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Research Paper

Used Mining Pit (Void) Limestone Mine in PT. Semen Baturaja (Persero) Tbk for Freshwater Aquaculture Ponds

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Abstract
In meeting the needs of cement raw materials of limestone, PT Semen Baturaja (Persero) Tbk do its own mining activities. Mining activities will have an impact on the surrounding environment. When mining activities are completed, there is a change in the natural order that will be generated, which is a mine hole (void). This research is started by study of literature, field observation, data retrieval, data processing, discussion, and conclusion. The climate in South Sumatra, this region is generally included in tropical regions. Mining activities at the limestone quarry of PT. Semen Baturaja (Persero) Tbk. carried out in two ways, it was surface mining, and blasting activity. There are two parameters that did not meet the requirements on the inlet, its nitrite (NO_2) and sulfide (H_2S) content. Industrial waste such as mining industrial waste is caused by the exceed nitrite limit. Decomposition of organic substances carried out by bacteria is the cause of exceeds the limit of sulfide, sulfide content is commonly found in industrial waste disposal sites, in this research, the mining industry. The results of the water test at the outlet showed one parameter of inorganic chemistry that did not meet the air requirements, namely the content of nitrite (NO_2). Based on the water test that has been adjusted with the government regulation, the water are safe for freshwater aquaculture, and the water are harmless for the fish.

Keywords
Postmining plan, reclamation, void, freshwater aquaculture

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1. INTRODUCTION

Limestone is one of the raw materials for cement. PT Semen Baturaja (Persero) Tbk in meeting the needs of cement raw materials in the form of limestone do its own mining activities. The location of limestone mining by PT. Semen Baturaja (Persero) Tbk is located in Pusar Village, West Baturaja District, Ogan Komering Ulu Regency (PT.SemenBaturaja, Persero). Mining activities cannot be denied will have an impact on the surrounding environment. These impacts can take the form of positive impacts and negative impacts. Positive impacts arise from mining activities such as increasing the income of the surrounding community, opening jobs, and so on. Meanwhile, the negative impacts caused are the change in the natural order and the color of the earth, noise, air pollution, water quality degradation, and others. Changes in the natural order that will be generated after mining activities are completed, one of which is a mine hole (void). Mining holes (void) that exist after mining activities are still too many that have not been managed properly. Pit holes (void) which are in lower topographic conditions make it a reservoir for running water and rainwater with a compacted soil structure. Good void management will contribute positively to mine reclamation management efforts, successful land revegetation and regional succession, and regional hydrology. Therefore, it is necessary to do an appropriate and accurate plan for reclamation and post-mining activities so that the objectives desired by all parties can be realized.

One of the problems that arise due to the increase in human activities is the pollution of water to water sources because they receive pollution loads that exceed their carrying capacity. Pollution that results in quality maintenance can come from centralized waste (point sources) such as: industrial waste, livestock, hotel, hospital and non-point sources such as agricultural, plantation and domestic waste (Suharno, 2012). Based on Government Regulation no. 78 of 2010, exploration IUP holders and exploration IUPK are required to carry out reclamation and post-mining. The reclamation in question is carried out on land disturbed by exploration activities (IndonesianGovernment). Referring to some of these changes, reclamation activities become a very important need to be done. Besides aiming to prevent erosion or reduce the speed of runoff, reclamation is carried out to keep the land from being unstable and more productive.

Reclamation is expected to be able to produce added value to the environment and create a situation that is far better than the previous environmental conditions (Munir, 2017).

This research uses the formulation of the problem, how the condition of the initial environmental of the limestone mining environment of PT. Semen Baturaja (Persero) Tbk, and how to utilize voids from limestone mines of PT. Semen Baturaja (Persero) Tbk for freshwater fish aquaculture. The mining method that will be applied to the existing mine of PT Semen Baturaja (Persero) Tbk is an open pit mine with an open pit method (PT.SemenBaturaja, Persero).

Reclamation activity is an activity to organize, restore, and improve the environment so that it can function according to its use. Meanwhile, post mining is an activity carried out to restore the function of the natural environment and social functions according to local conditions in all mining areas in a planned, systematic, and sustainable manner when part of mining activities will end or all mining activities end (ESDM, 2014).

