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Study of Water Quality for Aquaculture System in Ujung Pacu River, North Aceh Regency

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ABSTRACT

Ujung Pacu River is one of the rivers found in North Aceh Regency which is often used by surrounding communities such as for industrial, agricultural, residential and aquaculture activities that can affect river water quality. This study aimed to determine the water physical and chemical parameters in the Ujung Pacu River for aquaculture activities. The research method used was a survey method by determining the sampling station based on community activities around the river. The study consisted of 4 stations with 3 sampling points at each station. Data of water physical and chemical parameters were compared with water quality standards and analyzed descriptively with a quantitative approach. The results showed that the range of water quality values were various in each station. Ujung Pacu River is influenced by daily tide fluctuations. The highest water quality fluctuations occur in salinity, turbidity and depth. The pollution index in the Ujung Pacu river is included to criteria of lightly polluted rivers with range 1.8545 - 4.4979. The Ujung Pacu River is unsuitable for aquaculture systems using floating net cages system in river bodies.

Keywords: Ujung Pacu River, water quality, pollution index

ABSTRAK

Sungai Ujung Pacu adalah salah satu sungai yang ditemukan di Kabupaten Aceh Utara yang sering digunakan oleh masyarakat sekitar seperti untuk kegiatan industri, pertanian, perumahan dan akuakultur yang dapat mempengaruhi kualitas air sungai. Penelitian ini bertujuan untuk menentukan parameter fisik dan kimia air di Sungai Ujung Pacu untuk aktivitas akuakultur. Metode penelitian yang digunakan adalah metode survei dengan menentukan stasiun pengambilan sampel berdasarkan kegiatan masyarakat di sekitar sungai. Penelitian terdiri dari 4 stasiun dengan 3 titik pengambilan sampel di setiap stasiun. Data parameter fisik dan kimia air dibandingkan dengan standar kualitas air dan dianalisis secara deskriptif. Hasil penelitian menunjukkan bahwa kisaran nilai kualitas air di setiap stasiun bervariasi. Sungai Ujung Pacu dipengaruhi oleh fluktuasi pasang surut harian. Fluktuasi kualitas air tertinggi terjadi pada salinitas, kekeruhan dan kedalaman. Indeks polusi di sungai ujung pacu termasuk dalam kriteria sungai yang tercemar ringan dengan kisaran 1,8545 – 4,4979. Sungai Ujung Pacu tidak sesuai untuk sistem akuakultur yang menggunakan keramba jaring apung di badan sungai.

Kata kunci: Sungai Ujung Pacu, kualitas air, indeks pencemaran

1. Introduction

The aquaculture sector has contributed more than 17.9 million tons of fish to cover national consumption, an increase of 23.27 percent until 2015 compared to aquaculture fish production in 2014 of 14.52 million tons (Ministry of Maritime Affairs and Fisheries, 2016). However, this figure is estimated to still be increased through the use of various types of environmentally friendly research-based technology and integrated with the aquaculture patterns based on "Better Management Practices". The extent of potential uncultivated cultivation areas is an important added value to increase aquaculture production figures as well as supporting aspects of national aquaculture sector development. Aceh Province, which is

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one of the centers of national fisheries production, is currently categorized as province that has not exploited the potential of the aquaculture area properly. Statistics of the Aceh province (2016) stated that the capture fisheries production in Aceh Province reached 166.3 tons far exceeding aquaculture production which was only 64.1 tons in 2015. In other words there are still many areas in Aceh Province that have not been used optimally to increase production Aceh's aquaculture. The lack of environmental data sources and spatial information have caused many potential land for aquaculture activities not to be utilized properly.

