Analysis of Environmental Conditions and Diversity of Fisherman Catches as Indicators of Sea Water Pollution at The Beach of Karangmangu Village

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Abstract:

The habit of disposing of household waste by Karangmangu villagers will affect the environmental conditions of the surrounding beaches, especially for the marine life under the sea that fish are frequently captured by fishermen. Under these conditions, it is necessary to do research that aims to: 1) analyze the condition of the coastal environment of Karangmangu Village based on the provisions of water quality and 2) analyze the diversity of fish caught by fishermen on the beach of Karangmangu Village. This type of research is a descriptive study. Data collection using the observation method. The data obtained were in the form of environmental conditions, abundance of fish species, diversity, and dominance index. The results of the study 1) found trash along the coast in the form of household waste, 2) an abundance of fish species of 105 individuals/m^2 in the form of *Decapterus macrosoma*, *Rastralliger kanagurta*, *Selar crumenophthalmus L*, and *Euthynnus affinis*. The results of data analysis on the condition of the coastal environment of Karangmangu Village experience light pollution, the diversity index value is 0.30 which means low, the dominance index is 0.07 which means low. Based on the results of data analysis, it can be concluded that the condition of Karangmangu waters is classified as unstable, but it is still able to support the life of fish caught by fishermen, even though the value of diversity and dominance is low.

Keywords: fish diversity, karangmangu beach, household waste, pollution

1. Introduction

Rembang regency is a regency located on the North Coast of Central Java Province with a total area of about 1.104 Km long coastline ± 63,5 Km. 35% of the area of Rembang Regency is a coastal region with extensive 355,95 Km^2 (Pambudi et al. 2019). Geographically, the Rembang Regency lies between 111°00'- 111°30' East Longitude and 06°30'- 07°00' South Latitude (Pambudi et al. 2019). Of the 14 districts in the District of Rembang, 6 of them are located by the sea and most of its citizens ' livelihood as a fisherman (Setiyarso et al. 2016). Rembang become one of the regions that affect the economy of the region of Central Java, because it has the fisheries subsector potential (M & Paramartha 2012). The condition of fisheries and marine city Rembang currently have fishermen fishing with the number large enough that 1.120 soul and 1.329 as a labourer fisherman (Soares 2013). The fish including the main commodity subsector of marine fisheries potential as a provider of nutritious food in the District of Rembang because of the availability of abundant (Alizada et al. 2020)(Rajeshkumar & Li 2018)(Fitrah et al. 2016)(Aliyah et al. 2015)(Wulansari, Rahmawati 2010). This resulted in the demand for fish in the Village Karangmangu

continue to increase along with the demand for a source of food (Pankhurst & Munday 2011). The availability of fish is influenced by several factors like productivity of fish in an area that has a water quality limited. In addition, the availability of fish is also influenced by season and temperature (Pankhurst & Munday 2011). The season and temperature can affect the development and maturation of the gonads, ovulation and spermiation, spawning, embryogenesis and hatching, as well as the metabolism of the fish (Pankhurst & Munday 2011)(Yu et al. 2020).

Karangmangu Village is one of the villages in the district of Rembang which has an area of 46, 427 Ha. Karangmangu Village located in the Beach area of the North East part of Central Java (Soares 2013). Based on its location, Karangmangu Village widely known to the public as a village Fisherman Settlement. Therefore, almost all of the people work as fishermen for generations. Along the Coast Karangmangu Village find various human activities such as catching fish, parking place boat and fishing boat, where sand mining and also household waste disposal (Rohmah et al. 2015). In addition, the intensity of the cruise at the Beach Karangmangu Village from year to year is increasing with the use of more efficient technologies such as ships with varied sizes, a tool to detect the abundance of fish or tools to collect hordes of fish that can cause changes in the environment beach (Zefri Ade Gurukinayan1, Yunasfi2 & 1 2014). In addition to the use of technology that is more efficient, the presence of waste including the factors most influential in favor of changing the environment (Hasibuan 2016). The increasing activity of the population around the coast have an impact on the environmental conditions of the beach, the balance and preservation of coastal areas, especially the preservation of marine life. The impact of the disruption of marine biota one of them reduced fish catches of fishermen (Elyazar et al. 2007)(Putra et al. 2018)(Zefri Ade Gurukinayan1, Yunasfi2 & 1 2014).