The final form that is usually caused by limestone mining is the form of ex-mining land and also mine pit (void). Juniah (2014) categorizes voids into three parts, namely: (a) existing voids, are voids found in mining areas during mining operations; (b) void residuals, are voids that occur during mine closure; and (c) the final void is a void formed after the end of all mining production operations or the end of the mine's operational life (Juniah, 2014).

Fish farming in ex-mining ponds requires identification of local environmental conditions, by looking at factors that influence fish farming. Open mining will result in changes in soil physical, chemical and biological properties that can affect the water quality of post-mining ponds, so an analysis of the management of ex-coal mining land for sustainable fish farming is needed (Pagoray, 2014).

2. EXPERIMENTAL SECTION

This research was conducted on 27 August 2018 until 23 October 2018 at PT. Semen Baturaja, Tbk. This study took data at PT Semen Baturaja, Tbk. located in Ogan Komering Ulu Regency, South Sumatra, Indonesia. In conducting this research starting from field orientation activities, reference and data collection, data processing, consultation and guidance, as well as compilation and collection of reports. Then data processing and analysis are carried out, then conclusions and suggestions are taken. The equipment needed during the study is stationery, notebook, computer, cell phone, and calculator.

2.1 Study of Literature

This research first sought literature as an assistant in solving problems in the field. The literature used relates to research titles such as books with publications on post-mining plans, research journals, handbooks and archives from PT Semen Baturaja, Tbk.

2.2 Field Observation

Field observations are carried out by direct observation to the field on the general conditions of the field, mining activities and activities related to reclamation and post-mining plans at locations in PT Semen Baturaja, Tbk.

2.3 Data Retrieval

Data collection is done to get value from various aspects that affect the economic value of the post-mining plan. The data needed in this study are primary data and secondary data.

1. Primary Data Primary Data is data obtained from the orientation and observation results in the field, namely: data from the test results of water samples.
2. Secondary data Secondary data is supporting data obtained from PT Semen Baturaja documents, namely: Regional Deliberation Map of PT. Semen Baturaja (Persero) Tbk., Initial Baseline Data, Post Mining Plan Land Area Data.

2.4 Data Processing

Through primary data and secondary data that have been obtained, data processing will be carried out. Data processing is done to find out whether the postmining plan activities are beneficial for the company or the surrounding community.

2.5 Discussion

Problem solving in this research is done by analyzing the results of data processing, where the data analysis is guided by the literature related to the problem of this research.

2.6 Conclusions

After correlating the data analysis by examining the problems in the field, then get an outline or conclusion. Conclusion is the core problem in the field so that further research can be used as a reference reference. After that, the conclusion will be accompanied by a suggestion so that in giving the best possible advice so that it can provide solutions and consider the company.

3. RESULTS AND DISCUSSION

3.1 Regional Location

Location of limestone mining by PT. Semen Baturaja (Persero) Tbk is administratively located in West Baturaja Subdistrict, Ogan Komering Ulu District uses four-wheeled vehicles through provincial roads with a travel time of around ± 6 hours. Then go to Pusar village through the village road with a travel time of about ± 15 minutes. PT Semen Baturaja (Persero) Tbk has obtained a Production Operation Mining Permit (IUP Production Operation) for limestone mining Number: 01 / K / IUP-II.A3 / XXVII / 2010 with an area of 103.4 Ha on March 23, 2010. Location map can be seen in Figure 1.

3.2 Initial Environmental Conditions

Geographically, the research location is in Pusar Village, West Baturaja District, Ogan Komering Ulu District, South Sumatra Province. Area of exploration IUP of PT. Semen Baturaja (Persero) Tbk is an area of 96.84 Ha.

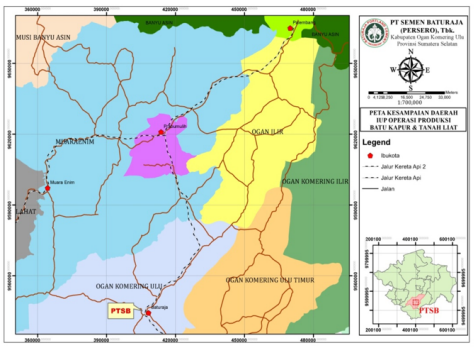

Figure 1. Location Map (Feasibility Study Document of PT. Semen Baturaja (Persero) Tbk., 2018)

Figure 2. Conditions of Forest Vegetation Components Around the Limestone Mine

3.3 Climate

Based on the type of climate in South Sumatra in general, this region is included in tropical regions. Climatological data in the form of rainfall data and meteorological data representing the study area were obtained from previous environmental reports, namely AMDAL (Environmental Impact Analysis Th 2017) and obtained from the Kenten Climatology Station Palembang. The data was collected for the span of the last 10 years (2006-2015) with climate factors including rainfall and rainy days, air temperature, wind speed and direction, and climate elements in the study area.