Ujung Pacu River is one of the rivers in the North Aceh Regency of Aceh Province which stretches from the upstream in the Ujung Pacu village to downstream in the Blang Naleung Mameh village and is directly connected to the Malacca Strait. Many community activities are found along this river, including agricultural activities, human settlements, aquaculture and industry. Agricultural activities are almost along the river flow. Waste flow generated from agricultural areas such as the residual use of fertilizers and pesticides would enter the river and affected the condition of the river waters. In addition, industrial waste which is a fertilizer-producing industry will also increase the level of waste in the waters. Residual residential waste and aquaculture activities are also directly channeled into this river. Anhwange et al (2012) stated that the river is one of the waters that are known to have many uses in every development sector such as agriculture, industry, transportation, public water supply, etc. Instead, the river is also used as a waste disposal site. Waste from industrial, domestic and agricultural activities is discharged into rivers causing large-scale water quality degradation.

Fishery activities in Ujung Pacu River so far are still engaging in capture fisheries conducted by local fishermen.It can be seen, the potential to develop aquaculture is still wide open, especially using the floating net cage system. Not much research has been conducted yet in this river, there for research is needed especially knowing the water quality of the Ujung Pacu river which includes physical and chemical parameters given a large number of community activities around the river. Next, The pollution index needs to be studied to determine the level of pollution in the river. This study aimed to determine the water physical and chemical parameters in the Ujung Pacu River for aquaculture activitie. Finaly, we could determine whether this river is suitable or not for aquaculture activities with floating net cage system.

2. Materials and Methods

2.1. Research site

The research method used was survey method on 4 stations with 3 points sampling. The determination of the stations was based on human activity around the river i.e. industrial activities, agriculture, aquaculture, and human settlements. Station 1 is located in the village of Ujung Pacu that on the upstream of the river which is the area of rice fields (agriculture). Station 2 is located in a large area of human settlements, agriculture and aquaculture areas. Station 3 is located in the aquaculture and agriculture areas and the last Station 4 is located in Blang Naleung Mameh Village which is an industrial, residential, aquaculture area and fish landing area (TPI). For more details can be seen on the map below.

2.2. Variable

The parameters observed were physical and chemical parameters performed in 2 ways i.e directly (in-situ) and indirectly (ex-situ). In-situ measurements are carried out on the parameters of temperature, pH, dissolved oxygen, salinity, current velocity, depth, and brightness. While the parameters ex-situ measured are Turbidity, Ammonia, Nitrite, Nitrate, Phosphate, and BOD analyzed in the laboratory (Table 1).

2.3. Research procedures

This research was conducted in a span time of three months from June to August. Ujung Pacu river water sampling was done on the right, middle and left side of the river for each station. Sampling at high tide and low tide and depth measurement is adjusted to the river depth. If the depth of river 60 cm then measurement depth is 10 cm, if the river depth above 60 cm to 300 cm then the depth of measurement is 20 cm, if the depth 300 cm to 600 cm then the measurement at depth 60 cm and if the depth of river more than 600 cm then the depth of measurement was 80 cm at surface and riverbed at each station (Rahayu et al, 2009). For samples measured in the laboratory will be put into a sample bottle of about 600 ml for each test parameter, then labeled and stored in an icebox.

