The Impact of Coastal Tourism Activities on Water Quality at Baluran National Park

Nike Ika Nuzula[1], Haryo D. Armono[1], and Daniel M. Rosyid[1]

Abstract— **Baluran is a national park identified as biologically and nun-biologically rich area in East Java. It has physical landscapes with high tourism potential. In the past five years, tourists visit has significantly increased, where leds to water quality degradation around the coast. The aim of this research is to determine the relationship between tourists visit and water degradation phenomena in the area of study. The PCA (Principal Component Analysis) and IPL (Environmental Pollution Index) is used for analysis. Research was performed in the rainy and dry seasons. The correlation of water quality parameters in dry season is higher than in the rainy season. Water environment pollution index is 0.027 (category not polluted) in dry season and 0.48 (category not polluted) in rainy seasons.**

Keywords—**Baluran National Park, PCA, IPL, water quality degradation.**

Abstrak—*Taman Nasional Baluran merupakan taman nasional yang diidentifikasikan sebagai area yang kaya akan potensi hayati dan non hayati di Jawa bagian timur. Kawasan ini memiliki struktur fisik landscapes yang dapat dimanfaatkan untuk kegiatan wisata. Peningkatan kunjungan wisatawan dalam 5 tahun ini menyebabkan aktivitas wisata dan kegiatan terkait meningkat, sehingga berpengaruh terhadap penurunan kualitas perairan dan obyek wisata. Pada penelitian ini bertujuan untuk mengetahui keterkaitan antara kunjungan wisatawan dalam setahun dengan perubahan kualitas perairan pada beberapa parameter. Metode analisis yang digunakan adalah PCA (Principal Component Analysis) dan analisis IPL (Indeks Pencemaran Lingkungan). Penelitian dilakukan di musim hujan dan musim kemarau. Nilai korelasi parameter kualitas air pada musim kemarau lebih tinggi daripada musim hujan. Indeks pencemaran lingkungan perairan Taman Nasional Baluran adalah 0,027 (kategori tidak tercemar) di musim kemarau dan 0,48 (kategori tidak tercemar) di musim hujan.*

Kata Kunci—*Taman Nasional Baluran, PCA, IPL, degradasi kualitas air.*

I. INTRODUCTION

Baluran National Park is a national park that is identified as an area that is rich in potential biological and non-biological bodies in Eastern Java. The area has had a great potential in the tourism sector, especially for tourists who want to enjoy the natural scenery. Tourists are very interested in visiting the National Park baluran as well as to enjoy the beauty of the land and sea. So far, the potential of non-livings in areas that have been identified and explored are the physical structure of landscapes that produce natural beauty as a tourist attraction of Baluran National Park. Beach landscape in Baluran National Park is the natural resource that can be utilized for the development of both limited and sustainable coastal tourism. One of the activities is the utilization of tourist diving, snorkeling, fishing, recreation, sunbathing and mangrove tracking.

Tourist visits fluctuate within a year, where the arrival of the peak season usually occurs in September and December. And the lowest season is in March every year. Fluctuations in tourist visits based on the data in 2015, showed that the decrease in traffic from September to November and from February to April due to the end of the school holidays. It is also caused by unfavorable weather in the territorial waters Baluran National Park in general, such as the inclusion of the rainy season, storms and high waves. Dodds (2007), stated that the dynamics of tourist arrivals and tourist activities are generally specified as coastal climatic conditions (rain and sun) and changes of hydro oceanographic factor [1]. Changes (turnover) in the condition of the sea waves, shifting sands and currents, the water level of the river and the fishing season in Southeast Asia, is generally associated with winter system [2]. Visits both foreign tourists and the archipelago has increased every year. Increased domestic tourist arrivals was highest in 2014 amounted to 52%.

The increase in tourist visits can improve the entire travel activities related directly to the marine tourism activities as well as unrelated as sea transportation, land, trade and fishing activities. It also can lead to an increased pressure on ecosystems and affect the degradation of coastal resources and water quality degradation. Water pollution caused by waste from Baluran tourism in the park is relatively small compared to domestic waste. The main pollutant sources are generally in the form of garbage, plastics, sewage farms and cans. Types and sources of these pollutants can affect water quality, health tourists and resource sustainability of coral reefs and mangroves [3]. Based on these problems, identification of physical and chemical parameters that have exceeded quality standards is required. The purpose of this research is to analyze the linkages between season tourist visits in a year with the changes in some parameters of water quality and identify the status of water pollution in coastal areas of Baluran National Park.

II. METHOD

The study area (Figure-1) is The Baluran National Park. Administratively, Baluran National Park is located in Banyuputih district, Situbondo, East Java, Indonesia. According to Muryono (2011), his publication mentions that Baluran National Park has an area of 25,000 ha with a coastline of 42 km [4]. This study is focused on coastal areas. Water quality measurement was performed in the dry season period (September) and rainy season (March).

