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Analysis of Tuna Fish Resource Management (Thunnussp) on a Sustainable basis at Fish Landing in Bontotiro District Bulukumba Regency

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Abstract**—** *This study aims to determine the management of the sustainability of tuna resources in Bulukumba Regency using the EAFM approach. This research was conducted in the waters of the Gulf of Bone by taking a fishing base location at the Fish Landing Port (PPI) of BontoTiro, Bulukumba Regency for four months, which began in December 2018 to March 2019. Analysis of data used in this study using 6 EAFM dimensions and assisted with Rapfish software.*

The results of the study show that some dimensions have a fairly good sustainability value (> 50%), namely on the social dimension (57.1%), Habitat and ecosystem (57.25%) and dimensions of fish resources (51.88%). Tuna fishing activities that focus on the management of fisheries resources must be able to cover the regulation of fish resource use environmental management, and human activities in its management. In the smallest dimension in sustainable management, tuna is in the economic dimension with a value of 29.56% or in the bad category. This needs special attention from the local government of Bulukumba Regency, as well as at the provincial and central levels in raising the economic level of fishing communities working on tuna fishing. There needs to be government policy and innovation in providing assistance and providing alternative new livelihoods and tuna processing which can have a significant impact on improving the welfare of fishing.
Keyword**— *Management, Tuna Fish, Sustainable.***

I. INTRODUCTION

Tuna commodity in 2017 based on the Ministry of Maritime Affairs and Fisheries in 2018 was able to produce an export value of 659.99 million US $ with a total production volume of 198.131 tons. The amount is estimated to reach 16% of the total tuna production in the world. South Sulawesi region as one of the centers for producing fisheries in Indonesia. In 2018 the commodity of tuna, skipjack and cobs production amounted to 56,292, tons worth the US $ 342,930 (Department of Marine and Fisheries of South Sulawesi Province, 2018).

South Sulawesi Province is one of the producers of tuna which is spread in Bone Bay and Makassar Strait. Sudirman, et al. (2018) explained the fishing base of tuna fishermen in Bone Bay in Bulukumba Regency, Sinjai Regency, Bone Regency, and Luwu Regency respectively. The increase in tuna activity that also occurs in Bulukumba Regency, from an economic point of view, is a profitable thing to continue but on the other hand, the activity will have an impact on the existence of tuna fish itself. In 2014, Bulukumba District showed an increasing trend in tuna fishing with total production reaching 241 tons, where the catch of tuna in the previous year was 221.3 tons (Department of Marine and Fisheries, Bulukumba Regency, 2014). Zainuddin, et al. (2015) explained that the level of utilization of tuna resource potential based on data from 2008-2013 showed that tuna catches on average were still below the allowed catch. Furthermore, Zainuddin, et al.

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(2015) described the amount of utilization of Total Allowed Catch (TAC) for tuna fish that has reached 55% in the waters of Flores sea

The activities of fisheries resource utilization activities especially on tuna fish by the fishermen who landed their catches at Bontotiro TPI experienced development or change. The fishing port that used to be a community fishing port is now managed by the Ministry of Maritime Affairs and Fisheries. The community that used to only market tuna in the nearest area now has an export scale. Exporters of tuna with an export scale provide distinct advantages for fishermen because of the tantalizing price certainty. But the fishing gear used still uses stretch fishing rods and works individually. So that for the increase in the number of catches, it must use labor/fishermen and fishing fleets whose numbers also increase.

Several studies have been carried out in analyzing the sustainable management of tuna in Indonesia, especially in waters in South Sulawesi (Bone and Sea of Flores), among others, by Sudirman, et al (2018) which have supply chains of tuna in South Sulawesi. Ma'arif (2011), Pranandi (2016) and Wiyono (2017) put more emphasis on capture technology aspects and the economic conditions of tuna fisheries in seeing the ability of sustainable management of tuna fish in Indonesia. Research on the EAFM (Ecosystem Approach for Fisheries Management) approach has been carried out on tuna in Nusa Tenggara, and also on other fish species such as flying fish in the waters of the Makassar Strait and the Flores Sea. This study aims to determine the management of the sustainability of tuna resources in Bulukumba Regency using the EAFM approach.