2.4. Data Analysis

Data of physical and chemical parameters obtained during the study will be

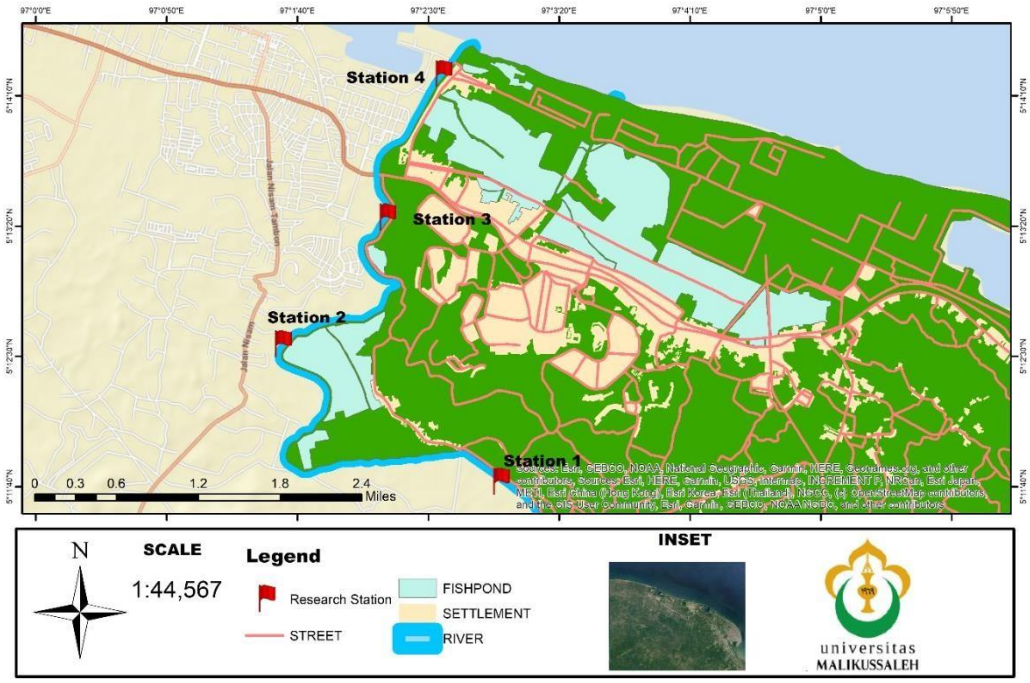

Figure 1. The map of research location Ujung Pacu River Kruenggeukuh, North Aceh

analyzed descriptively with quantitative approach and would be compared with applicable laws and other supporting literature. Water quality status was assessed by water pollution index method referring to the Minister of Environment Decree No. 115/2003 on Guidelines for Determination of Water Quality Status. Water pollution index was calculated by the following measures. Formula in Excel was used for calculation:

$$Pij = \sqrt{\frac{\left(\frac{Ci}{Lij}\right)^2 M + \left(\frac{Ci}{Lij}\right)^2 R}{2}}$$

Where Pij is pollution index for a specified water quality purpose (j); Ci is measured water quality parameters; Lij is standard water quality p arameter for each parameter at specified water quality purpose (j); (Cij/Lij)M is Cij/Lij maximum; (Cij/Lij)R is Cij/Lij average. Quality standard used is Government Regulation No. 82/2001 on Water quality and water pollution management Class III: Water quality for fisheries and animal husbandry and Minister of Environment Decree No 51/2004 on seawater quality standards. All data collected is presented in table and graphic form using Microsoft Excel 2010.

3. Result and Discussion

Ujung Pacu River is one of the rivers in North Aceh Regency which is a unity between Keude Beureugang River and Nisam Amplas River. This river has a length approximately 9.66 km stretches from upstream located in the village of Ujung Pacu to downstream in the village of Blang Naleung Mameh. Many

Table 1. The parameters and the methods for measuring water quality

Parameters	Unit	Methods
Temperature	^{0}C	Thermometer
Salinity	ppt	Handrefractometer
Brightness	cm	Secchi disk
Turbidity	NTU	Turbidity meter
pH	-	pH meter
Dissolved oxygen	mg.L^{-1}	DO meter
Nitrite	mg.L^{-1}	Spektrophotometric
Nitrate	mg.L^{-1}	Spektrophotometric
Phosphate	mg.L^{-1}	Spektrophotometric
BOD_5	mg.L^{-1}	DO meter