[1]Nike Ika Nuzula, Haryo D. Armono, and Daniel M. Rosyid are with Departement of Ocean Engineering, Institut Teknologi Sepuluh Nopember, Surabaya, 60111, Indonesia. E-mail: nike.prasade@gmail.com; armono@oe.its.ac.id; dmrosyid@oe.its.ac.id.

Determination of the observation stations numbers is tailored to the category of marine tourism (diving and snorkeling), and the presence of tourism businesses, and 9 observation stations were obtained. Physical parameter and chemical waters measurement performed at each station. The measurement was carried out on the ± 15 meters area from the shoreline. Measurements of water parameters conducted on two locations, directly measurement at Baluran coastline and in the laboratory. Measurements in the laboratory was performed in Laboratory of environmental engineering ITS. Water quality parameters that were measured are TSS, temperature, turbidity, pH, salinity, ammonia, DO, BOD, surfactant and phosphate.
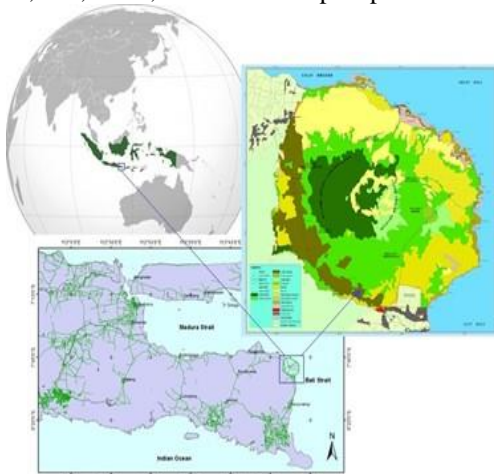

Figure 1. Study area

The method that used in this research is the PCA (Principal Component Analysis). It aim to extract the data of waters quality into an general information in the matrix which has similarities or relationships between attributes and presented graphically to be easily interpreted [5,6]. Determining of the status pollution levels were analyzed by using Environmental Pollution Index (IPL) method.

To determine the all of value of some parameter pollution index is used the following equation [7]:

$$P_{ij} = \sqrt{\frac{\left(\frac{c_i}{L_{ij}}\right)^2_M + \left(\frac{c_i}{L_{ij}}\right)^2_R}{2}} \qquad (1)$$

L_{ij} = Concentration quality standard parameters
C_i = Concentration of water quality parameters
$\left(\frac{c_i}{L_{ij}}\right)_M$ = maximum $\frac{c_i}{L_{ij}}$
$\left(\frac{c_i}{L_{ij}}\right)_R$ = average $\frac{c_i}{L_{ij}}$

The criteria used to determine whether the waters in coastal tourism area has been polluted or in good condition is:

- $0 \leq P_{ij} \leq 1.0$ = Good condition
- $1.0 < P_{ij} \leq 5.0$ = Lightly polluted
- $5.0 < P_{ij} \leq 10.0$ = Moderately polluted
- $P_{ij} \geq 10.0$ = Polluted

III. RESULTS AND DISCUSSION

A. Season Tourist Visits

Tourists visiting Baluran National Park generally aim to enjoy the underwater beauty, and beauty of the beach. The number of tourists visiting the Baluran National Park in 2011 are as many as 28 064 people and increased by 2015 as many as 86 658 people. Peak tourist visits associated with the holiday period, coastal tourism attractions, and cultural communities. Coastal tourism activities are appropriate when the intensity and duration rainy days is fewer because the sun shines longer and adapted to the wind conditions [8]. By looking at the trend of tourist visitors and demand for tourism destinations based on natural wealth to fast-growing wealth, Baluran National Park should be able to take an important role in coastal tourism. Context biodiversity as the basis for the formation of an interesting attraction and competitiveness, Baluran National Park has a tremendous wealth. Most foreign tourists who visit the park are from western Europe, travelers like the Netherlands, France, Belgium, Switzerland and some other countries of Western Europe. Foreign tourists usually stay for 1-2 days to enjoy the natural scenery in Baluran National Park. The concentration of the number of visitors usually occurs in the months of July to September each year.

A. The Correlation Between The Quality of Coastal Water with Tourist Visits

The analysis to identify correlations between water quality with tourist visits based on results of PCA methods are presented in Table 1 and Table 2. Table 1 and Table 2 shows that during September there was an increased negative correlation and significantly more than 60% between the parameter indicators of the pollution.

This means that tourist visitors do not give real effect to the pollution in coastal areas Baluran National Park. Increasing concentrations and correlations between water quality parameters with the parameters of pollution indicators increased during March. This is caused by the high volume of rain water from the land and the waves that were high. The amount of solid waste in coastal areas has increased in the rainy season, and an increased of organic material contents, such as phosphate [9].