Based on secondary data from Kenten Palembang Meteorology and Geophysics Agency, rainfall data and the number of rainy days in the activity area are presented in a span of 10 years. Based on the data obtained shows that the highest rainfall is 2,807 mm in 2010 and the lowest is 1,168 mm in 2011. The highest monthly rainfall is 715 mm in March 2005 and the lowest is 4 mm in August 2009. The number of rainy days the annual average ranges from 87 to 201 days, with a record of the lowest number of rainy days in October 2009 that is 1 day while the highest number of rainy days is December 2007 as many as 25 days. The average rainfall during 2008 ranged from 23.9 mm3 (June) to 634 mm^3, (November). The most rainfall data in December is 350 mm and the lowest is in August, which is 61.3 mm. Wet months occur for 7 (seven) months, namely October to April with rainfall ranging from 210 - 350 mm / month. Conversely, dry months occur for 5 (five) months, namely May to September with rainfall intensity between 8.84 - 17.57 mm / day and reaching the lowest point in August, which is 8.84 mm / day. The average number of rainy days from October to April is the months of rain (wet) with the frequency of rainy days ranging from 13-21 rainy days / month. The largest number of rainy days occurred in December and January which averaged 21 days / month. Dry months have a number of days of rain between 9-15 days / month that occur in May to September. Based on the description above and from the data presented for 10 (ten) years (2006 - 2015).

3.4 Vegetation components

Vegetation components are divided into several types that are observed, including the flora and fauna found in the land area. The flora and fauna itself will be further divided into 2 different types, namely terrestrial flora and fauna, and aquatic biota.

The aspects of vegetation (flora) observed in the study location were several types of plants such as shrubs (forest), and several types of plantations. The aspects of terrestrial fauna found in the study location are several types of animals such as frogs, snakes and several species of birds. Field observations show several types of mammals such as wild boar, and monkeys are also found in these locations. Several types of wild animals are found on the site, some of which are included in protected animals such as porcupines, and pangolin. The fauna aspect of the perennial biota found in the Ogan River shows several kinds of fish that are quite diverse. Some fish that can be seen include cork fish, lais fish, river catfish, and others. Condition of forest vegetation can be seen in Figure 2.

3.5 Geological conditions

The geology of the Baturaja formation is generally included in the Palembang group, which has Tma, Qtk and Tmpm formations. This stratigraphy from the Baturaja region is as follows: the lowest layer (base) of Baturaja limestone is the Basalt layer, and there are also quartz sand, quartz conglomerates and limestone. The Limestone Formation according to condition (1975) consists of two members, namely: Carolline Limestone, Sandy Limestone.

Formation Limestone is a facies from the lowest collection from the Telisa side with a thickness of 1,000-1,200 m developing as sandstone sediment and is an oily area (Talang Akar, Pendopo, Benakat). The Geological map of mining location can be seen in Figure 3.

3.6 Post-Mining Land Use

3.6.1 Mining activities

Mining activities carried out at the limestone quarry of PT. Semen Baturaja (Persero) Tbk., Carried out in two ways, namely surface mining, and conducting blasting. This is done because of the distance of the community house adjacent to the limestone mining area. So as to reduce the vibration caused by blasting activities, the class 500 T surface miner tool is used in parts close to the residents' homes. The surface miner tool works with a

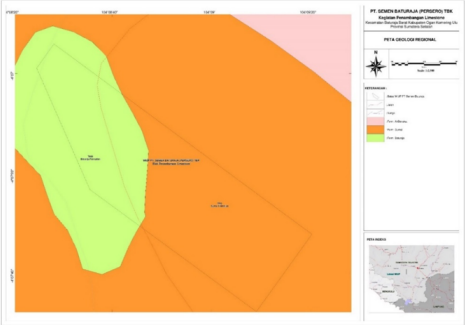

Figure 3. Geological Map of Mining Locations (Feasibility Study Document of PT. Semen Baturaja (Persero) Tbk., 2018)

Figure 4. The limestone mining process using a surface miner tool

gear wheel that crushes the limestone that is passed. The results of the grinding carried out by the tool were immediately collected using a wheel loader, which was then loaded with a back hoe load-digging device into the dump truck. Surface miner tool can be seen in Figure 4.