community activities are conducted around the Ujung Pacu River such as industrial activities, agriculture, housing, and aquaculture areas. The flow of water in the Ujung Pacu River is strongly influenced by daily tides activity where at high tides sea water enters far into the river body so that its salinity fluctuates. Tides can occur approximately 9 hours every day with a water discharge of around 12,279 $m^3.s^{-1}$. (Sriana, 2017). In the study along the Ujung Pacu River sampling point taken as many as 4 stations. The station 1 is located on the upstream of the Ujung Pacu River with coordinate points N 050 11'17,0 and E 0970 03'17,2". This area has a muddy clay on the bottom at the edge of the river, while a fine sandy in the middle of river. This area is used by the community as irrigation of rice fields. Station 2 is located in Paloh Gadeng village with coordinates point N 05012'35.4 and E 0970 01'37,5". This area has been influenced by the daily tide of the seawater, has a sandy clay sediment structure so that around this area is used as aquaculture area on the river side and settlement of Paloh Gadeng village community. Station 3 is located in Ujung Pacu Village which has a muddy clay sediment structure. At this point, it is an unproductive ponds area as well as a community agriculture area. This station 3 is at the coordinate point N 050 13'18,9" and E 0970 02'11,8". Station 4 is the last sampling point in this study that located at the downstream of the river in Blang Naleung Mameh village with the coordinate point N 050 14'18.3 ° and E 0970 02'35,7". This area has sandy sediment on the river's bottom, so that this area is utilized by the community as human settlements, fishpond, industry and fish landing area (TPI).

3.1. Physical parameters

The result of measurement of water quality parameters in Ujung Pacu river both physical and chemical parameters showed varying results on each station. Physical parameters included temperature, depth, brightness, turbidity and current velocity. The water temperature of all stations ranges from 30 – 32 ^{0}C, the depth ranges from 70 - 440 cm, the brightness ranges from 20 - 185 cm, turbidity ranges between 4.7 - 62 NTU and current velocity 0.1 - 0.38 $m.s^{-1}$. The results of physical parameters in the Ujung Pacu river presented in Table 3. Water temperature of Ujung Pacu river at all stations ranged from 30 - 32°C. River water temperature increasing from upstream to downstream. Chapman (1996) proposed that In running water, temperature normally increases gradually from the source of the river to its mouth. Based on Government Regulation Number 82 of 2001, the optimal temperature for fishery activity was the natural temperature deviation 3. Tatangindatu et al (2013) states that the right temperature range to support optimal growth for aquaculture fish is around 28 - 32 ^{0}C. The same was stated by Radiarta et al (2006) that the temperature range between 28 - 32 ^{0}C is very suitable for aquaculture activities with floating net cage systems.The temperature at downstream of Ujung Pacu was slightly higher, this thought to be due to the abundance of organic material in the river from the waste of community activities around the river such as industry, agriculture, and residential areas.

Table 2. Pollution index and water quality

	IP Class Category
0≤ IP ≤1.0	: Meet quality standards (good)
1.0< IP ≤5.0	: Lightly polluted
5.0< IP ≤10	: Fairly polluted
IP >10.0	: Heavily polluted

Ujung Pacu River was unsuitable as a floating net cage (KJA) area when viewed from the depth of the river because the depth at each station only ranges from 70 to 440 cm. Depth varies at each station where the deepest station was at station 3. The high depth at station 3 happened because this station have jutted baseline relief of the bottom river. In this area there is excavation to build the embankment at the edge of the river. This river has muddy sediment on the bottom so that the erosion of the substrate is very easy to occur due to the flow of river water. Beveridge (1991) mentioned that for fish farming activities in floating net cages (KJA), water depth at least 7 m is required. Consideration for maximum depth, that is not more than 15 m, because it will increase operational cost and difficulty of installation process of KJA system. In addition, Radiarta et al (2006) suggest that waters that have a depth of less than 10 meters and more than 30 meters are unsuitable for use as a area for floating net cage systems.