II. MATERIAL AND METHODS

2.1. Study Area

Location and Time of Research This research was carried out in the waters of the Gulf of Bone by taking a fishing base location at the Fish Landing Port (PPI) of BontoTiro, Bulukumba Regency for four months, which began in December 2018 to March 2019. The number of fleets currently operating is 79, so the used in this study were as many as 22 units of tuna fishing vessels.

2.2. Data Analysis

a. Maximum Sustainable Yield (MSY) Analysis

$$\frac{Ye}{f} = a - bf$$

Where :

a and b = Constants

Ye = Catch (unit)

F = Arrest effort (unit)

$$f_{optimal} = \frac{a}{2b}$$

$$MSY = \frac{a^2}{4b}$$

b. Sustainable Management Analysis

In this analysis using the ecosystem approach fisheries management (EAFM) approach was analyzed using raffish software. The general criteria for determining each dimension's attributes are the ease of being scored objectively, and the extreme point of sustainability can be stated simply as good or bad. The selected attribute must reflect the sustainability of each dimension and can be modified with other attributes if the information is available (Pitcher and Preikshot, 2001). The sustainability attributes of tuna management, both quantitative and qualitative, are grouped into six dimensions (fish resources, ecology, social, economic, technological, and institutional).

attribute

Table 1. Dimension attribute of EAFM

No.	Dimension	Indicator	Methodology / Data collection
1.	Fish Resource Dimension	Raw CPUE	Production of Tuna Fish in Bulukumba Regency 2012-2017
		Fish Size Trend	The size of tuna is landed at Bontotiro TPI in Bulukumba Regency, through length measurements and comparing length averages
		Composition of Catch Species	The proportion of tuna catches in 1 unit of tuna fishing vessels

		Range Collapse	The distance of the fleet in hunting down the catch target
2	Ecology Dimension	Water quality	• Temperature • chlorophyll
3	Dimensions of Fishing Technology	The selectivity of fishing gear	Use of types of environmentally friendly fishing gear
		Fisheries capacities and arrest efforts	The number of fishermen's Effort who landed tuna at TPI Bontotiro
		Certification of fishing vessel crew in accordance with regulations	Personal data of fishermen and ships that land tuna at TPI Bontotiro
		Size of the fishing vessel	The shape and size of the fleet used in tuna fishing activities
4	Social Dimension	Stakeholder participation	Identification of stakeholders and fisheries stakeholders in Bulukumba Regency
		The working relationship of fishermen	The working model of tuna fishing at PPI Bontotiro
		Stakeholder interaction	Stakeholder activity in meeting activities to discuss tuna management in Bulukumba Regency
		Fisheries Conflict	Service activities, fishermen who land tuna at TPI Bontotiro
5	Economic Dimension	Asset ownership	Number of productive assets of fishermen
		Working capital	Use of initial capital in tuna fishing activities
		Profit-sharing system	The procedure for the distribution of income between fishermen, bosses and collecting traders
		Household Income fishermen	Income analysis of tuna production activities that land tuna at TPI Bontotiro
6.	institutional dimension	Compliance with the principles of responsible fisheries	Public perception of the use of environmentally friendly fishing gear and the impact of fisheries policy
		Availability of facilities and human resources in law enforcement	Availability of law enforcement activities in monitoring tuna fishing activities in Bulukumba Regency
		Management Plan	Management plan designed by the Bulukumba Regional Government in the preservation and sustainability of tuna resources
		Level of policy synergy and fisheries management institutions	Analysis of cooperation between fisheries management institutions in Bulukumba Regency

III. RESULTS AND DISCUSSION

3.1. Result

The results In this study is the determination of sustainable management of tuna resources in Bulukumba Regency was based on six (6) dimensions used in the EAFM standard consisting of (i) Fisheries Resources (ii) Ecology (iii) Fishing Technology (iv) Social (v) economy and (institutional). The following are the results of each dimension based on the results of the analysis using Rapfish software.