Blasting carried out on limestone mines at PT. Semen Baturaja (Persero) Tbk., Carried out in stages. It aims to reduce vibrations that occur due to blasting activities, because of the distance of residents' homes that are not far from the mining location. Blasting is carried out only once in one day, at 12.00 WIB. Blasting activity can be seen in Figure 5.

Mining activities at PT. Semen Baturaja (Persero) begins

Figure 5. Blasting Activity PT. Semen Baturaja (Persero) Tbk

Figure 6. Activities of Loading Materials into the Dump Trucks

Figure 7. Dumping Activities at the Crushing Plant

with land clearing, and then continues with the construction of supporting infrastructure such as the construction of mining roads, construction of office buildings, etc. Overburden stripping activities are carried out after all facilities and infrastructure has been completed, then limestone mining activities are carried out. Activities of loading materials into dump trucks can be seen in Figure 6.

A dump truck that has been fully charged will send the excavated material to the Crushing Plant and then it will be directly flowed to the factory to be processed into cement. The dumping activities at the crushing plant and the stages of mining activities carried out by PT. Semen Baturaja (Persero) Tbk., can be seen in Figure 7 and Figure 8.

3.6.2 Post-mining plan

Land that has been mined will leave a hole that destroys the natural ecosystem; therefore it is necessary to carry out reclamation activities with the aim of restoring land functions. The land that has been mined will leave a mine pit (void). One of the land function restoration plans carried out is to convert some of the voids into freshwater aquaculture ponds. The creation of a freshwater aquaculture pond is intended to restore the function of land that has been mined, and provide economic value to the land. Plans for allotment of post-mining land can be seen in Figure 9.

Freshwater aquaculture will be carried out to provide economic value and can be used as an indicator that the water contained in voids is not dangerous, and is still in a standard regulated by the government.

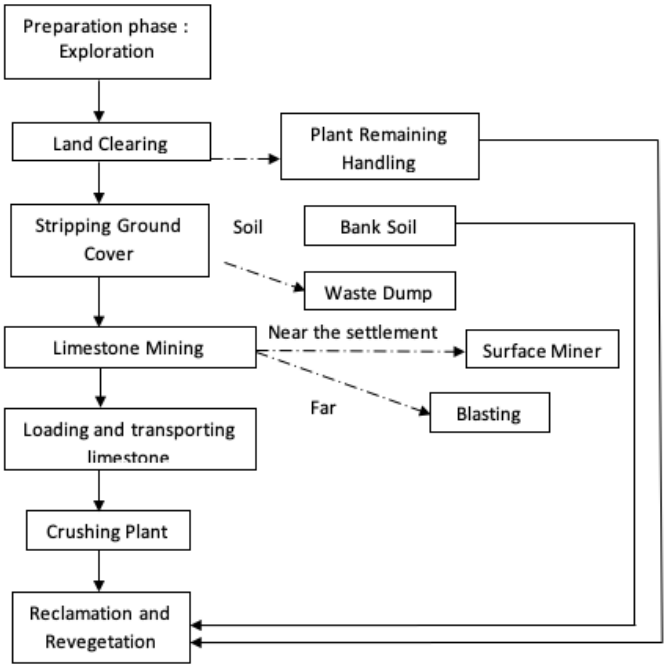

Figure 8. Mining Flow Chart PT. Semen Baturaja (Persero) Tbk

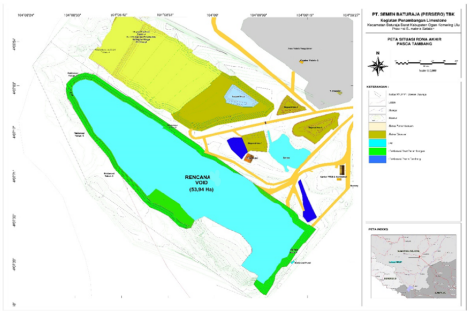

Figure 9. Land Allocation Plan (Mine Final Plan) PT. Semen Baturaja (Persero) Tbk

Figure 10. Sampling of Water in the Inlet (S: 04°07'41 "; E: 104°09'09") and Water Outlet (S: 04°07'37,7 "; E: 104°09'16,6")

3.6.3 Freshwater fish aquaculture

The type of fish that will be bred in this freshwater aquaculture pond is a type of tilapia. Test results of water samples indicate that the water is not dangerous, pH and water temperature are in accordance with the requirements for tilapia cultivation, so this makes it possible to cultivate freshwater fish with tilapia fish.