The brightness of the Ujung Pacu river ranges from 20 - 185 cm. The brightness increasing from upstream to downstream also. Ropiah (2000) stated that the good brightness for freshwater aquaculture is between 25 - 40 cm. On the other hand, brightness of less than 1 meter is considered inappropriate for the location of floating net cages and is considered suitable if the brightness is more than 3 meters

Table 3. Physical Parameters of Ujung Pacu River

Parameter	Station 1		Station 2		Station 3		Station 4	
	Range	Average	Range	Average	Range	Average	Range	Average
Temperature (^{0}C)	30 - 31	30,5	30 - 31	30.45	30 - 32	31	30 - 31.4	30.63
Depth (cm)	70 - 90	80	150 - 230	187.5	200 - 440	320	150 - 290	225
Brightness (cm)	20 - 25	22.5	36.5 - 60	45.13	40 - 125	62.75	55 - 185	89.63
Turbidity (NTU)	41 - 56.4	44.95	13 - 62	42.57	4.7 - 56.3	33.91	1.3 - 48.7	18.81
Current velocity (m/s)	0.1 - 0.15	0.13	0.11 - 0.25	0.16	0.08 - 0.38	0.17	0.06 - 0.38	0.19

(Radiarta et al, 2006). Therefore, in terms of brightness, Ujung Pacu River was unsuitable to serve as aquaculture area.

Turbidity is caused by both suspended and dissolved organic and inorganic materials such as mud, sand, organic materials for example plankton and other microorganisms (Irawan dan Sari, 2013). Furthermore, Chapman (1996) proposed that Temperature, turbidity, and TSS in rivers can be greatly affected by human activities for instance agriculture, deforestation and water use for cooling. Turbidity in the Ujung Pacu river varies from upstream to downstream of the river allegedly due to effecting by community activities around the station. Turbidity along the ujung pacu river river is around 4.7 - 62 NTU. According to the decree of the minister of environment No. 51/2004, the turbidity that is suitable for marine life is <5 NTU. Station 1 which is in the upstream of the river accommodates a lot of dissolved particulate matter from the surrounding area which is mostly a rice field area (agricultural). Furthermore, at stations 2, 3 and 4 besides also get influence from the activity of the community also get the daily tides effect from sea water so that happened the mixing of river water with sea water that caused increasing of turbidity. The high level of turbidity in the Ujung Pacu river cause this river is not feasible to serve as aquaculture areas, especially aquacuture in floating net cages (KJA). Generally, this river is not suitable for aquaculture activities because of its high turbidity fluctuations.

The current velocity of Ujung Pacu river flew from upstream to downstream is increasing as it is influenced by the daily tides of seawater, especially at stations 2, 3 and 4. Current velocity at Ujung Pacu River ranges from 0.1 to 0.38 $m.s^{-1}$. Mason (1993) in Fisesa et al., (2014) stated that water is categorized in very fast flowing water if the current velocity is > 1 $m.s^{-1}$, the fast flowing current is 0.5 to 1 $m.s^{-1}$, the moderate flowing current is 0.25 -0.5 $m.s^{-1}$, slow flowing current 0.1 to 0.5 $m.s^{-1}$, and a very slow flowing current of 0.1 to 0.25 $m.s^{-1}$. Based on these categories, the Ujung Pacu rivers fall into the category of slow flowing current rivers. It can be seen that the river is suitable for aquaculture activities using floating net cages.

b. Chemical parameters

The chemical parameters of the river included dissolved oxygen (DO), pH, Ammonia, nitrite, nitrate, phosphate, BOD and salinity. DO 4.3 – 8.1 $mg.L^{-1}$, pH 7.1 – 8.7, ammonia 0.03 – 0.44 $mg.L^{-1}$, nitrite 0 – 0.02 $mg.L^{-1}$, nitrate 0.01 – 0.07 $mg.L^{-1}$, phosphate 0.01 – 0.12 $mg.L^{-1}$, BOD 0.4 – 6.2 $mg.L^{-1}$ and salinity 0.5 - 26 ppt. Table 4 is the chemical parameter of the Ujung Pacu River.