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a. Fish Resources Dimension

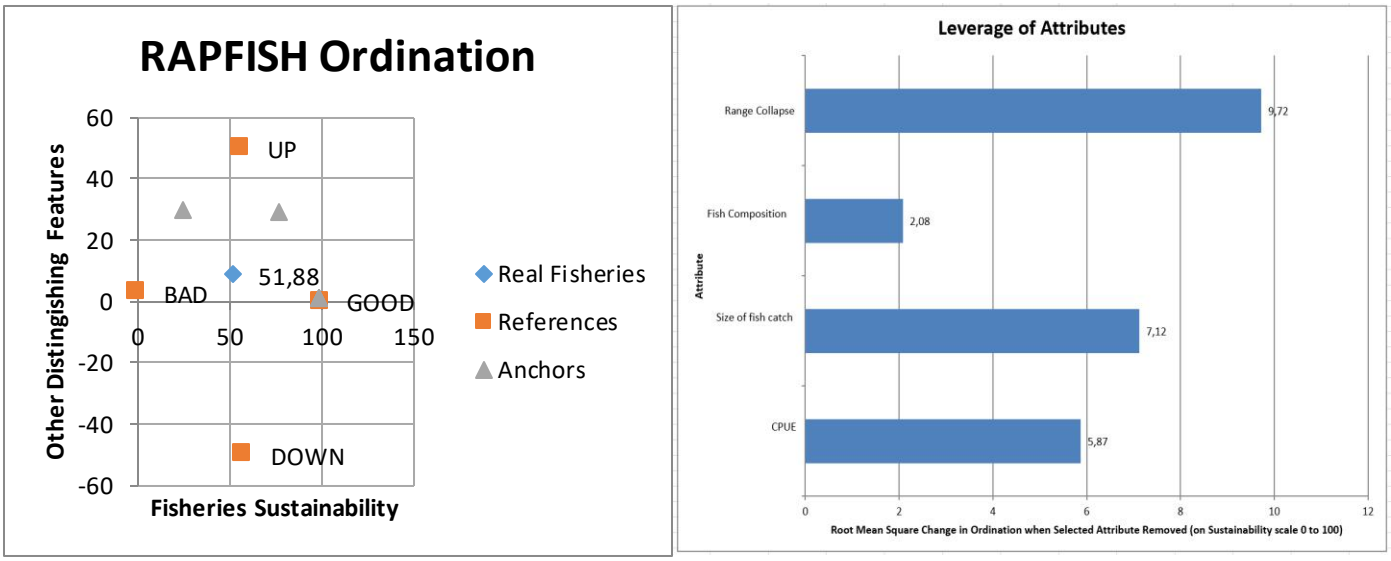

Fig.1: Results of Rapfish Analysis on Fish Resource dimensions

b. Ecology dimension

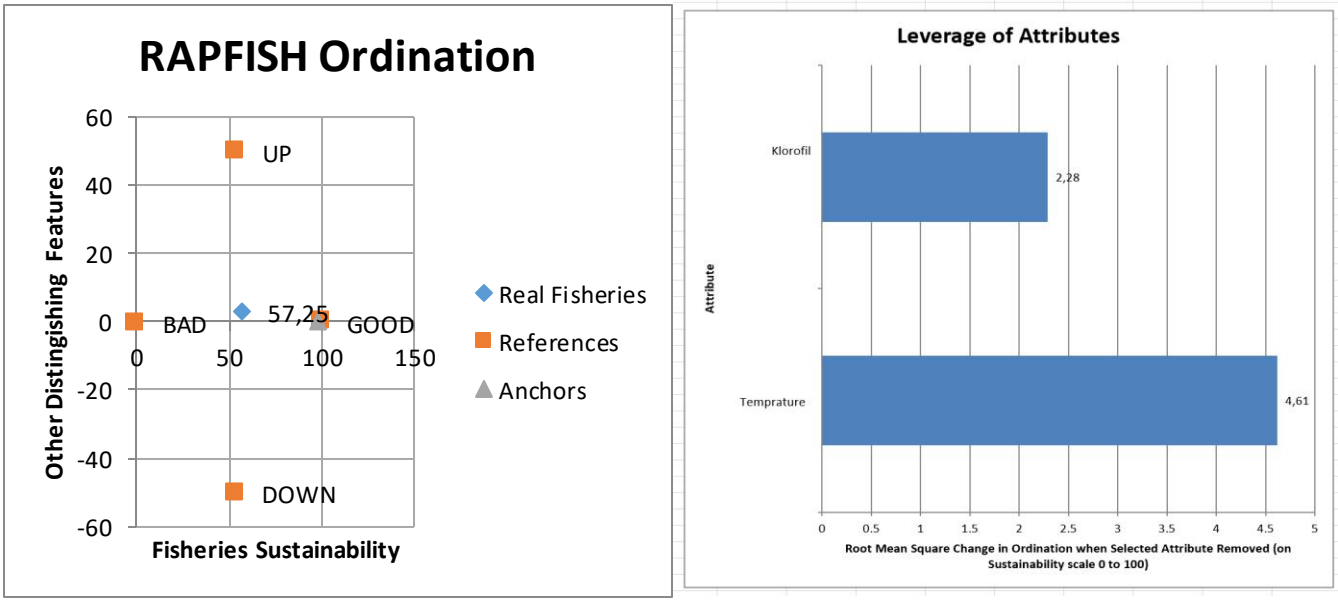

Fig.2: Results of Rapfish Analysis on the Ecosystem dimension

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c. Dimensions of Fishing Technology

