Available online at: http://ejournal-balitbang.kkp.go.id/index.php/ifrj
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INDONESIAN FISHERIES RESEARCH JOURNAL
Volume 26 Nomor 1 June 2020
p-ISSN: 0853-8980
e-ISSN: 2502-6569
Accreditation Number RISTEKDIKTI: 21/E/KPT/2018

MAPPING THE POTENTIAL OF MARINE LIVING RESOURCES IN THE OUTER ISLANDS OF SOUTHWEST MALUKU

Ralph Thomas Mahulette*[1] and Andarias Steward Samusamu[1]
[1]Research Center for Fisheries, Jln. Pasir Putih II, Ancol Timur, Jakarta Utara-14430, Indonesia
Received; September 27-2018 Received in revised from March 02-2020; Accepted March 13-2020

ABSTRACT

Southwest Maluku or Maluku Barat Daya (MBD) Regency is in the southeastern part of the outer rings of the Indonesian Archipelagic States. This regency consists of 17 districts covering 48 islands that lie scattered in the region in which 31 islands among them are uninhabited. Mapping information on challenges and opportunities on marine living resource dependence on community livelihood is limited. This area has a total population of about 72.300 persons with 4.069 (5.6 %) of them are fishers. The coastal ecosystems include coral reefs (595 Ha), mangrove (7.8 Ha), and seagrass (57 Ha). Seaweed harvesting and cultivation are ones that would be developed as an alternate livelihood for the community. The goal of this research was to describe a general situation of community livelihood that was supported by the role of marine fisheries. The environmental parameters, such as monthly air temperature, rainfall, and wind speed, were plotted as supporting information. General description of the fishing boat and fishing gear, annual production, and distribution of fishers and households around the islands were discussed. The result showed that the fisheries category was small scale with one-day fishing. The population distribution and fishermen were also used as a baseline parameter to elaborate on the potential of marine living resources in the interested area. Those resources were described with existing small-scale fisheries issues based on limited serial data that were gathered through field observation. The secondary data, such as Southwest Maluku District (MBD) annual data, from the Local Statistical Board (BPS) yearly report, were also used in this paper.

Keywords: Small Islands; marine living resources; Southwest Maluku

INTRODUCTION

Southwest Maluku Regency is an expanded administrative region, geographically located between 07^{0}07’ to 08^0 28’ S and 126^0 72’ to 130^0 09' E. The regency comprises of 17 districts that are located in three major islands: Terselatan Island, Lemola Island, and Barbar Island. Forty-eight small islands are spreading in the regency, which the capital city is Tiakur in Moa Island, with administrative boundaries are the Banda Sea in the northern part, Tanimbar Island in the east, Alor Islands in the west, and the Timor Sea in the south. The area is surrounded by marine and coastal regions, with a water-covered area is around 64,000 km^2. District of Mdona Hiera and Damer Islands are bordering with a neighboring country of the Democratic Republic of Timor Leste.

The general climate condition of the region is relatively warm, with annual air temperature ranging between 29.9 - 33.8 ^{o}C (BPS MTB, 2017), with an average of 30 ^{o}C occurs almost the whole year. Because this area consists of islands, the traditional living of the community are very familiar and harmonize with natural resources during every single day of life. In this climate condition, the coastal community of this area has an inherent benefit to produce traditional table or kitchen salt during the dry season to supply daily local consumption, particularly in Luang Island, where the people traditionally use salt to provide salted fish. Luang Island is known as a village that has produced dried anchovy since several decades ago.

Limited existing land-based resources, marine resources have played a significant role in supporting daily livelihood demand of the community to sustain their welfare as the inhabitants of the outer islands of Indonesia. The prospect of developing small islands is relatively slow even though the area has a perfect opportunity due to the availability of domestic resources that are recently commonly used in local communities and cultures. The marine renewable resources were relatively low exploited while the response to apply technology has been slow.

correspondence author:
e-mail: rijean0410@gmail.com
DOI: http://dx.doi.org/10.15578/ifrj.26.1.2020.19-32

Small scale capture fisheries contribute as the community's primary income. Therefore, the local fisheries resources should be sustained to maintain their livelihood. Some other interesting sources of livelihood also existed to describe a diverse source of income, such as seaweed harvesting and cultivation. Homemade table salt production is a traditional activity carried out by the coastal community, particularly during the dry season. The salt products are not for sale but mostly used for the family's daily needs. Seaweed farming and mariculture would also potentially contribute to natural resources in this area. These outer small island fisheries are incredibly complicated and in many cases are poorly understood.

The result of this study was expected to be used as one of the baselines to increase awareness on the importance of capture fisheries dependence livelihood in MBD community. Therefore, in the future, it should be attempted to increase market intervention through fisheries improvement programs and networking following the national agenda on achieving sustainable development goals.

MATERIALS AND METHODS

Short observation was done by applying rapid appraisal on 8 - 22 April 2016 in Moa Island, the main location of the current research. At first, the field surveys on two villages were conducted by interviewing the local government officers. The villages were Tiakur, the MBD District capital, and Kaiwatu, located at the Fish Landing Base (PPI) that is supervised by the Regency Marine and Fisheries Office.

Some secondary data and related information from several publications were used to explore the fisheries status of those villages. Secondary serial data were also available from the district fisheries office but was more limited than ones had been compiled from the Central Statistical Board (BPS MBD, 2005-2018). General environmental parameters and population size and distribution were mentioned as well. Fisheries aspects, such as annual landing, fisheries household, species composition, fleet structure, and gross domestic product were used to describe the role of capture fisheries in these outer islands.