Dissolved oxygen is the most critical parameter in fish farming (Affan, 2012). Dissolved oxygen in the Ujung Pacu river ranges from 4.3 to 8.1 $mg.L^{-1}$. According to Government Regulation Number 82 of 2001, proper dissolved oxygen for aquaculture

Table 4. Chemical Parameters of Ujung Pacu River

Parameter	Station 1		Station 2		Station 3		Station 4	
	Range	Average	Range	Average	Range	Average	Range	Average
DO ($mg.L^{-1}$)	4.7-7.7	6.18	4.8-7.7	6.16	5.1-7.3	6.45	4.3-8.1	6.57
pH	7.1-7.6	7.25	7.1-8.2	7.47	7.2-8.6	7.73	7.1-8.7	7.79
Ammonia ($mg.L^{-1}$)	0.28-0.39	0.34	0.20-0.44	0.32	0.05-0.35	0.24	0.03-0.38	0.19
Nitrite ($mg.L^{-1}$)	0.01-0.02	0.01	0.01-0.02	0.010	0.00-0.02	0.01	0.00-0.02	0.01
Nitrate ($mg.L^{-1}$)	0.03-0.07	0.05	0.03-0.05	0.04	0.01-0.06	0.04	0.01-0.06	0.03
Phosphate ($mg.L^{-1}$)	0.07-0.09	0.08	0.01-0.12	0.07	0.02-0.11	0.050	0.01-0.11	0,05
BOD ($mg.L^{-1}$)	0.4-2.5	1.6	1.7-4.4	2.91	1.8-6.2	3.25	0.7-5.2	2.56
Salinity (ppt)	0.5	0.5	0.5-13	3.75	3.0-26	9.5	6.0-26	13.42

activities is at least 3 $mg.L^{-1}$. Salmin (2005) and Radiarta et al. (2006) added that the waters can be categorized as good waters with low pollution levels if the dissolved oxygen level is > 5 $mg.L^{-1}$. In addition, the Dissolved Oxygen quality standard according to Minister of Environment Decree No. 51/2004 is > 5 $mg.L^{-1}$. Depending on the water temperature requirements for particular aquatic species at various life stages, the criteria values range from 5 to 9.5 $mg.L^{-1}$. Minimum dissolved oxygen concentration of 5-6 $mg.L^{-1}$ for warm- water biota and 6.5-9.5 $mg.L^{-1}$ for cold-water biota (Chapman, 1996). Furthermore, Blume et al (2010) suggested that human activities such as agriculture and waste disposal can cause a decrease in the concentration of dissolved oxygen in the waters. Judging from the value of dissolved oxygen levels contained in all stations in the Ujung Pacu river can be seen that this river is feasible to serve as aquaculture activity using floating net cages.

The pH values at all stations in the Ujung Pacu river ranged from 7.1 to 8.7. According to the Government Regulation Number 82 of 2001, the pH value that is eligible for fisheries activities belonging to the class III water quality standard is 6 – 9. Furthermore, numerous studies have confirmed that a pH range of 6.5 to 9 is most appropriate for the maintenance of fish communities (Chapman, 1996). Next, Minister of Environment Decree No 51/2004 stipulates that the optimal pH standard for the life of seawater biota is approximately 7 - 8.5. Based on that, it can be seen that Ujung Pacu River is good to serve as aquaculture area using floating net cages system.

Ammonia values ranged from 0.03 to 0.44 $mg.L^{-1}$. According to the Government Regulation Number 82 of 2001, the appropriate ammonia levels for fishing activities for sensitive fish are < 0.02 $mg.L^{-1}$. Furthermore, the ammonia content which is good for freshwater fish life is less than 1 $mg.L^{-1}$ if the ammonia level has exceeded 1.5 $mg.L^{-1}$, then the water have experienced contamination for aquaculture activities (Tatangindatu et al 2013). Minister of Environment Decree No51/2004 stipulates that the optimal ammonia standard for the life of seawater biota is around 0.3 $mg.L^{-1}$. Furthermore, Effendi (2003) suggested that ammonia levels in natural water are usually less than 0.1 $mg.L^{-1}$. High levels of ammonia indicate that there is contamination of organic materials derived from domestic waste, industrial waste, and agricultural fertilizer runoff.

