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STUDY OF MICROBIAL POLLUTION IN THE ACEH COASTAL WATERS AND ITS VICINITY

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ABSTRACT

Study of microbial pollution in the Aceh coastal waters and its vicinity were carried out in the period of August – September 2006. The purpose of the study is to monitor the marine and coastal environments related to the bacterial condition in Aceh waters after the tsunami disaster. The sediment and water samples were collected from 28 stations in four sites in the Aceh waters (Eastern Aceh, Northern Aceh, Western Aceh and Simeulue Islands waters), using the RV. Baruna Jaya VIII. The determination of microbial pollution was based on parameters of coliform and pathogenic bacteria. The coliform bacteria was analysed by membrane filter technique and pathogenic bacteria (*Salmonella* and *Vibrio*) by isolation method based on the selective culture media of Salmonella and TCBS agar. The results of the study showed that density of total coliform bacteria varied between 40 and 1055 CFU/100 ml with an average of 443 CFU/100 ml. Based on the pattern of the distribution of coliform bacteria it was found the highest number in Eastern Aceh with the value of 611 CFU/100 ml and the lowest number in Western Aceh with the value of 348 CFU/100 ml. Based on the density of coliform bacteria, Aceh waters was in the lower permissible level of the Indonesian and WHO standards, means that the coastal environment in Aceh waters is still in good condition. Four genera of pathogenic bacteria isolated from seawater samples were *Pseudomonas, Citrobacter, Aeromonas* and *Proteus*, and 6 genera from sediments samples were found i.e. *Pseudomonas, Citrobacter, Aeromonas, Yersinia, Proteus* and *Vibrio*. The pathogenic bacteria from the samples such as *Salmonella typhy* and *Vibrio parahaemoliticus* had low pathogenic potential. This indicated that the risk of pathogenic bacterial contamination in Aceh and its vicinity waters were relatively low, therefore, the conditions of coastal and marine environments were relatively in good condition.

Keywords: Aceh coastal waters, Coliform bacteria, Pathogenic bacteria, Indonesian standard, WHO standard

INTRODUCTION

The earthquake in Nanggroe Aceh Darussalam (NAD) Province and Nias Islands, North Sumatera Province in December 26, 2004, measured 8.9 on the Richter Scale, and was classified as one of the strongest earthquake ever recorded. The epicenter of the largest tremor was determined to be in the zone 225 km south-southwest of Banda Aceh, at the northern tip of Sumatera. Yasuda (2005) explained that the earthquake in Aceh was tectonic earthquake located in the ring of fire of the Pacific ocean, which was caused by a sudden movement of the active faults. The western part of Aceh has partially subsided permanently about 0.5-1 m. While, Simeulue and Nias Islands located in the front of subduction zone have partially lifted up about 1–1.5 m (Natawidjaja *et al.*, 2004).

The earthquake in NAD Province crushed the oceanic crust generated by the huge tsunami. The waves of the Indian ocean caused by the tsunami reached the heights of more than 10 meters (Yasuda, 2005). The Indian ocean tsunami was a natural catastrophe, causing serious destructions on human institutions and infrastructure (Alverson and Fischer, 2005). Besides, shoreline displacements occurred in some areas such as the western part of the coast of Aceh and the northern part of Sumatera, including a portion of Banda Aceh, Meulaboh, Simeulue and Nias islands. The satellite images showed that in particularly impacted

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areas more than 45% of the reefs were damaged, and the surviving reefs suffered huge amount of debris that washed away from the land (Anonymous, 2006). In addition, the tsunami in NAD Province have caused severe negative impacts on the marine and coastal natural resources and fishery habitats. The damages on fishery habitats such as coral reef, mangrove, sea grass and estuarine ecosystem could decrease the natural resources particularly the fish stocks. In connection with fisheries sector, the tsunami disaster caused fisherman, fishing industries and fish farming (marine aquaculture) in Aceh and northern part of Sumatera collapsed. Meanwhile, in Nias Islands about 70 % of the small-scale fishing fleets and 800 fishing canoes were destroyed, and thousands of floating cages of fish farming in North Sumatera were damaged (Anonymus, 2006).