B. The Dominant Parameter of Water Quality

The result of PCA analysis related to the identification of dominant water quality parameters describe in Figure 2 and Figure 3. The above PCA result shows the determination of all parameters in October, measuring with a related percentage of around 99.7 % while in March it achieved 99 %. The main contribution parameter to the formation of first major axis in October and March were Salinity and temperature. BOD, TSS, turbidity and pH as a second major axis former in March and Surfactant, phosphate, DO as a third major axis. Conversely, data at dry season show that Surfactant, phosphate, DO are the second major axis former, and BOD, TSS, Turbidity, and pH form the third major axis. Arum (2005) said that DO, salinity and temperature will experience the huge changing after transition season at November [10]. Pollutants that are specifically derived from domestic input will increase the value of its waters chemical parameters in the rainy season [9].

TABLE 1.
CORRELATION PARAMETER OF WATER QUALITY IN THE COASTAL BALURAN NATIONAL PARK (SEPTERMBER 2015)

	TSS	Temperature	Turbidity	pH	Salinity	Ammonia	DO	BOD	Surfactants	Phospathe
TSS	1									
Temperature	0,53	1								
Turbidity	0,89	0,23	1							
pH	0,18	-0,07	0,25	1						
Salinity	-0,50	-0,53	-0,38	0,60	1					
Ammonia	-0,60	0,02	-0,62	0,07	0,37	1				
DO	-0,37	0,00	-0,48	0,23	0,14	0,64	1			
BOD	0,54	-0,15	0,77	-0,03	-0,19	-0,77	-0,81	1		
Surfactants	-0,03	-0,35	-0,02	-0,74	-0,32	-0,30	-0,34	0,32	1	
phosphate	0,01	-0,02	-0,05	0,83	0,50	0,41	0,59	-0,49	-0,67	1

TABLE 2.
CORRELATION PARAMETER OF WATER QUALITY IN THE COASTAL BALURAN NATIONAL PARK (MARCH 2016)

	TSS	Temperature	Turbidity	pH	Salinity	Ammonia	DO	BOD	Surfactants	Phospathe
TSS	1									
Temperature	0,14	1								
Turbidity	0,95	0,04	1							
pH	-0,34	-0,43	-0,45	1						
Salinity	-0,27	-0,55	-0,29	0,67	1					
Ammonia	0.01	0.01	0.01	0.01	0.01	1				
DO	-0,58	-0,47	-0,67	0,93	0,74	0.01	1			
BOD	0,53	-0,04	0,67	-0,69	-0,65	0.01	-0,80	1		
Surfactants	0,25	0,74	0,32	-0,76	-0,49	0.01	-0,76	0,26	1	
phosphate	0,12	0,67	0,16	-0,59	-0,19	0.01	-0,53	-0,04	0,93	1

C. The Water Pollution Index of Coastal Zone in Baluran National Park

The water pollution index value of coastal zone in Baluran National park can see in Table 3. Table 3 shows that in general the water quality parameter in Baluran National Park indicates a good condition for domestic biota's growth. There are several parameters that exceed the minimum and maximum quality standard limit for coastal ecotourism activity, such as Ammonia and DO.

The ammonia content in wet season for all observation stations ranges from 7.63 – 19.98, the highest value is at station 4, 5, and 8 (areas near the cow farm and land) and for the lowest observation station is far from the land. This content is higher than quality standard value those set in Environment minister's decision No. 51 in 2004 for marine biota and it is not suitable for snorkeling and diving in wet season. Ammonia content that exceeds 0.2 mg/l is toxic for several fish species. Besides, the high ammonia content can be used as an indication of the organic matter pollution presence that comes from agriculture's fertilizer flushing. Ammonia source in water is the result of decomposition of organic nitrogen (protein and urea) and also organic nitrogen in the soil [12]. Ammonia rises when the Dissolved Oxygen (DO) is low, so ammonia is found rare in water with an adequate amount of DO. Unionized ammonia becomes acute for water organisms and poisoning level depends on water salinity, temperature and pH.

From the analysis result in Table 3 indicates that the increase of tourists does not yet draw the significant change to the water quality of Baluran National Park. The result was the increase of pollution index, which was only 0.001. From the analysis result, the high pollution index value is located near the settlement area. Domestic waste enters the coastal water through the ground water flow, depending on the concentration and impact to the coastal and marine water's ecology.