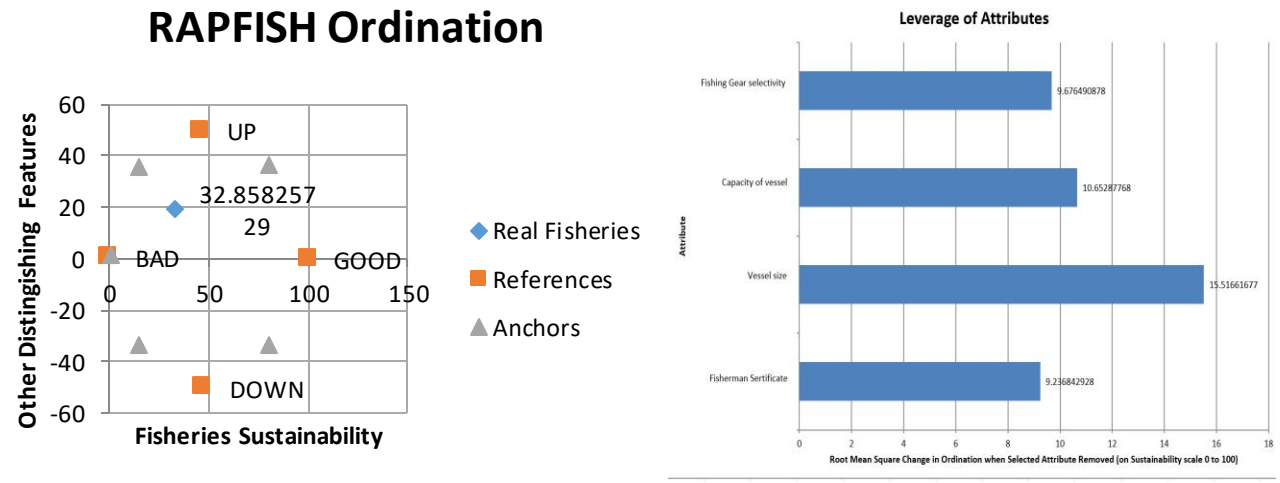

Fig.3: Results of Rapfish Analysis of the Fishing Technology dimension

d. Social dimension

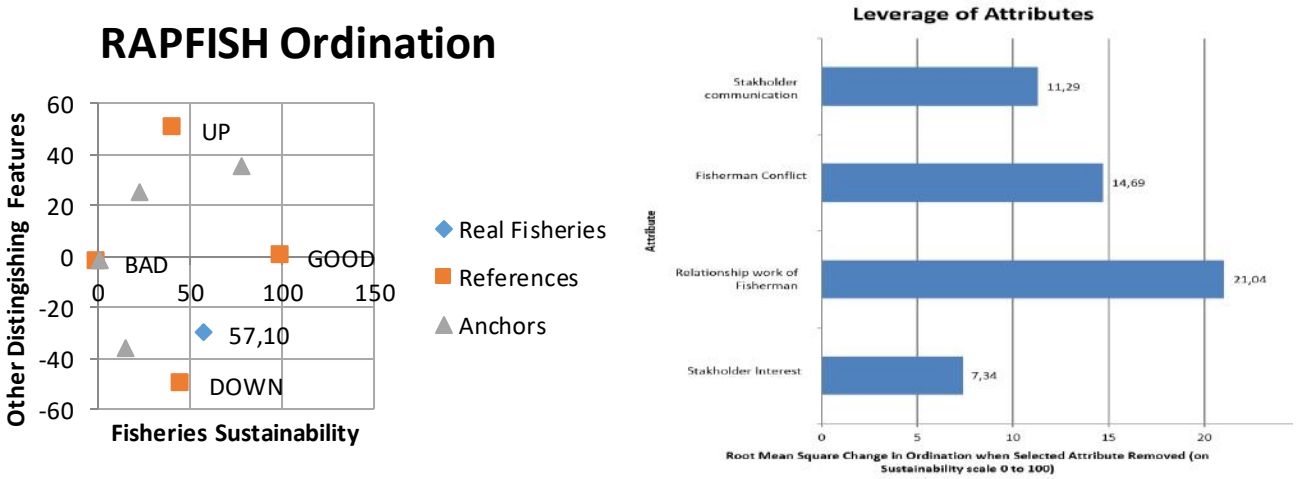

Fig.4: Results of Rapfish Analysis of Social dimensions

e. Economic dimension

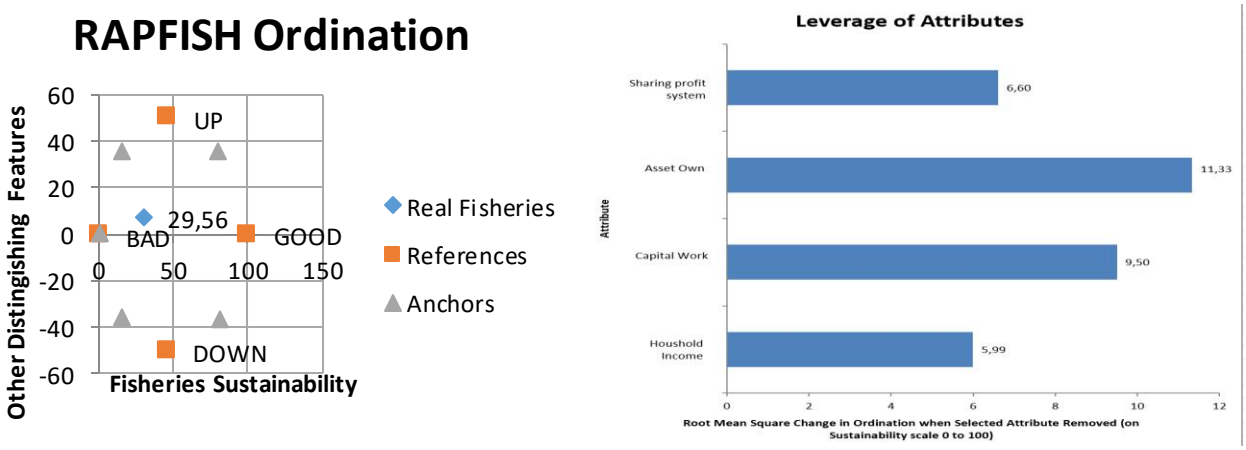

Fig.5: Results of Rapfish Analysis on the Economic Dimension

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f. Institution Dimension

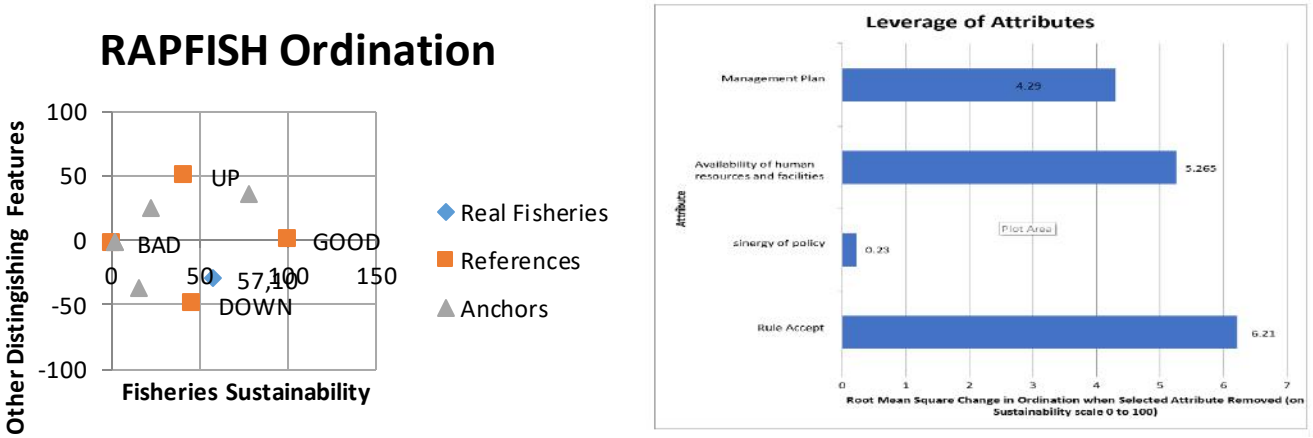

Fig.6: Results of Rapfish Analysis on Institutional Dimensions

3.2. **Discussion**

In the last 6 years, there have been developments in the number of fleets carrying out tuna loading and unloading activities at Bontotiro PPI so that this affects the optimum effort of catching tuna landed at PPI Bontotiro. Catch per unit effort is the annual fishery catch rate obtained using time series data for a minimum of five years. The following are CPUE results for tuna commodities landed in Bulukumba Regency during the period of 2012 to 2017 based on statistical data from South Sulawesi Province (table 2).

Table 2. CPUE of Tuna based on Production in Bulukumba Regency

Years	Trip	Catch (ton)	CPUE
2012	1548	3309,9	2,138178
2013	2016	1280,1	0,63497
2014	2016	3309,9	1,641815
2015	2052	9803	4,77729
2016	2412	8897	3,68864
2017	2520	2201	0,873413

Source: Primary data after processing, 2019.