The main problem of NAD Province are natural and anthropogenic pollutions. Natural pollution is caused by natural activities such as cyclones, wind wave, sea level rise and tsunami. The anthropogenic pollution caused by human activities can be divided into two categories, i.e. the land-based and sea-based activities (Chua *et al.*, 2000; Lee, 2004). The accumulation of pollutants in the coastal and marine environments caused by the heavy pollution threaten the sustainability of marine living resources, human health, as well as the marine ecosystem. The discharge of domestic sewage from human settlements and industry are directly or indirectly disposed into the rivers, and the sea becomes waste repository, increasing the presence of certain pathogens bacteria and algal bloom in the marine environment. The most frequently used as valuable indicator of polluted condition in the marine environment is the coliform bacteria and some pathogens bacteria such as *Salmonella typhi, Vibrio parahaemolyticus* and *Clostridium perfringens*. (Poole and Hobson, 1979; Nix, 1993; Chua *et al.*, 2000; Lee, 2004). The oceanographic survey conducted by the Research Centre for Oceanography, LIPI assessed the environmental condition in the coastal and marine ecosystems in Nanggroe Aceh Darussalam Province. The aim of the study is to monitor the water quality based on the bacteriological survey in Aceh waters and its vicinity in connection with the reconstruction and rehabilitation of human infrastructures, facilities and standard of living, etc.

MATERIALS AND METHODS

The oceanographic survey was carried out using the RV. Baruna Jaya VIII from August to September 2006 in Aceh waters and its vicinity. Twenty eight stations divided into four study areas were established for microbiological study (Fig. 1 and Table 1). Four stations (St.1 to 4) were located in the eastern part, eleventh stations (St.5 to St.15) in the northern part, eleventh stations (St.17 to St.27) in the western part of Aceh waters and two stations (St.28 and 30) in the waters of Simeuleu Island. Seawater samples were collected,

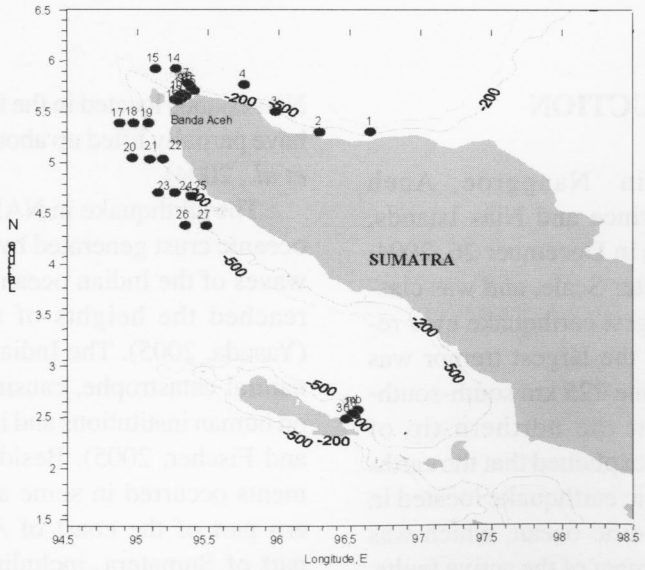

Figure 1. Location of the sampling stations of microbiological study in Aceh waters and its vicinity, NAD Province in the period of August – September 2006

Table 1. Location of sampling in Aceh waters and its vicinity (estern, northern and western part of Aceh and Simeuleu Islands) in the period of August - September 2006