Fish survival depends on the conditions of its habitat, either from the condition of the physics, chemical conditions or the conditions of the biology of the waters (Putra et al. 2018). The large number of fish that can be caught fishing in an area (biomass) describes how much the level of productivity and the quality of the region. The quality of a certain area is said to be good if the parameters of the environmental conditions still meet the quality standards that exist. However, the problem about the condition of the environment of the beach in the Village of Karangmangu a result of waste can lead to a reduction of the quality of the environment the beach, fishermen's catches fish, the condition of the biota of the water, and the health of the surrounding community (Poedjiastoeti 2006).

Based on the above conditions, the need to do research that aims to analyze the environmental conditions of the Karangmangu based on the provisions of the raw water quality and to analyze the diversity of the fish the fishermen on the Beach Karangmangu Village. In addition, the additional objectives of this research is to provide insight to the public on the importance of maintaining the condition of the shore, especially the beach in the Karangmangu Village (Salim et al. 2019).

2. Research Methods

This research is a descriptive research kuantitaf that describe about the condition of the object of research naturally without any treatment. The method used in this research is observation method describes the environmental conditions and the diversity of the

fish the fishermen on the beach Karangmangu Village. This research was conducted on the beach of the Karangmangu Village District Sarang Rembang. This study was conducted for one month in February 2021. Tool used in this research namely stationery, plastic, pH meter, salinometer, a thermometer and a camera. As for the materials used in this research is a sample of sea water.

Steps of descriptive quantitative research was conducted through several stages, namely the stage of field observation aimed to determine the initial state of the conditions of the study site. Observation is done by directly observing to determine the location that will be used for research. The second stage is the determination of research location. Location determination based on the results of a survey that has been done is on the beach Karangmangu Village presented in Fig.1.
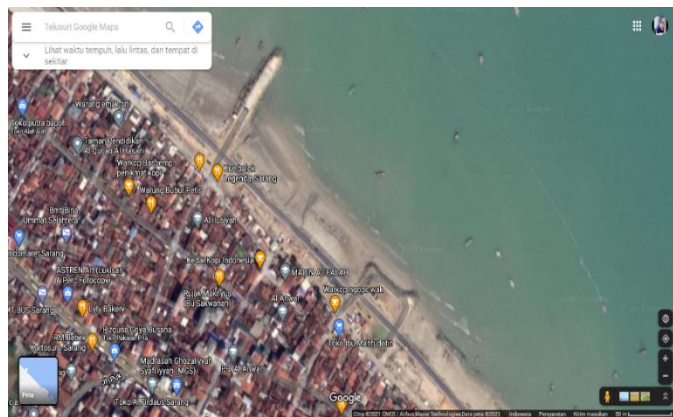

Fig. 1. Study Site
(Source: Documentation of google maps beach Karangmangu Village, 2021).

The third stage is the stage of setting up the tool. Tools that will be used in the study namely stationery, plastic, pH meter, salinometer, a thermometer and a camera. The fourth stage of sampling. Sampling of sea water is made with the technique of documentation and engineering roaming the research location. The location of the research is drawn perpendicular from the edge of the beach where the disposal of waste to the direction of the fishing areas results fishermen along the ±200 meters. The distance of the location of research is ±200 meters to the left and ±200 meters to the right from a waste disposal site.