Descriptive analyses were applied through graphical and tabulation to identify the performance status and the trend of fisheries and their opportunities for coastal community livelihood. Secondary fisheries data from 2005 to 2017 were treated as a supporting database to obtain and provide a better profile regarding the improvement of the existing fisheries status and condition.

RESULTS AND DISCUSSION

RESULTS

Demographic Characteristics

There are three large groups of small islands, i.e., the Terselatan group with an area of 4,681 km^2, Lemola group of 1,506 km^2, and Babar group of 2,446 km^2. Concerning government authority, those areas were divided into eight districts: (*kecamatan*) Wetar, Terselatan, Leti, Moa Lakor, Damer., Mdona Hiera, Babar, and East Babar Islands. Among the islands, Kisar Island, Leti Island, Wetar Island, and Marsela Island are the small outer islands of Indonesia (BPS, 2016). These islands were separated by the deep sea, whereas Sermata Island is surrounded by coral reefs.

The total population is about 72,234 people, with inhabitants spread into 17 districts representing 17 among 48 islands of the area. The highest population lives in Terselatan District, with 11,343 people contributed 15% of the population, followed by Leti and Moa Lakor (10%), Babar, and East Babar (8%), while the rest were less than 5%. There are 31 islands uninhabited. The distance between the capital of MBD to provincial capital is about 270 km across the Banda Sea (BPS-MTB, 2018) (Figure 1).

Small islands with relatively limited natural resources and fragile ecosystems would drive uncertainties to support their sustainable development. Observation on ecological information of Wetar Island (Yonvitner *et al*., 2016) indicates the role of harvesting marine fish resource is the highest contribution with an index of 0.76 compared to agricultural and fishery sectors (<0.06). Therefore, maintaining fish resources with a precautionary approach should be one of the priorities to support their livelihood.

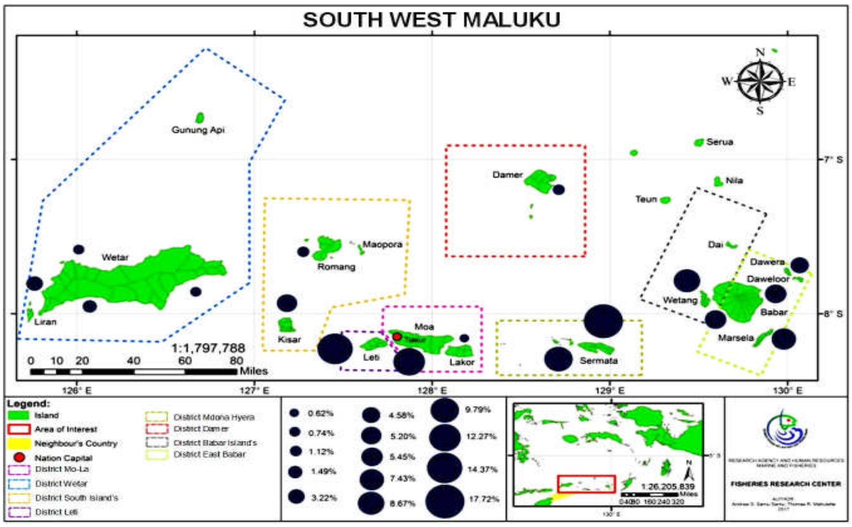

Figure 1. Islands and population distribution of MTB.

Fishing as one of the main activities of coastal communities is still not being supported by factory facilitations (BPS Maluku, 2018), this indicates that small scale home bases were the main of community fisheries business. There is one landing place located in Wetar Island and three small landing places in MBD (BPS Maluku, 2018).

The Climate Condition: Air Temperature, Rainfall, and Wind

A coherent fluctuation of oceanic and atmospheric conditions drives an important impact on climate (Chang *et al*., 2005). The air temperature is one of the standard climate parameters that usually took a part of the seasonal variability of fish abundance and its distribution that affected the behavior of capture fisheries. Monthly average of air temperature, rainfall rates, and wind speed and direction were explored based on data of three consecutive years. The air temperature ranged from 25.6 to 29.4°C, with an average of 27.7 ± 0.99°C with a trend of slightly increase. From 2015 to 2017, the lowest one occurred in August 2015 while the highest one in November 2016. This monthly air temperature showed that the value of air temperature from October 2015 to May 2016 relatively remained at a high level. The seasonal cycle in the tropics is usually correlated with variability of monthly rainfall and much of tropical rain confined to the region of SST higher than 27°C (Xie, 2007). Monthly rainfall data of 2015 – 2017 indicated that high rates of rainfall occurred in the early months of 2015 and 2016 then shifted to the 1st quarter of 2017. The highest one occurred in April 2017 (564 mm), and the lowest ones (parched season) were from September to November 2015, with an annual average of 164±146 mm (Figure 2).