This tilapia aquaculture pond was made so that voids from limestone mines could provide positive benefits for the surrounding community and for PT. Semen Baturaja (Persero) Tbk. Sampling of water in the inlet and outlet are done for knowing the water quality. Sampling of water can be seen in Figure 10. The water test results can be seen in Table 1 and Table 2.

Based on the Regulation of the Governor of South Sumatra Number 8 of 2012 concerning Quality Standards Liquid waste for industrial, hotel, hospital, domestic and domestic activities shows that the water content has met the specified requirements. Republic of Indonesia Government Regulation number 82 of 2001 concerning air quality management and monitoring of water disbursement which states that activities for freshwater cultivation are included in class II [10]. The results of the water tests that have been carried out show that the inlet and outlet samples are qualified to regulate class II water quality. The results of the water test on the inlet show two inorganic chemical parameters that do not meet water requirements, namely nitrite (NO_2) and sulfide (H_2S) content. Nitrite content that exceeds the limit referred to by waste water from industrial waste is the mining industry. The sulfide content that exceeds the limit is caused by the decomposition of organic substances carried out by bacteria. The sulfide content is commonly found in industrial waste disposal sites, in this research, the mining industry. The results of the water test at the outlet showed one parameter of inorganic chemistry that did not meet the air requirements, namely the content of nitrite (NO_2).

The results of water tests that have been adjusted with the Indonesian Government Regulation for freshwater cultivation activities, both tilapias, can be done because they have met water quality requirements, and have qualified for a place for tilapia.

4. CONCLUSIONS

Based on the research that has been done, the following conclusions are:

Table 1. Water Test Results in the Inlet (S: 04°07'41 "; E: 104°09'09")

Num.	Parameter	Unit	Maximum Level [9]	Yield	Inspection Method
	A. Physics				
1	Temperature (in the Laboratory)	°C	38	25.4	SNI 06-6989.23-2005
2	Total Dissolved Solids (TDS)	mg/l	2000	31	Direct Reading
3	Total Suspended Solids (TSS)	mg/l	200	22	Direct Reading
	B. Inorganic Chemistry				
1	pH *(in the Laboratory)	#	(6-9)	6.07	SNI 06-6989.11-2004
2	Iron *(Fe)	mg/l	5	0.12	SNI 6989.4-2009
3	Manganese *(Mn)	mg/l	2	0.05	SNI 6989.5-2009
4	Barium (Ba)	mg/l	2	0.001	SNI 06-6989.16-2004
5	Copper *(Cu)	mg/l	2	<0.003	SNI 6989.6-2009
6	Zinc *(Zn)	mg/l	5	0.03	SNI 6989.7-2009
7	Total Chrome (Cr)		0.5	<0.018	SNI 06-6989.17-2004
8	Cadmium *(Cd)	mg/l	0.05	<0.0015	SNI 6989.16-2009
9	Mercury (Hg)	mg/l	0.002	<0.0001	AAS-MVU
10	Lead *(Pb)	mg/l	0.1	<0.003	SNI 6989.8-2009
11	Arsenic (As)	mg/l	0.1	<0.0009	AAS-HVG
12	Selenium (Se)	mg/l	0.05	<0.0012	AAS-HVG
13	Cyanide (CN)	mg/l	0.02	0.004	Spectrophotometry
14	Cobalt (Co)	mg/l	0.4	0	SNI 6989.68-2009
15	Flouride (F)	mg/l	2	0.25	SNI 06-6989.29-2004
16	Free Ammonia (NH_3—N)	mg/l	1	0.33	SNI 06-2479-1991
17	Nitrate, as N (NO_3)	mg/l	20	2.92	SNI 06-2480. 1991
18	Nitrite, as N *(NO_2)	mg/l	1	0.18	SNI 06-6989.9-2004
19	Biochemical Oxygen Demand (BOD5)	mg/l	50	2.62	SNI 06-2503-1991
20	chemical oxygen Demand (COD)	mg/l	100	19	SNI 6989.2-2009
21	Dissolved Oxygen (DO)	mg/l	-	2.07	SNI 06-6989.14-2004
22	Sulfide (H_2S)	mg/l	0.05	<0.03	SNI 6989.70-2009
	B. Organic Chemistry				
1	Oil and Fat	mg/l	5	0.19	SNI 06-6989.10-2004
2	Phenol	mg/l	0.5	0	SNI 06-6989.21-2004