Techniques of data retrieval environmental conditions is performed using the method of observation three times repetition. Data retrieval environmental conditions using measuring instrument salinometer to take data of sea water salinity, pH meters to retrieve the data the pH of the water, thermometer to take a temperature data water (Rizki, Riza;Ghalibda, Musrifin;Yoswaty 2016). For data retrieval fish is done by using the method of interviews with some of the fishermen in the Village Karangmangu and observation. Data collected in the form of the number of fish catches of fishermen at the time the research took place.

Data analysis in quantitative descriptive research in the form of environmental conditions, abundance of species, the diversity of fish, and the domination. To analyze

the changes in the environmental conditions of the beach in the Karangmangu Village can refer to the raw water quality of the sea (Goleman, Daniel; Boyatzis, Richard; Mckee, Annie 2018). To analyze the abundance of species and the diversity of types of fish, can use the formula of Shannon-Wienner (Cox et al. 2012). To analyze the dominance of the fish on the Beach of the Village Karangamangu can use the index formula dominance type of Simpson (Rahmatullah et al. 2016). For detailed formula described below.

2.1 The Abundance of Species

The abundance of a number of individuals in an area bounded by the factors that determine how much the abundance of individuals that can live (Ramadanti 2018). The species is said to overflow if the species number more than with any other species. To determine the abundance and diversity of fish catch of the fishermen on the Beach Karangmangu Village Sarang District Rembang can use the formula an abundance of different types of Shannon-Wienner (Cox et al. 2012). The formula presented below:

(1)

$$D = \left(\frac{ni}{A} \right)$$

Descryiption:

ni = The number of individuals that one type
A = Area sampling (m^2)
D = The abundance of species

2.2 Species Diversity

To determine the species diversity of the fish the fishermen on the Beach Karangmangu Village Sarang District Rembang can use the formula and diversity index of Shannon-Wienner (Cox et al. 2012). The index of diversity/diversity indicates the existence of a relationship between the number of species and number of species that compose a community.

$$H' = -\sum_{i=1}^{S} \left(\frac{ni}{N} \right) \ln \left(\frac{ni}{N} \right)$$

(2)

Descryiption:
H' = Diversity index of Shannon-Wienner.
Ni = The number of individuals that one type.
N = The total number of individual.

Based on the index of species diversity according to the Shannon-Wienner, can be defined as follows:
a. Value H' > 3 show that species diversity is high
b. Value H' $1 \leq H' \geq 3$ show that the species diversity level was
c. Value H' < 1 show that the diversity of species little or low

2.3 The Dominance of The Fish

To know the index of dominance of the fish on the Beach Karangmangu Village, Sarang District, Rembang can use the index formula dominance type of Simpson (Rahmatullah et al. 2016) following:

$$D = \sum (Pi)^2 \qquad (3)$$

Descryiption:
D   = The dominance of the fish
Pi   = The proportion of the number of the i-th of the total number of the fish (ni/N)

The value indicates the dominance of the right between 0-1. Category of Dominance do Seberi criteria on the value indicates the dominance of Simpson (C), following:
a. $< C \leq 0.50$ = Low category
b. $0.50 < C \leq 1.00$ = High category

3. Result and Discussion

3.1 Result

The number of parameters used for the determination of water quality status in accordance with the rules of the quality of the raw water sea (Goleman, Daniel; Boyatzis, Richard; Mckee, Annie 2018) six parameters include brightness, smell, garbage, temperature, pH, salinity parameters of analysis in this study. The results of the analysis of water samples can be seen in Table 1. While the results of the observation about the garbage that is thrown in the beach Village Karangmangu presented in figure 2. And the results of observations about the diversity of fish in the coastal village of Karangmangu presented in figure 3.