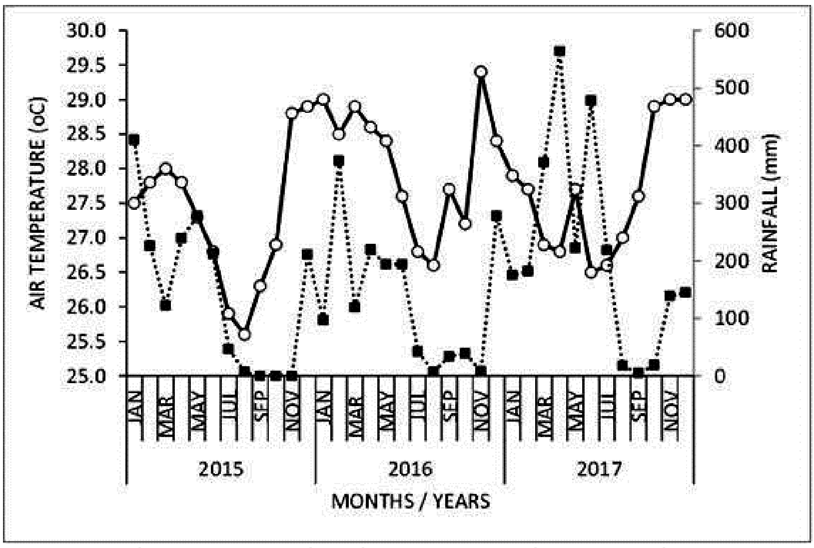

Figure 2. Monthly air temperature (2015-2017).
Source: BPS-MBD (2015-2017)

Other monthly climatic parameters such as rain days, humidity, wind speed, and percentage of the bright sun are also described. The lowest day of rainfall commonly occurred in August to November, with some exceptions in January 2016 and November 2017. Humidity was relatively high for the whole year, with a range from 76 to 89%, the wind speed was uncertain due to monthly data that in 2016 was higher than those in 2015 and 2017. The average bright sun was 64%, with a range from 34 to 98%.

Table 1. Monthly rainfall, humidity, wind and sun parameters 2015 – 2017.

MONTHS	RD (days)			HUM(%)			WIND (m/s)			SUN (%)		
	2015	2016	2017	2015	2016	2017	2015	2016	2017	2015	2016	2017
JAN	27	9	20	88	80	87	6	14	5	41	78	34
FEB	20	22	23	84	85	86	6	13	5	69	52	48
MAR	20	15	22	84	84	89	6	16	5	71	68	38
APR	27	23	23	84	84	89	5	15	5	60	75	39
MAY	20	18	20	80	83	82	7	12	7	68	83	62
JUN	25	17	23	81	81	85	8	18	8	76	68	40
JUL	19	12	17	81	78	82	8	17	8	73	70	51
AUG	13	7	8	76	77	76	9	17	8	94	92	86
SEP	1	7	4	77	80	78	7	13	6	98	83	90
OCT		9	4	76	77	77	7	18	4	97	77	83
NOV		5	17	77	76	79	4	10	3	90	88	63
DEC	18	23	13	80	82	80	6	20	2	58	45	54
AVERAGE	19	14	16	81	81	83	7	15	6	75	73	57

The Essential Fish Habitat

The Essential Fish Habitats (EFH) is an area or a volume of water and bottom substrates that provide the most favorable habitats for fish populations to spawn, feed, and mature throughout their full life cycle. Fish used the seas, including marine areas and their associated physical, chemical, and biological properties. "Substrate" includes sediment, hard bottom, structures underlying the waters, and related natural communities. "Necessary" means the habitat required supporting a sustainable fishery and the managed species' contribution to a healthy ecosystem, and "spawning, feeding, or growing to maturity" covers a species' full life cycle. These are important for the conservation of biodiversity and sustainable fisheries management. The sustainability of fish populations and their associated fisheries could be conserved by limiting anthropogenic stressors in such habitats (Valavanis *et al*., 2008; NOAA, 2013).

The area of MBD, approximately 72,427 $km^{2,}$ consisted of 8,633 km^2 land and 63,778 km^2 of marine areas. Comparing the areas among regencies in Maluku Province, this particular regency covers around 35% of the Maluku Province (BPS Maluku, 2019; BPS MTB, 2018). Emphasizing the principle of coastal essential fish habitats and ecosystems (coral reef, mangrove, and seagrass), there is an indication that the coral reef is the largest area among others; however, they are randomly distributed among islands. The coral reef is the largest area (594.8 Ha) followed by seagrass (57 Ha), and mangrove (7,2 Ha) with the highest essential fish habitat occurs in Mdona Hiera Island (Table 2).

Table 2. The land and marine including its essential fish habitat areas in MBD.

SUB DISTRICT/ ISLANDS	Km²		Ha		
	Land	Marine	Cr	Mv	Sg
Wetar	1,725		5.3	0.1	0.4
West Wetar	511		26.5	2.5	1.3
North Wetar	990		4.1	1.8	0.9
East Wetar	714	17,533	6.0	0.8	5.4
Terselatan	51		3.6	0.0	1.0
North Kisar	17		83.0	0.0	1.0
Romang	281		16.3	0.2	3.9
Damer	392		0.7	0.0	0.5
Letti	244	27,580	15.5	0.0	1.5
Moa	960		17.5	0.1	1.6
Lakor	303		7.5	0.1	4.0
Mdona Hyera	232	18,665	263.8	0.8	32.9
Babar	1,086		8.7	0.5	0.2
Wetang	140		2.1	0.3	0.3
East Babar	499		3.7	0.1	0.6
Masela	280		128.1	0.1	1.2
Dawelor Dawera	209		2.4	0.0	0.4
Total area	8,633	63,778	594.8	7.2	57.0

Remarks: Cr: coral reefs, Mv: mangrove, Sg: sea grass
Source: BPS-MBD (2018)

Capture Fisheries

Small scale fisheries targeting small and large groups of pelagic fishes were the daily livelihoods in the coastal community of MBD. The number of fishers was about 10 thousand in 2015 then decreased to 4 thousand in 2017 (BPS-MTB 2018). There was no available information to clarify the reduction in the number of fishers. However, their distribution by district indicates that the highest proportion to the population with an age of older than 15 years occurred in Madona Hyera District at about 51% of the male population. The ratio of fishers to the population indicates that the fisherman community mainly lived in Mdona Hiera District (Figure 3).