Based on the table and graph above shows the value of CPUE for tuna production in Bulukumba Regency experienced fluctuations in the last six years. The highest CPUE value was found in 2015 with a value of 4.77 tons/trip while the lowest value in 2013 was only 0.63 tons/trip. Based on the CPUE value that has been obtained and then continued using regression analysis, the regression equation is obtained as follows:

CPUE = -6,777 + 0,004331F

In determining the sustainable products used in this study is to use the Schafer method approach. Based on the results of Schafer's analysis showed that the optimal CPUE value that can be done in 1 year is 782 trips while the amount of sustainable products that can be obtained in 1 year is 2650.1 tons.

Based on the results of the analysis of the dimensions of fish resources shows that the value dimension of fish resources in the management of tuna in Bulukumba Regency is at a value of 51.88 percent or in the good category. In the analysis of each attribute used in the assessment indicators of fish resource dimensions, attributes that have the highest sensitivity (leverage) are in attribute ranges collapse or tuna fishing distance. Based on the ecosystem dimension shows that the value of sustainability in the ecosystem and habitat dimensions is at a value of 57.25% which is in the good category. In the analysis of sensitivity attributes in ecosystem dimensions. The attributes of temperature and salinity are attributes that have the highest value or have a high enough sensitivity in the management of sustainable tuna in Bulukumba Regency. The conditions of temperature and salinity which have a significant change from time to time have a fairly high influence on the presence of tuna commodities in the catchment location which is the place for tuna fishermen production activities in Bulukumba Regency.

On the dimensions of fishing, technology is at a value of 32, 86 or in the bad category. In the sensitivity analysis (leverages) on each of each attribute shows that the highest value is on the attributes of fishing vessel size modification or with a value of 15.52. Modification of fishing vessel size as an attribute that has

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high sensitivity is caused because the fishing fleet used in tuna fishing activities is not in accordance with the condition of the correspondence possessed by the fishing fleet so that exploitation can occur in tuna fishing activities. the social dimension in tuna management is at the value of 57.10 percent or in good condition (good). On the other hand, the value of the raffish ordination analysis is still in the range of the down so that there needs to be an increase in the aspect of the social dimension. In analyzing each attribute used in this dimension, the attributes of the fishermen's work relationship have the highest sensitivity value with a value of 21.04. This indicates that the tuna fishing activities by Bulukumba fishermen who landed their fish in Bontotiro PPI by working in groups and are still traditional are the most important aspects that need to be considered in the sustainable management of tuna in Bulukumba