Information:

*) : Accredited #) : No Units

Table 2. Water Test Results in the Outlet (S: 04°07'37,7 "; E: 104°09'16,6")

Num.	Parameter	Unit	Maximum Level [9]	Yield	Inspection Method
	A. Physics				
1	Temperature (in the Laboratory)	◦C	38	26.8	SNI 06-6989.23-2005
2	Total Dissolved Solids (TDS)	mg/l	2000	20	Direct Reading
3	Total Suspended Solids (TSS)	mg/l	200	17	Direct Reading
	B. Inorganic Chemistry				
1	pH *(in the Laboratory)	#	(6-9)	6.07	SNI 06-6989.11-2004
2	Iron *(Fe)	mg/l	5	0.08	SNI 6989.4-2009
3	Manganese *(Mn)	mg/l	2	0.05	SNI 6989.5-2009
4	Barium (Ba)	mg/l	2	0.001	SNI 06-6989.16-2004
5	Copper *(Cu)	mg/l	2	<0.003	SNI 6989.6-2009
6	Zinc *(Zn)	mg/l	5	0.01	SNI 6989.7-2009
7	Total Chrome (Cr)		0.5	<0.018	SNI 06-6989.17-2004
8	Cadmium *(Cd)	mg/l	0.05	<0.0015	SNI 6989.16-2009
9	Mercury (Hg)	mg/l	0.002	<0.0001	AAS-MVU
10	Lead *(Pb)	mg/l	0.1	<0.003	SNI 6989.8-2009
11	Arsenic (As)	mg/l	0.1	<0.0009	AAS-HVG
12	Selenium (Se)	mg/l	0.05	<0.0012	AAS-HVG
13	Cyanide (CN)	mg/l	0.02	0.002	Spectrophotometry
14	Cobalt (Co)	mg/l	0.4	0	SNI 6989.68-2009
15	Flouride (F)	mg/l	2	0.17	SNI 06-6989.29-2004
16	Free Ammonia (NH_3—N)	mg/l	1	0.32	SNI 06-2479-1991
17	Nitrate, as N (NO_3)	mg/l	20	2.9	SNI 06-2480. 1991
18	Nitrite, as N *(NO_2)	mg/l	1	0.174	SNI 06-6989.9-2004
19	Biochemical Oxygen Demand (BOD5)	mg/l	50	2.51	SNI 06-2503-1991
20	chemical oxygen Demand (COD)	mg/l	100	15	SNI 6989.2-2009
21	Dissolved Oxygen (DO)	mg/l	-	2.01	SNI 06-6989.14-2004
22	Sulfide (H_2S)	mg/l	0.05	0	SNI 6989.70-2009
	B. Organic Chemistry				
1	Oil and Fat	mg/l	5	0.13	SNI 06-6989.10-2004
2	Phenol	mg/l	0.5	0	SNI 06-6989.21-2004
		Information:			
	*) : Accredited			#) : No Units	

1. The condition of the environmental baseline at the research location located in Pusar Village, Baturaja Barat District, Ogan Komering Ulu District, South Sumatra has a tropical climate. The highest rainfall is 2,807 mm in 2010 and the lowest rainfall is 1,168 mm in 2011. Aspects of flora and fauna vegetation show the diversity of plants and animals that exist, ranging from trees, shrubs, to plantation crops, with the types of animals that quite diverse, ranging from amphibians, reptiles and mammals. The Ogan River which is located near the location also stores fish diversity.
2. Test results of water samples indicate that the water is clean and harmless. Positive test results indicate that making freshwater fishery cultivation can be done to provide economic value.

5. ACKNOWLEDGMENT

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