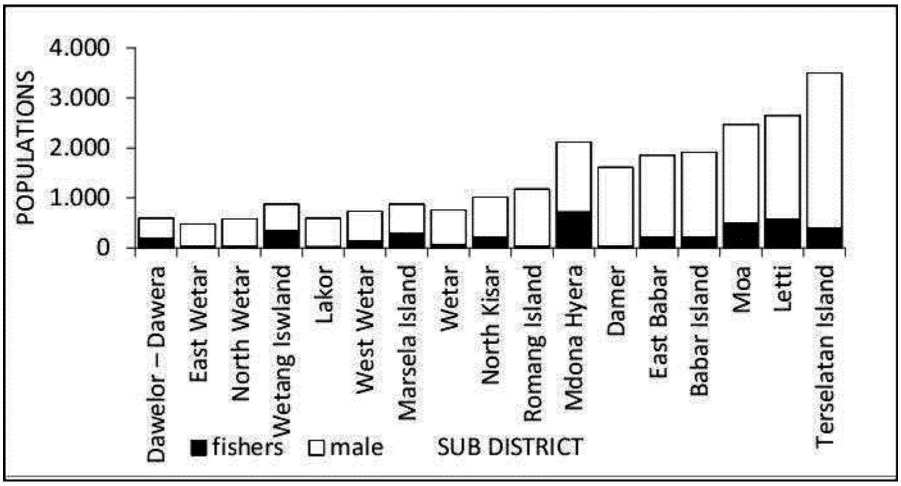

Figure 3. Proportion number of fisherman and male > 15 years.

The annual landing of finfish (small & large pelagic, demersal, including seaweed) tended to increase in 2011 and was relatively stable until 2016, then slightly decreased in 2017. There were unavailable data for 2006, 2007, and 2010. The contributions of the seaweed harvest tended to decline after 2011 (Figure 4). The major landed pelagic fish, consisted of scads (*Decapterus* spp), skipjack (*Katsuwonus pelamis*), tuna (*Thunnus* spp.), and mackerel (*Rastrelliger* spp.), tended to be relatively stable after 2015, while anchovies (*Stolephorus* spp.) tended to decline compared to the previous two years and no landing in 2017 (Figure 5).

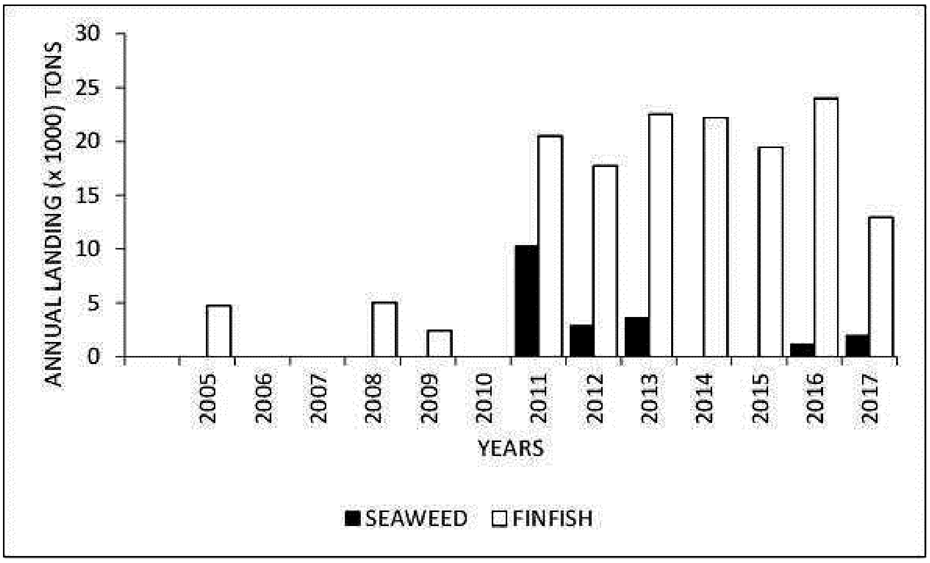

Figure 4. Annual landing reported in MTB (2005 – 2017).
Source of Data: BPS-MTB 2007-2018