In the economic dimension that is at the value of 29.56 percent which describes the economic dimension in the bad category. From the results of attribute analysis which is a measurement on the economic dimension, the highest value on attribute sensitivity to be sustainable tuna management is found in the asset ownership attribute with a value of 11.33. Based on the table and the results of Rap Flying Fish analysis above shows that the value of institutional dimensions produces a sustainability index of 39, 1 percent or a poor sustainability index because it is below the 50 percent range. On each attribute that is used as a measuring instrument on the institutional dimension in the Leverages analysis (sensitivity) attributes indicate that the highest attribute is in compliance rules that is equal to 6.21. This shows that in tuna management in Bulukumba Regency, the attribute of regulatory compliance is the most important to be considered in tuna fishing activities. The fishing fleet used by tuna fishermen who landed at Bontotiro PPI is still difficult to be able to easily complete the letters as a condition for carrying out fishing activities in Indonesian waters

The management of fish resources in Bulukumba Regency, especially tuna, is a very important and prominent aspect in the fisheries sector as a determinant in the sustainability of production activities and tuna fishing. The following is an elevated diagram on each dimension used in tuna management in Bulukumba Regency in this study:

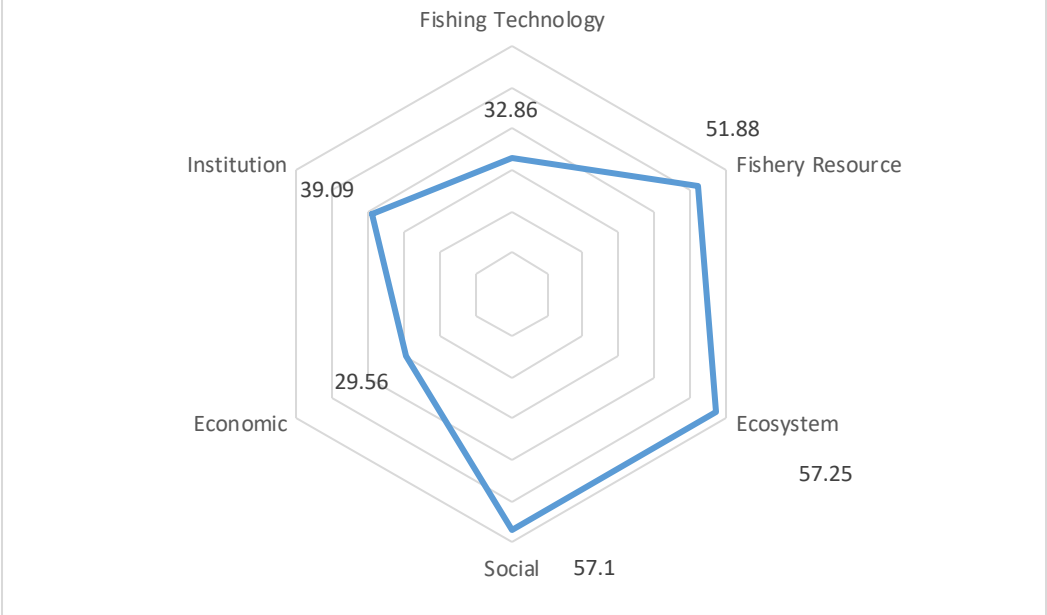

Fig.7: A Layout Diagram of the Overall Dimensions of EAFM in Tuna Management

Based on the elevated diagram above shows that some dimensions have fairly good sustainability value (> 50%), namely on the social dimension (57.1%), Habitat and ecosystem (57.25%) and dimensions of fish resources (51.88%) Tuna fishing activities that focus on the management of fisheries resources must be able to cover the regulation of fish resource use, environmental management and human activities in its management. In the smallest

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IV. CONCLUSION

Based on an analysis of the sustainability of tuna resources in Bulukumba with the raffish method, the dimensions of habitat and ecosystems, the social dimension, the dimensions of fish resources management can continue. While the institutional dimensions, dimensions of fishing technology and the economic dimensions of management cannot continue.

With the description of CPUE value, social conditions and ecosystem conditions in tuna activity in Bulukumba Regency, it can be a recommendation for rules and policies to provide limits on fishing activities to maintain tuna resources in Bulukumba Regency.

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