No Station	Location	Date	Time Sampling	Position		Sea Depth (m)
				Longitude (E)	Latitude (N)	
1	Eastern part of Aceh	31 - 08 - 06	12:52	96° 40. 042'	05° 18. 454'	458
2		31 - 08 - 06	23:38	96° 18. 294'	05° 18. 411'	74
3		01 - 09 - 06	04:16	95° 59. 519'	05° 30. 279'	441
4		01 - 09 - 06	08:47	95° 46. 062'	05° 46. 124'	1137
5	Northern part of Aceh	01 - 09 - 06	14:35	95° 24. 644'	05° 42. 648'	219
6		01 - 09 - 06	17:55	95° 23. 169'	05° 44. 631'	544
7		01 - 09 - 06	20:42	95° 21. 818'	05° 46. 827'	171
8		02 - 09 - 06	02:59	95° 20. 877'	05° 39. 465'	40
9		02 - 09 - 06	00:49	95° 19. 393'	05° 40. 623'	219
10		02 - 09 - 06	06:06	95° 17. 969'	05° 39. 337'	112
11		02 - 09 - 06	04:20	95° 19. 341'	05° 37. 954'	43
12		02 - 09 - 06	09:55	95° 17. 642'	05° 36. 499'	38
13		02 - 09 - 06	08:05	95° 16. 231'	05° 37. 284'	268
14		05 - 09 - 06	09:20	95° 16. 714'	05° 55. 644'	231
15		05 - 09 - 06	01:57	95° 08. 000'	05° 55. 512'	925
17	Western part of Aceh	03 - 09 - 06	02:40	94° 52. 561'	05° 23. 29'	724
18		03 - 09 - 06	02:40	94° 58. 543'	05° 23. 344'	376
19		02 - 09 - 06	23:55	95° 04. 918'	05° 23. 361'	54
20		03 - 09 - 06	12:00	94° 58. 022'	05° 02. 86'	845
21		03 - 09 - 06	16:15	95° 13. 836'	05° 02. 048'	304
22		03 - 09 - 06	19:27	94° 58. 022'	05° 02. 794'	45
23		08 - 09 - 06	03:00	95° 12. 540'	04° 40. 108'	830
24		08 - 09 - 06	09:44	95° 21. 959'	04° 40. 048'	58
25		08 - 09 - 06	11:30	95° 28. 421'	04° 40. 236'	26
26		08 - 09 - 06	14:30	95° 20. 548'	04° 23. 101'	650
27		08 - 09 - 06	18:35	95° 29. 716'	04° 22. 956'	73
28	Seumeulu Island	10 - 09 - 06	03:30	96° 26. 919'	02° 32. 470'	391
30		10 - 09 - 06	05:55	96° 30. 239'	02° 29. 318'	481

using rosette sampler from the surface down to the bottom layer, and the sediment samples were collected using box corer. The microbiological parameters used for determining water quality consisted of coliform bacteria and pathogenic bacteria as indicator of water pollution.

Indicator of water pollution bacteria was examined by using the method of membrane filter technique (Anonymous, 1992). A hundred ml of sea water sample was transferred into a sterilized filtering apparatus. Later the filter paper containing the filtered materials was removed to a petridish containing the agar medium (M-Endo agar) and incubated at temperature of 35° C for approximately 24 hours (Millipore, 1975; Poole and Hobson, 1979). The colonies of coliform bacteria are indicated by the green or metallic golden color on the surface of filter membrane.

To isolate the pathogenic bacteria (*Salmonella* and *Vibrio*), they are collected from the sediment and seawater samples, and then cultured in selective medium for 24 hours at room temperature. The bacteria of Salmonella group was isolated by using the selective media, Selenith broth and then the suspected colonies were tested based on the procedure from the World Health Organization (Anonymous, 1977) and Poole and Hobson (1979). The bacteria of Vibrio group was

isolated in selective media, Thiosulphate Citrate Bile Sucrose agar and the suspected colonies, were tested following the scheme of Barrow and Miller (1976).

RESULTS

The results of study of the microbiological condition in the periode of August–September 2006 in Aceh waters and its vicinity, are listed in Tables 2 and 3 and illustrated in Figures 2, 3, 4 and 5. The numbers of coliform bacteria in the water column at all stations, ranged from 40 to 1055 CFU/100 ml, with the average of 443 CFU/ 100 ml (Table 2). The higher number of coliform bacteria was found at Station 1 (eastern part of Aceh waters) and the lower number was at Station 15 (northern part of Aceh waters). The stations located close to the coast showed higher numbers of bacteria compared to those of the offshore stations. The horizontal distribution of coliform bacteria at the surface layers of the four

Table 2. Total numbers of Coliform bacteria from the surface water in Aceh waters and its vicinity (eastern , northern and western part of Aceh and Simeuleu Islands) in the period of August - September 2006