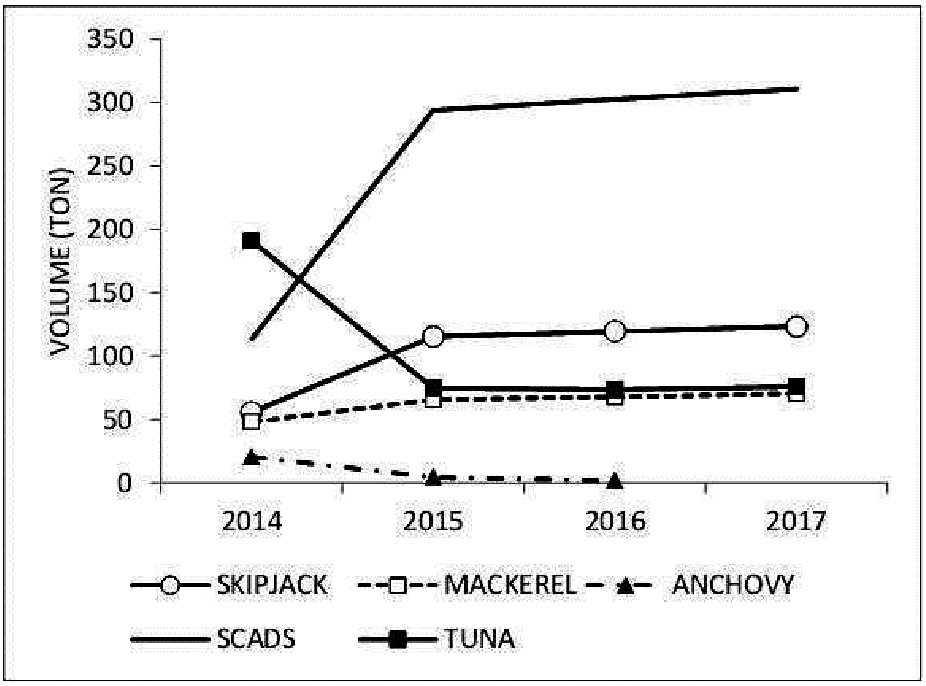

Figure 5. Trend of several pelagic species landed in MBD during 2014 – 2017.
Source: BPS-Maluku (2015 – 2018).

Catch Composition and Fishing Effort

Limited data on catch composition showed the landing data of the year 2016 indicated small pelagic fishes as the significant composition of the catch with scads as the dominant species. The reef fishes and demersal fishes also play a critical role in the existing fisheries (Figure 6). These short landing data indicate that associated species of a broad-scale ecosystem from neritic, oceanic, to demersal and coral reef species were harvested by local fishermen. Red snapper, which was commonly caught by dropped line, provided the most considerable contribution of demersal fish. The reef fish was dominated by leopard grouper, while kawa-kawa was dominant in the large pelagic group. Scads and skipjack were the primary fish resources for daily needs. Multi-species small scale fisheries were indicated by the fish catch composition varying with available habitat, fishing modes, and fishers group. Mentioning the small size demersal fish at the landing-place, one should clarify if the fishing gear they used is environmentally acceptable. This typical small size demersal group of species were also likely caught by bottom gill net.

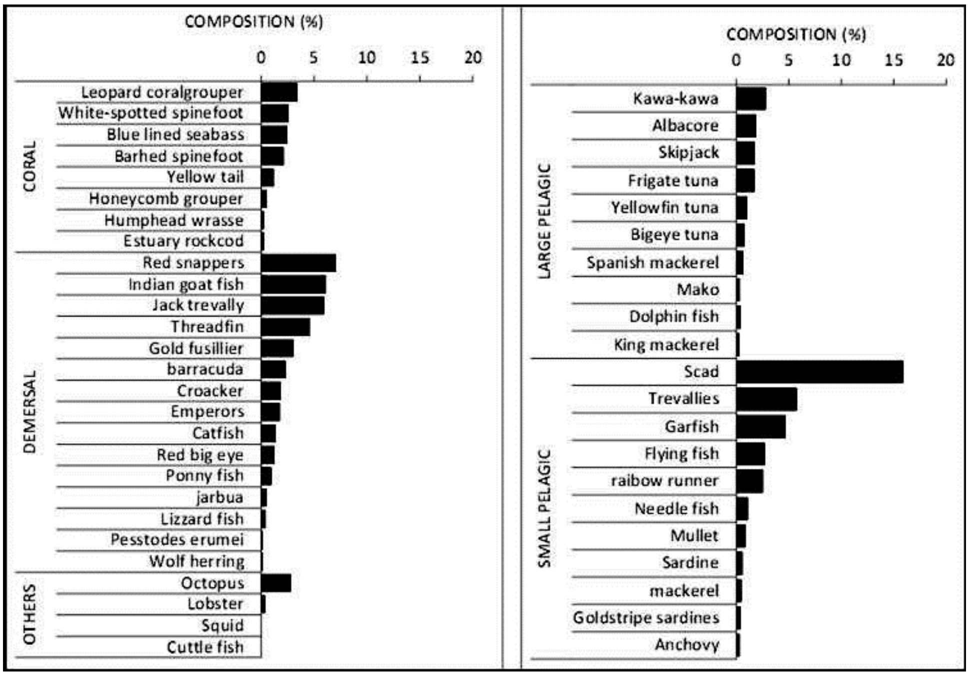

Figure 6. Catch composition of fish landed in MTB in 2016.

Elaborating catch data to the number of fishing boats by size categories (Figure 7), the major fishing boats operating in the area were vessels with and without outboard engines. Therefore, the fishing ground was relatively close to the coast with a reasonable fishing effort of one-day fishing. The fishery has been shifted from non-engine power to outboard engine since 2009. A significant increase almost 10 times higher than in 2008. On the other hand, non-engine boats have decreased to about 45%.

Typical of a one-day fishing boat operated in the area (Figure 8) was the major effort in the regency. Since the purse seiner was relatively higher capital investment, the boat of small purse seiner was commonly operated by 1 to 2 fishers.

Based on the last 12 years data collection of number and type of fishing gears, the major fishing gears were gill net, which has targeted small pelagic and neritic tuna since 2005, and hand line, which has targeted tropical tuna since 2010. Therefore, in addition to the gill net, hand line has also played a significant role in fish exploitation in these small islands waters. A small number of purse seines contribute to total production (Figure 9). The number of fishing gear types has significantly increased, and the hand line has become the common one in this region.