Table 1. The Results of Analysis of Samples Sea Water Beach Karangmangu

No		Parameters	Quality Standard/Maximum Levels	The Results of The Analysis	Description
1.				**Physics**	
	a.	Brightness	> 3 meter	± 2 meter	Doesn't meet the raw water quality of the sea
	b.	Smell	Odorless	Odorless	Meet the raw water quality of the sea
	c.	Trash	Nihil	There are	Doesn't meet the raw water quality of the sea
	d.	Temperature	Natural	30°C	Sea water temperature according to weather conditions
2.				**Chemical**	
	a.	pH	6,5 – 8,5	7,1	The pH of the water of the sea meets the raw water quality of the sea
	b.	Salinity	Natural ‰	26‰	The salinity of ocean water meets the water quality standard of the sea

Fig. 2. The garbage disposal is accidental to the aquatic ecosystem of the ocean
(Source: Personal documentation in the waters of the beach Karangmangu, 2021)

Fig. 3. The Fish Catch of The Fisherman Karangmangu
(Source: personal documentation in the waters of the beach Karangmangu, 2021)

Based on the results of the identification of the diversity of fishes on the beach Karangmangu, there are four fish species from two families who presented in Table 2. Based on the results of the analysis of fish have been identified at the beach Karangmangu that there are 168.000 individuals of 4 species. The results of the analysis of the abundance of the fish species found are presented in Table 3. The results of the analysis of the diversity of the fish species found are presented in Table 4. The results of the analysis of the dominance of the fish that is found is presented in Table 5.

Table 2. The Fish Catch of The Fisherman Karangmangu

No	Species	Family	Total
1.	Layang (*Decapterus macrosoma*)	Carangidae	50.000 individual
2.	Banyar (*Rastralliger kanagurta*)	Scombridae	50.000 individual
3.	Selar Bentong (*Selar crumenophthalmus L*)	Carangidae	60.000 individual
4.	Tongkol (*Euthynnus affinis*)	Scombridae	8.000 individual

Table 3. Analysis of The Abundance of Fish Catch of Fisherman Karangmangu

No	Species	Family	The Abundance of Species
1.	Layang (*Decapterus macrosoma*)	Carangidae	125 individual/m^2
2.	Banyar (*Rastralliger kanagurta*)	Scombridae	125 individual/m^2
3.	Selar Bentong (*Selar crumenophthalmus L*)	Carangidae	150 individual/m^2
4.	Tongkol (*Euthynnus affinis*)	Scombridae	20 individual/m^2

Table 4. The Analysis of Fish Diversity Catch of Fisherman Karangmangu

No	Species	Family	Species Diversity
1.	Layang (*Decapterus macrosoma*)	Carangidae	0,36
2.	Banyar (*Rastralliger kanagurta*)	Scombridae	0,36
3.	Selar Bentong (*Selar crumenophthalmus L*)	Carangidae	0,36
4.	Tongkol (*Euthynnus affinis*)	Scombridae	0,15

Table 5. The Analysis Dominance of The Fish Catch of Fisherman Karangmangu

No	Species	Family	The dominance of the fish
1.	Layang (*Decapterus macrosoma*)	Carangidae	0,0841
2.	Banyar (*Rastralliger kanagurta*)	Scombridae	0,0841
3.	Selar Bentong (*Selar crumenophthalmus L*)	Carangidae	0,1225
4.	Tongkol (*Euthynnus affinis*)	Scombridae	0,0025

3.2 Discussion

Based on the data results Table 1 shows that the observations made at the beach Karangmangu, shows the value of the brightness of the water of the sea of ± 2 meters. However, the data of the brightness of the sea water obtained is low and does not meet the water quality standard that is equal to 3 meters (Goleman, Daniel; Boyatzis, Richard; Mckee, Annie 2018). The factors that cause the low value of the brightness of the water which is the number of solids of domestic sewage and community activities around the beach Karangmangu as well as the lack of binding of the substrate by mangrove plants (Mainassy 2017). These data indicate that the beach Karangmangu still worth it to life spot certain types of fish. In addition, the parameters of the trash on the beach Karangmangu also need to be analyzed its existence and found that the