Nitrite content in the water is relatively small and smaller than nitrate because it is immediately oxidized to nitrates. The source of nitrite comes from agricultural, aquacultur, industrial waste and domestic waste. The natural water contain nitrites of about 0.001 $mg.L^{-1}$ and preferably not exceeding 0.06 $mg.L^{-1}$ (Effendi, 2003). The value of nitrite in Ujung Pacu river ranges from 0 to 0.02 $mg.L^{-1}$. It indicates that Ujung Pacu river water is not in its natural condition. When compared with Government Regulation Number 82 of 2001 that nitrite level for class water quality class III including aquaculture equal to 0,06 $mg.L^{-1}$, hence condition of Ujung Pacu river still eligible to be used as aquaculture area using floating net cages.

Nitrate (NO_3) is the main form of nitrogen in natural water and is a major source of nutrients for the growth of phytoplankton and other aquatic plants. Nitrate levels greater than 5 $mg.L^{-1}$ illustrate the water have been the occurrence of pollution (Effendi, 2003). Furthermore, according to the Government Regulation Number 82 of 2001, the nitrate value for fishing activities should not exceed 20 $mg.L^{-1}$. Ujung Pacu River is still suitable for aquaculture area because nitrate value ranges only from 0,01 – 0,07 $mg.L^{-1}$. Nitrate levels greater than 0.2 $mg.L^{-1}$ can cause eutrophication of water and may cause blooming as well as a trigger factor for the rapid growth of aquatic plants such as water hyacinth.

The phosphate values in the Ujung Pacu river range from 0.01 – 0.12 $mg.L^{-1}$. According to the Government Regulation Number 82 of 2001, phosphate quality standard value for aquaculture activity is 1 $mg.L^{-1}$. Levels of phosphate based on fertility level there are three, namely, water with low fertility rates ranging from 0 to 0.02 $mg.L^{-1}$, water with moderate fertility rates ranging from 0.021 to 0.05 $mg.L^{-1}$, and water with high fertility rates ranged from 0.051 – 0.1 $mg.L^{-1}$ (Effendi, 2003). Furthermore, Anhwange et al (2012) suggested the recommended maximum phosphate levels for rivers and water that have been reported is 0.1 $mg.L^{-1}$. Thus, it can be seen that the Ujung Pacu River has various fertility rates from medium to high fertility and deserve to be used as aquaculture area with the highest average is at station 1 that is 0,08 $mg.L^{-1}$ where there are large of agriculture activity. All nutrient almost compounds (NO3 and PO4) in marine waters and sourced from river flows which generated by agricultural, aquaculture, industrial and household or waste activities population (Casali et al., 2007).

Biology Oxygen Demand is the amount of dissolved oxygen needed by decomposer

bacteria to decompose organic pollutants in water. The greater the BOD concentration of waters shows the concentration of organic matter in the water is also high (Yudo, 2010).