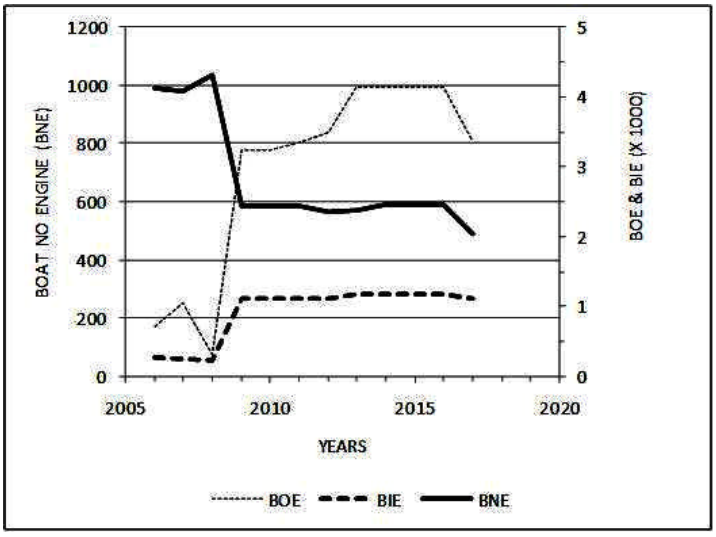

Figure 7. Trend of number of boat by size categories in 2005 – 2017.
Source: BPS MTB (2006 – 2018). Remarks: BOE = Boat with outboard engine; BIE = Boat with inboard engine; BNE = Boat with no engine

Figure 8. Typical fishing boat in the Indonesian region.

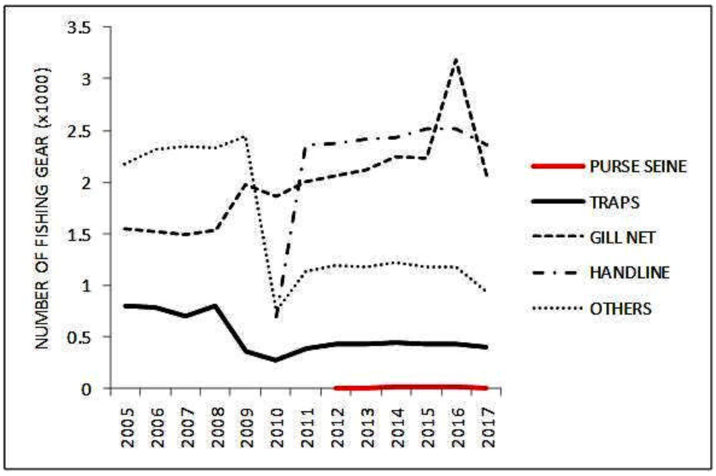

Figure 9. Number of main fishing gear in 2005 – 2017.

The harvesting of small and large pelagic fishes seems have not done by local fishermen only. Global fishing watch (Anonymous, 2018) indicated that a couple of fishing vessels with VMS (>30 GT) from other landing bases outside of MBD have also been operating in the southern part offs Leti Island, Moa Island, and Lakor Island (Figure 9). The data strengthened the indication that the available resources in this area were harvested by migrant fishers, who fish in the inshore of the Islands (Figure 10). Transboundary issues on migrating fishes will be the challenges for future fisheries development programs in the area.

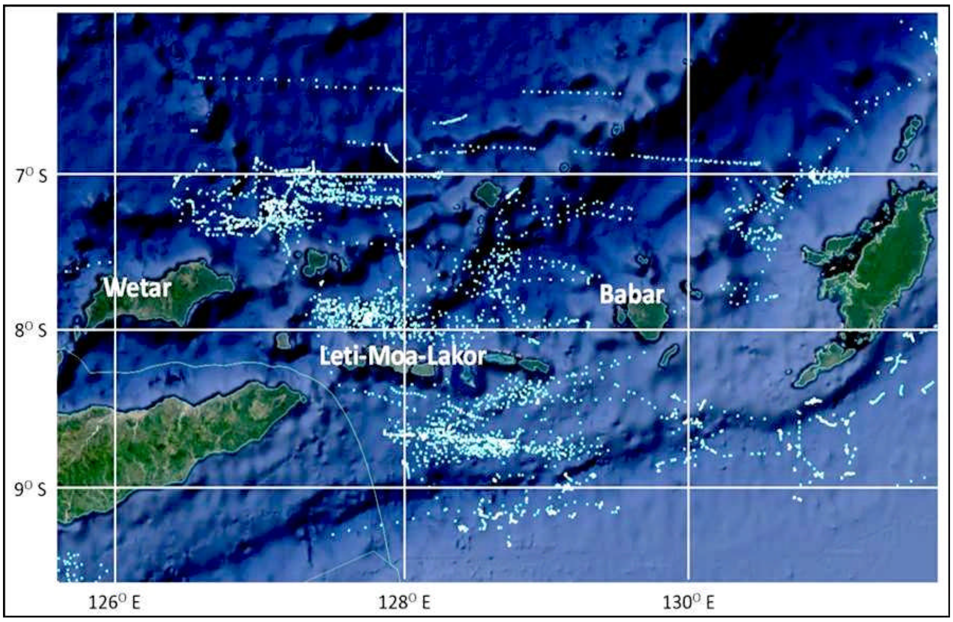

Figure 10. Tracking fishing vessels in southern part of MBD.
Source: Global fishing watch downloaded 26 February 2019

Seaweed Cultivation

Harvesting wild seaweed is one of the typical activities of the coastal communities in Indonesia. Maluku Sea, in general, was perfect for the cultivation of seaweed, especially for *Eucheuma cottonii* and *Gracilaria spp*. (Figure 11).

In Southwest Maluku, *Euchema cottonii* was the most common seaweed to cultivate. In some islands of Southwest Maluku, such as Mdona Hiera, Wetar, and Masela, the bays were a good location and suitable for the cultivation of seaweed. The production data indicate that five districts (Mdona Hiera, Roma, Wetar, West Wetar, Marsela, and Leti) were the major sources of seaweed in MBD (Figure 12) with lower volume in 2015 compared to 2014. There is no additional information on seaweed cultivation.

