as potential entrepreneurs,
- e. Create collaboration of community economic network with joint business entity
- f. The government must conduct the mapping of disaster-prone area and formulate disaster mitigation strategy, which is currently unavailable in Depapre Bay.

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5.1.2. Capacity Development Program for Community

As a strategy to develop the capacity of the people of Depapre, the vulnerability analysis has identified that the weak variables that need to be addressed is low education attainment and insufficient capacity development program. The following activities need to be implemented to address the issues:

- Strategy to increase education attainment level to reach higher education level for the people of Depapre, this strategy would automatically improve the quality of life for the people, who have been at the disadvantage all this time because they have low education level.
- Capacity development program for the people of Depapre Bay, especially capacity to have better awareness about their rights and better motivation to have accomplishments.
- Capacity development program for technical and managerial skills to improve livelihoods of the community, to help them expand their livelihoods and upscale their business
- Trainings and *capacity building* programs for the local community related to increasing their awareness on marine resources, functions, and their benefit for the community. Knowledge and awareness about marine resources as well as their functions, and benefits highly important to strengthen the MPA network in this area.

5.1.3. Social economic adaptation strategy within the context of developing area (Depapre Port)

The presence of new economic activities in the area, with the biggest one being Depapre Port, will change the facade of Depapre Bay. These changes will soon be followed by other changes, including the influx of migrants who will perform various activities. The main concern would be the marginalization of the local people due to their low competitiveness, and the migrants might have better capacities than the local people. In addition, the local people also have low resilience, thus they might be easily left behind and become marginalized group in their own home.

An effective adaptation strategy is needed to anticipate these concerns. Some of the strategies that need to be developed are:

- Cultural Adaptation. It is important to educate and change the mindset of the local people to prevent cultural a. shock and to fortify them against negative influences from the outside. The opening of the area to the outside influence will also bring bad influences such as liguor and addictive drugs, that would easily influence the youth who have never been exposed to this kind of substance and not aware about the danger, they need cultural defenses to fortify themselves against these negative influences. Therefore, regional governments need to provide more intensive mental and spiritual education. Furthermore, the local people believe that nature has provided all their needs, thus they tend to be more relax and uncompetitive, thus, cultural adaptation also need to change the mindset of the local people to be more open and competitive, to create a more dynamic culture/ready to compete (in a positive way). The local people need to change their perception about livelihood, when they go to sea to catch some fish, they still only seek to fulfill their daily need, they still have no business mindset, it is important for them to think in a more progressive manner, not just to catch fish for consumption, but rather seek business opportunity. Preparing the local people mentally is very important, especially the youth, as productive forces in the future, to prepare them for the future competition, and even become a cultural mouthpiece to the outside world. The principle of this cultural adaptation is to help the locals to be more selective in receiving influence from the outside, they need to take the goods and reject the bad ones.
- b. Social Adaptation. Social adaptation is carried out by strengthening social cooperation connection, especially among the indigenous/local communities to strengthen their social network; this is particularly relevant for the protection the indigenous community. The social cooperation can be developed by increasing social communication between tribes/communities, also by increasing the intensity of mutual assistance, joint customary events, etc. to create a sense of shared ownership over natural resources, territory, and identity. With this sense of ownership and communal identity, the community will share every problem. Ondoafi plays an important role in encouraging this social collaboration because social cooperation can be easily established based on the same cultural backgrounds and identity/fate.
- c. Economic Adaptation. The development of Depapre Port will automatically create extensive economic opportunities; there will be new business fields or employment opportunities to support regional economic activities. Many people will compete for the opportunities however, only those who are highly competitive will win the competition. In order to compete, people must be smart (able to read the opportunities), skilled (able

to create opportunities) and observant (able to seize the opportunities), and the locals of Depapre must be prepared to compete with the more competitive migrants. The locals should not only rely on ownership of natural resources but also lack the ability to efficiently use the resources. It is important to create new livelihoods smartly, such as by providing the needs of workers, such as food stalls, lodging, grocery stores, transportation, and entertainment.

5.1.4. Facilitation Programs

For the livelihood development programs and adaptation, programs can remain consistent, facilitations are needed. The facilitations are especially for the local community, to help them run their business, either for technical and/or managerial skills. The regional government must develop the initial facilitations program, and the facilitation activities can be done by academics from universities as well as non-governmental organizations (NGOs as well as scholars).