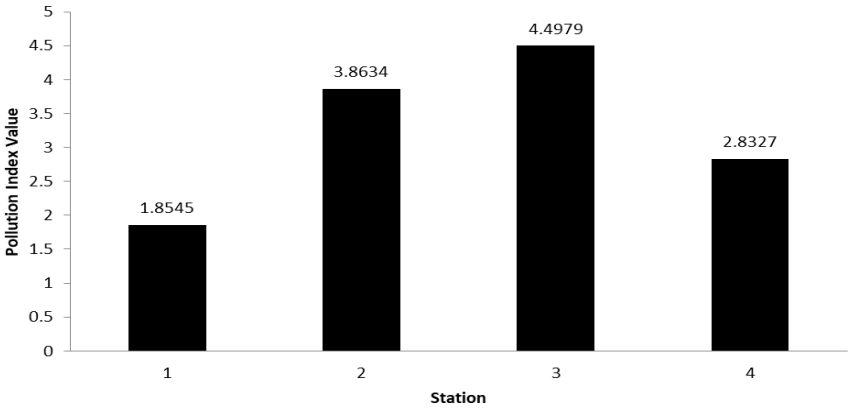

Figure 2. Pollution Index at each research station

Biological Oxygen Demand (BOD) values in the ujung pacu range from 0.4 to 6.2 mg.L^{-1}. According to the Government Regulation Number 82 of 2001, the save level of BOD for fishing activities is 6 mg.L^{-1}. Salmin (2005) pointed out that the higher concentrations of BOD indicate that the water have been contaminated, the BOD concentration is low and can be categorized as good water having BOD levels ranging from 0 to 10 mg.L^{-1}. The BOD quality standard according to Minister of Environment Decree No. 51/2004 is around 20 mg.L^{-1}. High BOD values in water can be caused by waste disposal from housing to rivers and agricultural land (Anhwange et al.,2012). Thus, it can be seen that the Ujung Pacu river is included in the category of healthy water and has a low level of pollution and is suitable to be used as a media of aquaculture.

The Ujung Pacu River has a salinity value that fluctuates because of daily tides activity. The salinity value in the Ujung Pacu river ranges from 0.5 to 26 ppt. Ujung Pacu River has the high fluctuation of salinity lead to not feasible to be used as media for aquaculture, especially floating net cage. But if the river water used as a medium for aquaculture ponds, it can still be used with attention to the time of entry and disposal of wastewater into the river. Organism that can be cultured in the Ujung Pacu river is an organism that would survive in large salinity change range (Euryhaline). Tilapia is included in to the euryhaline fish group, which has wide range tolerance in salinity (freshwater euryhaline fish has a salinity tolerance > 8 ppt) (Lutfiyah, 2014). In addition, milkfish is euryhaline fish that they can survive in a wide salinity range (0-35 $^{0}/_{00}$) (Mansyur and Tonnek, 2003). Furthermore, the euryhaline characteristic of the milkfish has allowed for its cultivation in a wide range of aquatic environments from inland freshwater lakes to ocean cages (FitzGerald, 2004).

3.3. Pollution Indeks (PI)

Pollution Index (PI) is Water Quality Index an important and widely used was developed in 1970 by the National Sanitation Foundation of the United States (NSF)(Lumb et al, 2006). Poonam et al (2013) stated that PI estimation endeavors single value which decrease the big quantity of parameters and represent data in a simple way. Pollution indexes at the ujung pacu river runways at four stations are 1.8545, 3.8634, 4.4979 and 2.8327, respectively (Figure 2). Overall, the calculation of the pollution index in the river runway is included in the criteria of Lightly polluted rivers. The lowest pollution index value is on station 1 with value of 1.8545. The level of pollution is low because it is on upstream of the river and receives less pollution due to human activities. Most of the waste that enters the river comes from agricultural land around the upstream of the river. On the other hand, station 3 has the highest pollution index value compared to other stations with value of 4.4979. The large agricultural area around the river is the biggest contributor to waste at this station. In addition, waste flow from stations 1 and 2 increasing the amount of waste and leading pollution levels at this station increase also. The Pollution Index Value at Station 4 is 2.8327 lower than stations 2 and 3. Although around this station there are a lot of human activities such as agriculture, aquaculture, fertilizer factories and housing, but due to the

influence of daily tides seawater causes the level of waste decreases. Therefore, it can be said that aquaculture activities cannot be carried out in river bodies with a cage system, but can be used on ponds around the river by treating the water before use.

4. Conclusion

Ujung Pacu River has large water quality fluctuations, especially in salinity, turbidity, and depth. The pollution index measurement shows that the Ujung pacu river included in the Lightly polluted river criteria. Thus, it is unsuitable for aquaculture activities in river bodies such as floating net cages system.

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