No Station	Location	Date	Time Sampling	Position		Sea Depth (m)	Depth Sampling (m)	Numbers of Coliform bacteria (x CFU / 100 ml)	Average
				Longitude (E)	Latitude (N)				
1	Eastern part of Aceh	31 - 08 - 06	12:52	96° 40. 042'	05° 18. 454'	458	0	1055	611
2		31 - 08 - 06	23:38	96° 18. 294'	05° 18. 411'	74	0	530	
3		01 - 09 - 06	04:16	95° 59. 519'	05° 30. 279'	441	0	460	
4		01 - 09 - 06	08:47	95° 46. 062'	05° 46. 124'	1137	0	400	
5	Northern part of Aceh	01 - 09 - 06	14:35	95° 24. 644'	05° 42. 648'	219	0	395	474
6		01 - 09 - 06	17:55	95° 23. 169'	05° 44. 631'	544	0	305	
7		01 - 09 - 06	20:42	95° 21. 818'	05° 46. 827'	171	0	625	
8		02 - 09 - 06	02:59	95° 20. 877'	05° 39. 465'	40	0	835	
9		02 - 09 - 06	00:49	95° 19. 393'	05° 40. 623'	219	0	420	
10		02 - 09 - 06	06:06	95° 17. 969'	05° 39. 337'	112	0	680	
11		02 - 09 - 06	04:20	95° 19. 341'	05° 37. 954'	43	0	545	
12		02 - 09 - 06	09:55	95° 17. 642'	05° 36. 499'	38	0	695	
13		02 - 09 - 06	08:05	95° 16. 231'	05° 37. 284'	268	0	595	
14		05 - 09 - 06	09:20	95° 16. 714'	05° 55. 644'	231	0	80	
15		05 - 09 - 06	01:57	95° 08. 000'	05° 55. 512'	925	0	40	
17	Western part of Aceh	03 - 09 - 06	02:40	94° 52. 561'	05° 23. 29'	724	0	645	348
18		03 - 09 - 06	02:40	94° 58. 543'	05° 23. 344'	376	0	465	
19		02 - 09 - 06	23:55	95° 04. 918'	05° 23. 361'	54	0	565	
20		03 - 09 - 06	12:00	94° 58. 022'	05° 02. 86'	845	0	185	
21		03 - 09 - 06	16:15	95° 13. 836'	05° 02. 048'	304	0	185	
22		03 - 09 - 06	19:27	94° 58. 022'	05° 02. 794'	45	0	500	
23		08 - 09 - 06	03:00	95° 12. 540'	04° 40. 108'	830	0	120	
24		08 - 09 - 06	09:44	95° 21. 959'	04° 40. 048'	58	0	210	
25		08 - 09 - 06	11:30	95° 28. 421'	04° 40. 236'	26	0	125	
26		08 - 09 - 06	14:30	95° 20. 548'	04° 23. 101'	650	0	320	
27		08 - 09 - 06	18:35	95° 29. 716'	04° 22. 956'	73	0	510	
28	Seumeulu Island	10 - 09 - 06	03:30	96° 26. 919'	02° 32. 470'	391	0	745	462
30		10 - 09 - 06	05:55	96° 30. 239'	02° 29. 318'	481	0	180	
Total Numbers of Coliform Bacteria								12415	
Mean Total Numbers of Coliform Bacteria								443	
Minimum Value of Numbers of Coliform Bacteria								40	
Maximum Value of Numbers of Coliform Bacteria								1055	
Range Value of Numbers of Coliform Bacteria								40 - 1055	

Table 3. Pathogenic bacteria isolated from sediment and seawater samples in the Aceh waters and its vicinity (eastern, northern and western part of Aceh and Simeuleu Islands waters) in the period of August - September 2006