Introduction on seaweed farming (cultivation) has been adopted in the region based on the finding of previous research on general oceanographic conditions that met the seaweed farming requirements (Sulistiyo, 1996) (Table 3).

Figure 11. *Eucheuma cottonii* the largest cultivation in Southwest Moluccas.

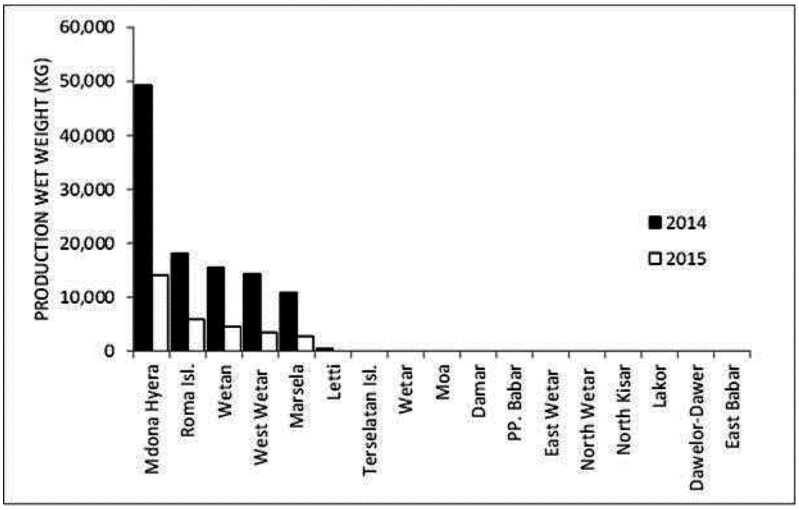

Figure 12. Production seaweed cultivation by sub-district.
Source of data: BPS MBD (2016)

Table 3. Oceanographic parameters conditions of seaweed farming

No.	Parameters	Range
1	Wave heights	< 0.5 M
2	Current velocity	40 – 100 m/dt
3	Temperature	26 – 30 °C
4	Depth	> 10 M
5	Visibility	> 5 M
6	Salinity	32 – 34 ppt
7	pH	7.3 – 8.3
8	Nitrat	0.9 – 3.5
9	Fosfat	0.2 – 1
10	Bottom profiles	Muddy and free of debris

Source: *P2O-LIPI, Jakarta*

Common Salts Production

Common salt was one of the common ingredients used by the coastal community to avoid fish from freshness decay in post rigor mortis after being caught from the sea. They prefer to keep large pelagic fish, while the small size is often excessively discarded. The traditional way of salting the fish successfully reduces discards, the decarded fish. Besides being used to preserve fish, the salt is used as a support for daily needs. Meanwhile, firstly harvest of the shell of crocus clam (*Tridacna crocea*), which is a type of the smallest clams and most abundant populations, was usually good for seawater shelters. At the same time, they produce the common salts in the limestone reefs. This type of reef was suitable to use by the community in Southwest Maluku as traditionally homemade common salts. Luang Island, Damer District, and Mdona Hiera area were very suitable for the development of common salts commodity. The coastal community on the islands has made the traditional common salts for their consumption over the past decades. Communities in those two islands collected the seawater with a bucket, and then hold them on the shell of giant clams and dried under the sun for six to eight months to become a salt crystal. The community in Luang Island has traditionally used the common salt to make salted fish.

Figure 13. Harvesting Hole clams (*Tridacna crocea*) located on the Luang Island.

Discussion

The Southwest Maluku Regency (MBD) is part of Maluku Province that consists of 48 islands. The land area is about 8,600 km^2, with 12 miles of territorial waters of about 64,000 km^2 (BPS 2018). This region was confirmed as one of the outer islands of the country that is relatively categorized as an underdeveloped region. Its human development index was at the lowest rank in the country, with an index of 59.43 (BPS Maluku, 2018). This indicator suggested and proposed more support from the Province or Central Government to strengthen and develop its local capacity of the areas. The marine fisheries are potential as an essential community income resources, including artisanal harvesting of a wide variety of inshore and lagoon fish as well as invertebrate species. Therefore, they need more appropriate effort to increase competitiveness capability, such as a small size local market to sell their fisheries product.

According to the trend of population increase, they need to have several jobs opportunity for their future livelihood. The community needs some technical infrastructure support such as transportation and fishing vessels to facilitate their fishing activities. They also need some improvement as well as restoration of the fishing boats to be able to overcome several various weather-related pressures that cause slowing down the fishing activities. The community needs to strengthen the knowledge of the supply chain that is helpful and might be available to improve their small scale fisheries.

Data on climate parameters and fish production of the study sites were to be short to describe its relationship connectivity. However, the fact that the high frequency in rainfall would strongly affect their daily fishing activities. This parameter has significantly influenced the catch production due to the dependence on using traditional boats with a high risk of safety at sea. Meanwhile, observation of the relationships long-term data on rainfall in some other areas in marine capture fisheries production and intensity of precipitation in west Java indicates that fishing season does not occur in the year after high rainfall (Fitri *et al*., 2017). On the other hand, the traditional knowledge of coastal communities in Kisar Island, Leti Island, and their surrounding islands were well adapted with changes in the environment and fish populations (Stacey *et al*., 2011; Patipeilohy, 2013).