5.2. Strategy for Strengthening Depapre Bay Conservation Based on Local Wisdom

5.2.1. Improving Participation in the Initiation and Establishment of Depapre Bay Marine Protected Area (MPA)

The data needed for the initiation and establishment of Depapre Bay MPA is still very few and inadequate, community support is also insufficient. This resulted from the strategy for initiating and establishing Depapre Bay MPA in the beginning, which was a top-down process, only from the regional government, without the participation of the local community and indigenous people. Consequently, the bargaining power of the initiation and establishment of Depapre Bay MPA is weak.

The initiation and establishment of Depapre Bay MPA still need to be supported by complete and reliable data on location, also support from the local community, especially the *Tiaitiki* institution, because they have better knowledge about the characteristics of resources in Depapre Bay, such as the location of coral reef, mangrove and sea grass ecosystems, and their present conditions. Adopting this local knowledge of indigenous people, would not only makes the work of the initiative team easier and more efficient, it would also strengthen the legitimacy of the proposal and establishment process. The team would even have better advantage if representatives from *Tiaitiki* institutions become part of the team, thus the Team is not only composed of government, and academics, but also has representatives from the local community.

5.2.2. Institutional Development of Tiatiki as a basis for Co-management

The development of conservation area around Depapre Bay must be based on local wisdom; therefore *Tiaitiki* institutions must be the pillar of the initiation, establishment, and management of Depapre Bay MPA. Therefore, the authority (in this case the Provincial Maritime Affairs and Fisheries Office) must place Depapre Bay community, in this case, *Tiaitiki* institution as the main actor. The problem is, Tiaitiki stakeholders have insufficient capacity. Therefore, facilitation from non-governmental institutions, both NGOs and academics, to strengthen the personal and institutional capacity of Tiatiki is highly needed. With adequate capacity, the stakeholders would be able to oversee the process of MPA initiation, all the way until the establishment of institutional management of the MPA, with a stronger bargaining position of the local communities, to ensure the interests of Depapre Bay community are not neglected.

As a form of cooperation and local community involvement in the management of the Depapre Bay area, it is expected that there will be sharing of authority in the implementation of management, with a clear distribution of rights, obligations, and authorities among stakeholders, between the government and community, this is what we define as Collaborative Management (Co-management).

5.2.3. Selection of Effective Management Model for the MPA

An effective management of the MPA is needed to ensure that the area can play their functions as a source of sustainable ecological, socio-cultural and economic benefits. In order to accomplish that in Depapre Bay, a strategy is needed:

a. Adaptive management, in this case, the formal approach alone will not be effective, it must also involve

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informal approach. The involvement of local communities through *Tiaitiki* institutions will ensure the sustainability of the management of this area.

- b. Ecosystem-based Management, this strategy is the best approach to ensure the sustainability of ecosystem functions and services, and able to become sources of sustainable fund that benefit the community welfare through the development of Payments for Ecosystem Services.
- c. Integrated Management. The wide range of interests in Depapre Bay has made this area multi-use, multidisciplines, multi-stakeholders, and consequently, filled with competition for different interests. The involvement of all stakeholders would ensure the representation of their interests, it is also equally important that stakeholders understand each other's interest, to reach mutual agreement. Regional government (Jayapura Regency or Papua Province) can act as facilitator or mediator.

5.3. Strategy for Institutional Economic Incentive Scheme for the Development of Marine Protected Area of Depapre Bay

Strategy that can be developed as an incentive strategy for the development of the protected area is Payments for Environmental Services or PES. The basic levy of the PES is IDR 51,587.52 per person per visit. The payment can be done by integrating the payment system with payment of the support services in that area, such as accommodation, transportation and or equipment rental. This levy is an effort to maintain the sustainability of the management program and in turn would be able to promote resources sustainability Jayapura Marine Protected Area.

The proposed scheme is a revenue-sharing system from the ecosystem service levy that will be done by adhering to the principles of justice and equity. The proportion of distribution of the levies is as follows:

- 30 percent belongs to the people of Depapre Bay, Jayapura, as a whole, and the distribution is based on the proportion of the coastal and marine ecosystems area, the number of visitors/tourists visiting the sub-district, and the proportion of regional budget spent for the environmental management of that area.
- 70 percent belongs to the local MPA management, in which the utilization is also shared proportionally based on the need of the MPA management.