No Station	Location	Date	Time	Position		Pathogenic Bacteria											
				Longitude (E)	Latitude (N)	Aeromonas		Citrobacter		Proteus		Pseudomonas		Vibrio		Yersenia	
						Sediment	Seawater	Sediment	Seawater	Sediment	Seawater	Sediment	Seawater	Sediment	Seawater	Sediment	Seawater
1	Eastern part of Aceh	31 - 08 - 06	12:52	96° 40. 042'	05° 18. 454'	-	-	-	-	+	+	-	-	-	-	-	-
2		31 - 08 - 06	23:38	96° 18. 294'	05° 18. 411'	-	+	-	-	-	-	-	-	+	-	-	-
3		01 - 09 - 06	04:16	95° 59. 519'	05° 30. 279'	-	-	-	-	-	-	+	+	-	-	-	-
4		01 - 09 - 06	08:47	95° 46. 062'	05° 46. 124'	-	-	-	-	-	+	-	-	-	-	+	-
5	Northern part of Aceh	01 - 09 - 06	14:35	95° 24. 644'	05° 42. 648'	-	-	+	-	-	-	-	+	-	-	-	-
6		01 - 09 - 06	17:55	95° 23. 169'	05° 44. 631'	-	-	-	-	-	-	+	+	-	-	-	-
7		01 - 09 - 06	20:42	95° 21. 818'	05° 46. 827'	-	-	-	-	-	+	-	-	-	-	-	-
8		02 - 09 - 06	02:59	95° 20. 877'	05° 39. 465'	+	-	-	-	-	+	-	-	-	-	-	-
9		02 - 09 - 06	00:49	95° 19. 393'	05° 40. 623'	-	-	-	-	+	+	-	-	-	-	-	-
10		02 - 09 - 06	06:06	95° 17. 969'	05° 39. 337'	-	-	-	-	-	-	-	+	-	-	-	-
11		02 - 09 - 06	04:20	95° 19. 341'	05° 37. 954'	-	+	-	-	-	-	-	-	+	-	-	-
12		02 - 09 - 06	09:55	95° 17. 642'	05° 36. 499'	+	-	-	+	-	-	-	-	-	-	-	-
13		02 - 09 - 06	08:05	95° 16. 231'	05° 37. 284'	-	-	-	+	-	-	-	-	-	-	-	-
14		05 - 09 - 06	09:20	95° 16. 714'	05° 55. 644'	-	-	-	-	-	-	-	+	-	-	-	-
15		05 - 09 - 06	01:57	95° 08. 000'	05° 55. 512'	+	-	-	-	-	-	-	+	-	-	-	-
17	Western part of Aceh	03 - 09 - 06	02:40	94° 52. 561'	05° 23. 29'	-	-	-	-	-	-	-	+	-	-	-	-
18		03 - 09 - 06	02:40	94° 58. 543'	05° 23. 344'	-	-	-	-	-	-	-	+	-	-	-	-
19		02 - 09 - 06	23:55	95° 04. 918'	05° 23. 361'	-	-	-	-	-	+	-	-	-	-	-	-
20		03 - 09 - 06	12:00	94° 58. 022'	05° 02. 86'	-	-	-	+	-	-	+	-	-	-	-	-
21		03 - 09 - 06	16:15	95° 13. 836'	05° 02. 048'	-	-	-	-	-	+	+	-	-	-	-	-
22		03 - 09 - 06'	19:27	94° 58. 022'	05° 02. 794'	-	-	-	-	+	-	-	+	-	-	-	-
23		08 - 09 - 06	03:00	95° 12. 540'	04° 40. 108'	-	-	-	-	-	-	+	+	-	-	-	-
24		08 - 09 - 06	09:44	95° 21. 959'	04° 40. 048'	-	-	-	-	-	-	+	+	-	-	-	-
25		08 - 09 - 06	11:30	95° 28. 421'	04° 40. 236'	-	-	-	-	+	+	-	-	-	-	-	-
26		08 - 09 - 06	14:30	95° 20. 548'	04° 23. 101'	-	-	-	-	+	+	-	-	-	-	-	-
27		08 - 09 - 06	18:35	95° 29. 716'	04° 22. 956'	-	-	-	-	+	+	-	-	-	-	-	-
28	Seumeulu Island	10 - 09 - 06	03:30	96° 26. 919'	02° 32. 470'	-	-	-	-	-	-	+	+	-	-	-	-
30		10 - 09 - 06	05:55	96° 30. 239'	02° 29. 318'	-	-	-	-	-	-	+	+	-	-	-	-