The occurrence of essential fish habitats clearly shows that the fish harvested by fishers mainly associated with neritic and oceanic species such as large pelagic (tuna and tuna-like fish) and small pelagic (mackerel & scads) fish groups instead of coral reef fish or demersal fish. The main fishing gears were gill net and hand line that have targeted those two groups of fish, while other gears mostly catch demersal and coral fish. The operated vessel structure was dominated by outboard engine boats that for one-day fishing. Therefore, it indicated that the coastal fisheries of the study sites were categorized as small scale fisheries.

There were plenty of reasons that could have affected the fisheries development of MBD Regency, including local fisheries management practices that might not be well established yet at regency level. Besides that, several reasons from outside the fishery aspects affect the environmental status of essential habitat regarding the ecosystem functions, also the social and economic framework within the particular fishery aspect. Many of these depend on land-use practices and domestic income demand that are available to generate conflicts towards fishery sustainability. Climate change could also have the possibility of making more unpredictable conditions. Therefore, the future of capture fisheries of this area varies among districts because of some possible reasons. In the present situation, the fisheries resources of the larger islands were relatively intense exploited by local small scale fisheries. This phenomenon indicates why there was no appropriate space for the expansion of some neighbor larger fishing vessels, which could probably affect the resources at risk. Small scale fisheries have been known to be less heavily exploited in general, and mostly oriented to daily subsistence rather than food consumption.

In some particular waters in Indonesia, catches were locally depleted, catch per unit effort was relatively very low, commercial size species tend to decrease, and overfishing has been reported, particularly to long live species with low resilience. Conventional theory indicated that without a better understanding on historical harvesting for all fisheries sectors, it is difficult to predict the economic-based cultural system of these fisheries. Therefore, future MBD Regency is facing a high risk of overharvesting by migrant fishers with medium technology and bulky catches in their coastal area or ecosystems (Hutubessy *et al*., 2017). High consumer demand (domestic and export) for fish, especially 'prestige' products and other coastal resources, in line with population growth and per capita demand for goods from growing economies and high prices could be the driver of diminishing fish resources. These were also due to limited capacity and data available as a typical situation in the remote area in Indonesia that is indicated by a low human development index (HDI) (BPS Maluku, 2018).

Global status of world seaweed production from 2011 to 2015 tended to increase from 22 to 30 million tons and mainly from the farming sector. Harvesting from the wild has remained less than 5% (Ferdouse *et al*., 2018). As part of tropical marine waters, harvesting wild seaweed is one of the common activities of coastal communities in Indonesia. The national capture fisheries statistics indicate the production of wild seaweed in 2016 was 42 thousand tons, which was ten times higher than one in 2006 (DGCF, 2017). Anyhow, the contribution of the MBD Regency from this marine living resource was not well noticed, but it could be one of the alternative livelihoods. There was a global concern rising to the climate change impact on seaweed abundance, distribution, and quality (Straub *et al*., 2016 in Buschmann *et al.,* 2017).

Initiative on government strengthening through conceptual integrated local-based fisheries management, which considers ecosystem interactions known as Ecosystem Approach to Fisheries Management or EAFM, could sustainably drive the fisheries production. This approach would play an important role in supporting the fishery system for their livelihood dependence on marine living resources.

The small island ecosystem is relatively complex and uncertain; however, it is strongly supporting a lot of benefits from fish resources. Some research findings clearly showed that fisheries are directly impacted by the dynamic ecosystems as well as anthropogenic activities, such as artisanal habitat modification. Therefore, these small islands are highly vulnerable, both to macroeconomic shocks and to the changes in biodiversity that support fisheries and other sources of livelihood (Teelucksingh *et al*., 2013). Finally, the mapping on the potential of marine living resources in the outer islands of Southwest Maluku could contribute to reducing the knowledge gap on poor data to promote sustainable development of small outer islands of MBD Regency.

CONCLUSIONS

Capture fisheries is a significant source of livelihood and protein contributions in the communities of small outer islands of the MBD Regency. There were several groups of fish resources, consist of small and large pelagic fishes, including several tuna species, demersal and reef fishes, and crustacean species (shrimps and crabs) that were mostly harvested by small scale fisheries. The small and large pelagic fishes had relatively broad distribution, and some were migrating species that are commonly seasonal dependent. The demersal and reef fish resources in the islands were relatively limited due to the deep-sea ecosystem surrounding the islands. The pelagic fish resources in this area play a role as the backbone for long term fisheries development plan within the fishing effort, emphasizing on handline and gillnet. Increasing awareness of essential fish habitats, particularly concerning coastal fisheries, should be in line with the existing traditional ecological knowledge. Minimizing the landscape modifications and habitat destructions that contribute by anthropogenic activities, along with manageable small scale fisheries, could significantly drive forward to sustainable fisheries development goals in the future. It should be taken into consideration to propose to local government institutions the importance of developing databases and information as the references to develop appropriate fisheries management plans in this region. Fisheries production of Southwest Maluku from capture fisheries and aquaculture had gradually increased in 2010-2016, then slightly decreased in 2017. The highest fish landing occurred in 2016, with the total production reaching about 21 thousand tons. To illuminate the hidden contributions of small-scale fisheries sustainable development: such as social, economic, and environmental as well as governance, ones should recognize that initiating local fisheries management plans through adopting a precautionary approach should be shortly addressed. Improving knowledge on this typical fragile fisheries data would much support the resilience of the coastal community of MBD Regency.

ANKNOWLEDGEMENTS

Thank you very much for Development Consultant Southwest Maluku and SKPDT team of the Ministry of Maritime Affairs and Fisheries and Local Government Southwest Maluku data and information for Fiscal Year 2016. And also thank you to Mr. Duto Nugroho as senior scientist for input and addition of data to improve this paper.

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