TABLE 3.
INDEX OF ENVIRONMENTAL POLLUTION IN COASTAL TOURIST AREAS BALURAN NATIONAL PARK

| Location	Poluttion Index		Water Quality Status	
	September	March	September	March
Station 1	0.02	0.04	Good condition	Good condition
Station 2	0.03	0.03	Good condition	Good condition
Station 3	0.01	1.07	Good condition	Lightly polluted
Station 4	0.02	1.05	Good condition	Lightly polluted
Station 5	0.05	1.01	Good condition	Lightly polluted
Station 6	0.04	1.02	Good condition	Lightly polluted
Station 7	0.02	0.02	Good condition	Good condition
Station 8	0.02	0.03	Good condition	Good condition
Station 9	0.03	0.02	Good condition	Good condition
Average	0.027	0,48		
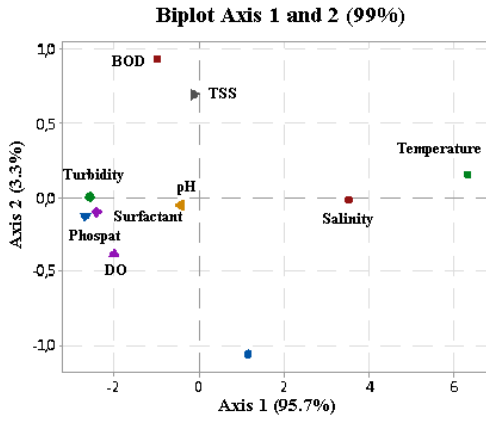
Figure 2. Correlation between water quality parameters according to the time of Conservation (September 2015)
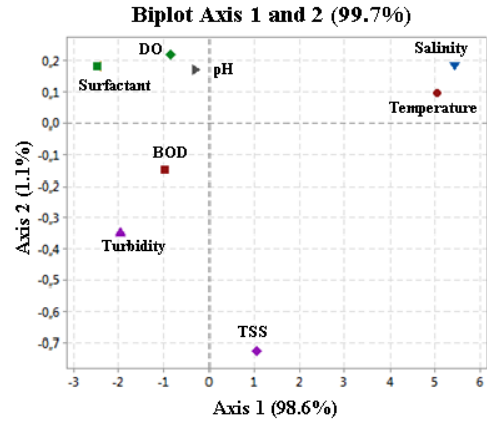

Figure 3. Correlation between water quality parameters according to the time of Conservation (March 2016)

CONCLUSION

The increase in the number of tourist arrivals in Baluran National Park is influenced by climatic factors that support marine tourism activities. The increasing tourists do not affect significantly in the rise of the pollution. The correlation between parameters increased during September compared to March. Besides the rainy season and high waves, the cause of increased value of this water parameter quality is dairy farms in coastal Baluran National Park. Index of water pollution in Baluran National Park is 0.027 and is still in the category has not been polluted. And water environment pollution index is 0.48 and considered in category not polluted in rainy seasons.

ACKNOWLEDGEMNT

REFERENCES

[1] Dodds, R., 2007. Malta's tourism policy: standing still or advancing towards sustainability? Island Studies Journal, 2(1): 47-66.
[2] Wong PP. 1991. Coastal tourism in Southeast Asia. ICLARM, Education Series 13, 40p, Manila.
[3] Monoarfa, W., 2002. Dampak pembangunan bagi kualitas air di kawasan pesisir Pantai Losari Makassar. Science & Technology, 3 (3): 37-44.
[4] Muryono, Mukhammad. 2011. Analisis tata ruang (zonasi) pengembangan ekowisata di kawasan taman nasional baluran jawa timur. Berk Penel Hayati Volume 17 halaman 115-117.
[5] Bengen, D.G., 2000. Sinopsis teknik pengambilan contoh dan analisis data biofisik sumberdaya pesisir. Pusat Kajian Sumberdaya Pesisir&Lautan Faperikan, Institut Pertanian Bogor (PKSPL-IPB), Bogor.
[6] Pradhan, U.K., P.V. Shirodkar & B. K. Sahu, 2009. Physico-chemical characteristics of the coastal water off Devi estuary, Orissa and evaluation of its seasonal changes using chemometric techniques. Current Science, 96 (9):1203-1209.
[7] Nemerow, N.L. 1991. Stream, Lake, Estuary and Ocean Pollution. Secand edition. Van Nostrand Reinhold. New York.
[8] Scott, D., G. McBoyle & M. Schwartzentruber, 2004. Climate change and the distribution of climatic resources for tourism in North America. Climate Research, 27:105-117.
[9] Davies, O.A., A.A.A. Ugwumba & D.D. Abolude, 2008. Physico-chemistry quality of Trans-Amadi (Woji) Creek Port Harcourt, Niger Delta, Nigeria. Journal of Fisheries International, 3 (3):91-97.
[10] Arun, A.U., 2005. Impact of artificial structures on biodiversity of estuaries: a case study from cochin estuary with emphasis on clam beds. Applied Ecology & Environmental Research, 4(1): 99-110.
[11] Effendi H. 2003. Telaah Kualitas Air Bagi Pengelolaan Sumberdaya dan Lingkungan Perairan. PT. Kanisius. Hal 257.