parameters of the waste does not meet the water quality standard (Goleman, Daniel; Boyatzis, Richard; Mckee, Annie 2018). There are trash found along the beach Karangmangu, but for the parameters, the smell still meet the water quality standard which does not smell (Goleman, Daniel; Boyatzis, Richard; Mckee, Annie 2018). For the parameters of the temperature, the measurement is done in the morning at 08.30 AM and obtained a sea water temperature of 30ºC (Mainassy 2017). The temperature value obtained show that 30ºC is a good temperature for the development of the fish (Hasibuan et al. 2018), especially against the hatching of fish eggs will not affect the abundance of species of fishes. The value of the sea water temperature can vary because influenced by several external factors such as weather, wind, sea currents and of course human activities directly (Rizki, Riza;Ghalibda, Musrifin;Yoswaty 2016). As for the pH, the obtained value of 7.1, which shows that the pH value of 5.3 to 7.3 relatively good for the growth and development of fish (Mainassy 2017)(Hasibuan et al. 2018). For the salinity of the sea water on the beach Karangmangu naturally showed a value of 26 ‰, which means still meet the water quality standard of the sea (Hasibuan et al. 2018). The salinity of sea water is classified either to the growth and development of fish if the value obtained from the results of the study ranged from 25-34 ‰. However, the salinity of the sea water may change if more and more activities that people do on the beach Karangmangu (Rizki, Riza;Ghalibda, Musrifin;Yoswaty 2016). Range of measurement of water quality parameters during the study were in the range of decent conditions for the growth of certain fish commonly consumed by people in Karangmangu (Rayes 2013).

Based on the data of Table 2 shows that the number of fish species have been identified at the beach Karangmangu as much as 168,000 individuals of 4 species, among others *Decapterus macrosoma* of the family Carangidae, *Rastralliger kanagurta* of the family Scombridae, *Selar crumenophthalmus L* of the family Carangidae dan *Euthynnus affinis* of the family Scombridae. *Decapterus macrosoma is a species of the family Carangidae, which became a major component of the resources of pelagic fish small in the waters around Java Sea-Strait of Makassar, which has a high economic value so that it becomes one source of foreign exchange* (Suwarso & Zamroni 2013)(Zamroni et al. 2019)(Akerina, I . M. F., Silvester B. P. 2019). Based on the data of table 2, the number of species *Decapterus macrosoma* caught in fishing nets Karangmangu that as many as 50,000 individuals in a single catch. The average *Decapterus macrosoma* have a body length ± 24,75 cm (Akerina, I . M. F., Silvester B. P. 2019) and the average body weight of 200 grams (Zamroni et al. 2019). *Decapterus macrosoma* is a type of fish that live in clear sea water with a salinity of water high (± 32-34 ‰) as well as his life is affected by the season. *Rastrelliger kanagurta* is a type of fish that plays an important role in the activities of utilization of resources of pelagic fish small in tropical waters (Hariati et al. 2015). The average size body length *Rastrelliger kanagurta* 25 cm and can reach a maximum length of 35 cm. Geographically, its existence is widespread in the waters of Indonesia, such as in the

waters of the Strait of Malacca with a water temperature of approximately 17°C (Hariati et al. 2015). *Rastrelliger kanagurta* feed on plankton and are usually found clustered in the column waters. Based on table 2, the number of species *Rastralliger kanagurta* caught in fishing nets Karangmangu as many as 50,000 individuals in a single catch. *Selar crumenophthalmus L* of the family Carangidae is that fish is important for fisheries in Rembang Regency, precisely in the Village of Karangmangu (Wulansari, Rahmawati 2010), because the production of catches is the most high, the price is relatively cheap as a provider of protein so that it can reach all levels of society Karangmangu (Wulansari, Rahmawati 2010). *Selar crumenophthalmus L* typically inhabits shallow coral reefs (Bakhtiar et al. 2020). The growth and survival of *Selar crumenophthalmus L* will be determined by the environmental conditions of the place of residence and the availability of food (Bakhtiar et al. 2020). Based on table 2, the number of species *Euthynnus affinis* caught in fishing nets Karangmangu as many as 8,000 individuals in a single catch. *Euthynnus affinis* of the family Scombridae is the class of large pelagic fish that generally has a body length of 50-60 cm and are predators. Most of its habitat in the waters off with at 18-29°C (Anggraeni 2014). The spread of *Euthynnus affinis* in the waters of the Indian Ocean covers an area of tropical and sub tropical and time distribution takes place regularly (Adji 2008). *Euthynnus affinis* a group of fish are fast swimmers, meat eaters (carnivores) and life huddle (schooling) (Anggraeni 2014).