The proportion of the shared revenue is as follow:

- 50 percent for ecosystem rehabilitation/restoration;
- 20 percent for operational fund for management/maintenance of the ecosystem; and
- 30 percent for development fund for the village/urban village, that should be proportionally shared based on the area of coastal and marine protected area managed by the hamlet, the number of visitors/tourist visiting the respective village/urban village and share of village budget spent for the environmental management.

CHAPTER 6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

- 1. Some of the main problems in Depapre Bay, in term of ecological aspects are (a) Destruction of coral and *fishing ground* (within the area of *Tiaitiki*) resulting from the backfilling of Depapre port, (b) Turbidity and destruction of coral and sea grass caused by sedimentation, from the construction of the port; and (c) The on-going practice of destructive fishing, and using tooba root (sap from local tree). In term of social aspect, the strategic issues are: (a) Uncertainty in the establishment of Depapre Bay Marine Protected Area, resulting from the shift of authority in marine management from regency office to provincial office; (b) overlap in planning between MPA and construction of the port, the blueprint of the port development, which refers to the Port Work scope Map or *Peta Daerah Lingkungan Kerja Pelabuhan* (DLKPr and DLKPk) includes the entire Depapre Bay area, this overlap might lead to conflict of authority and zoning conflict for the marine area; (c) Lack of socialization and community involvement in development planning, including the plan for the Port construction and the establishment of the Marine Protected Area, which seems to be planned on the same area.
- Potential alternative livelihoods that can be developed for the community of Depapre Bay based on economic, social, and market feasibility assessment are (a) Construction and renting of cottage, (b) Smoked fish business, and (c) promotion of FAD for fishing.
- 3. The people of Depapre Bay have developed a natural resources management system called *TIAITIKI*, in term of institutional, it is relatively complete, it already has boundaries system, rights system, sanctions system, and monitoring and evaluation mechanism, however, these systems are not yet defined as written regulations and formalized, they are still in form of customary rules, norms, and informal.
- 4. Vulnerability level of the Depapre community can be classified as **VULNERABLE**, with the most vulnerable aspect is social aspect, and the strongest one is Physical aspect, even though it still not yet Invulnerable.
- 5. Level of social resilience of the people of Depapre is still at the **FAIR**, with the most resilient factor is leadership, and the weakest factor is self-organizing.
- 6. The value of the marine conservation area can be estimated to be around IDR 1.62 trillion per year, meanwhile, total cost to manage the area can be up to IDR 2.82-12.07 billion per year, to manage the area of 5,747.66 hectare. We can safely say that the management of the protected area of Depapre Bay, Jayapura, is economically feasible because the benefit of managing the area is far greater than the transaction costs that must be spent annually. The charging can be done through PES (*payment for environmental services*) approach, with the management of the ecosystem services levy should be institutionalized as a public service body or *Badan Layanan Umum* (BLU). As the institutional model of the management.
- 7. The strategies that needed to be implemented to improve livelihood resilience and at the same time improve the management of Depapre Bay MPA are:

A. Strategy to improve social economic resilience, trough:

- a. Livelihood Development Program
- b. Capacity Development Program
- c. Social Economic Adaptation Strategy
- d. Management and Technical Facilitation Program
- B. Strategy for Strengthening Depapre Bay Conservation Based on Local Wisdom, through:
 - a. Improving Participation in the Initiation and Establishment of Depapre Bay Marine Protected Area (MPA)
 - b. Institutional Development of Tiatiki as a basis for **Co-management**
 - c. Selection of Effective Management Model for the MPA, through adaptive management, ecosystem-based management, and integrated management approaches
- C. Strategy for Institutional Economic Incentive Scheme for the Development of Marine Protected Area.

6.2 Recommendations

Recommendations to improve research and management of Depapre Bay in the future are:

- 1. Follow up the special study on the effectiveness of Tiaitiki-based management in ensuring a sustainable management of Depapre Bay area with the presence of Depapre Port.
- 2. It is important to follow-up the agreement between government institutions on the management of Depapre Bay MPA, with the plan to build Depapre Port at the same location and at the same time with the establishment of the MPA. A clear and firm decision is needed to prevent conflict of interest and competition between the MPA and the Port.
- 3. A study on the role of *Tiaitiki* institution model in managing the area is also needed because the more dynamic changes in resource utilization in Depapre Bay might place the customary institution in the sideline, or in a marginalized position, of the changes is the development of the Port.

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