Based on Table 3, shows the value of the index of abundance of *Decapterus macrosoma* about 125 individuals/m^2 in a single catch. This means an abundance of *Decapterus macrosoma* is still relatively low (Hariati 2011). Factor abundance *Decapterus macrosoma* is low it is possible due to the condition of the substrate or the place of life of the species *Decapterus macrosoma* as well as the activity of transmigration performed by these species (Nurfitriani et al. 2017). In Table 3, the abundance of *Rastrelliger kanagurta* shows a value of about 125 individuals/m^2 in a single catch. This means an abundance of fish kite is still relatively low (Hariati 2011). In Table 3, the abundance of *Selar crumenophthalmus L* showed a value of 150 individuals/m^2 in a single catch. The value of the index of abundance of the species of *Selar crumenophthalmus L* the highest among the 4 species identified at the beach Karangmangu. The abundance of *Euthynnus affinis* presented in Table 3 showed a value of 20 individuals/m^2, that means an abundance of *Euthynnus affinis* is the lowest among 4 species are often caught in fishing nets Karangmangu.

Based on Table 4, shows the value of the index of diversity (H') species *Decapterus macrosoma*, *Rastrelliger kanagurta*, *Selar crumenophthalmus L* < 1 that was 0.36. This means that the diversity of the third species is relatively small or low (Cox et al. 2012). While the value of the index of diversity (H') species *Euthynnus affinis* known is the lowest among 4 species were identified that was 0.15. The difference in the value of the index of diversity vary on the waterfront can be caused by physical factors of water as well as the availability of nutrients and the nutrient utilization of different of each

species (Rashidy et al. 2013). The availability of nutrients as well as the ability of each type of fish to adapt to the existing environment (Sirait et al. 2018).

Based on Table 5, shows the value of the index of dominance (D) between the species of *Decapterus macrosom* and *Rastrelliger kanagurta* the same, namely by 0,0841 which means the predominance of very low. From Table 5, showed the dominance of *Selar crumenophthalmus L* is highest among any other species that is equal to 0,1225. This means the dominance of *Selar crumenophthalmus L* is still relatively low, because the values obtained ≤ 0,50.

4. Conclusion

From the results of the research can be concluded that the condition of the physics and chemistry of the waters beach Karangmangu in unstable conditions, but there is likely to be able to live in 4 different species of fish. The Parameter that plays an important role in determining the quality of coastal waters Karangmangu among others, the brightness, the smell, the garbage, the temperature, pH and salinity. Due to the condition of the beach Karangmangu that is not stable, it is possible to be the cause of death or physiological disorders of fish. Having in mind that the beach of the village Karangmangu in the condition of less stable, it turns out that identified 4 species of fish that inhabit the waters of Karangmangu Village, among others *Decapteus macrosoma* of the family Carangidae, *Rastralliger kanagurta* of the family Scombridae, *Selar crumenophthalmus L* of the family Carangidae and *Euthynnus affinis* of the family Scombridae. Among the 4 species of fish, *Selar crumenophthalmus L* is a fish which is most abundant and dominate obtained by the fishermen of the Karangmangu Village.

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