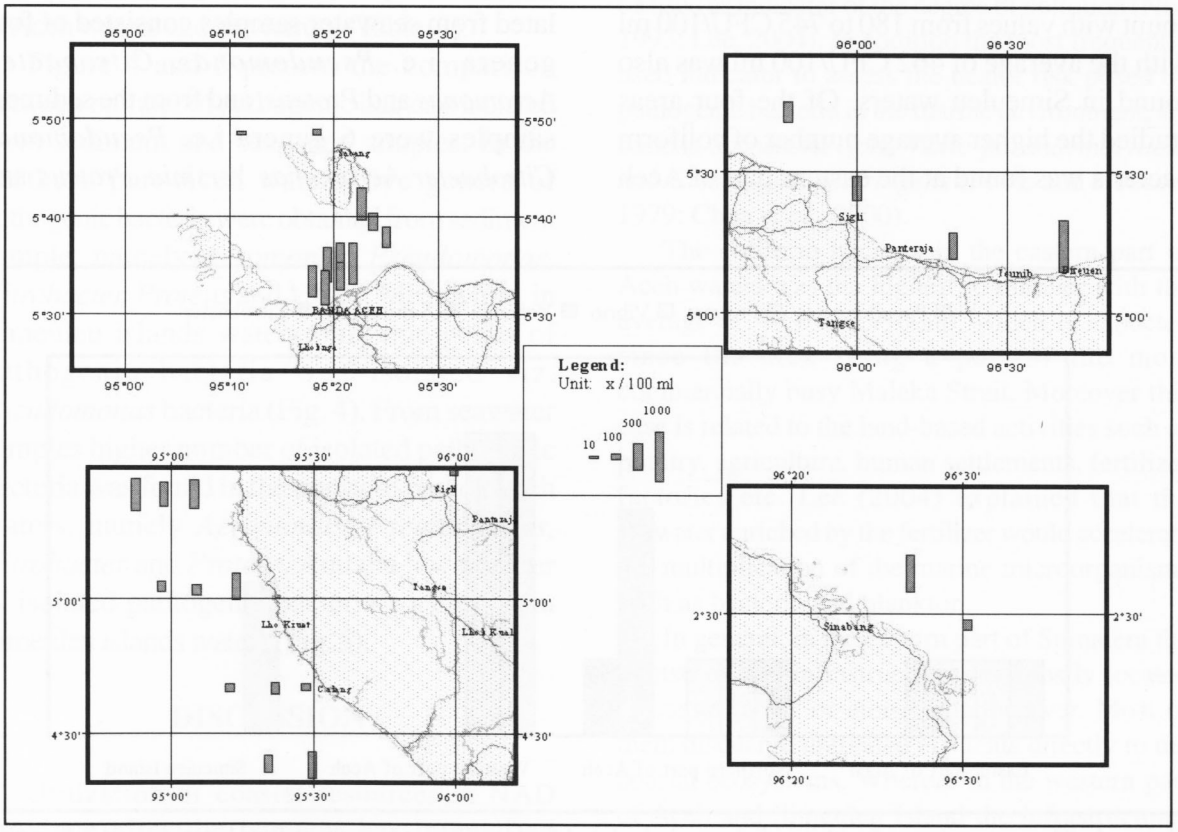

Figure 2. Distribution of coliform bacteria in Aceh waters and its vicinity (eastern, northern and western part of Aceh and Simeuleu Islands) in the period of August – September 2006

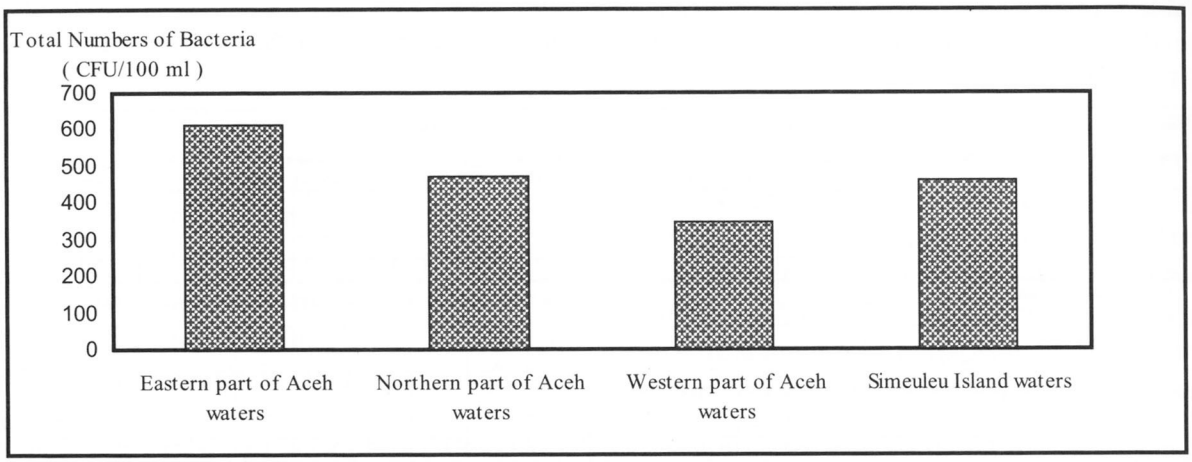

Figure 3. The comparison of coliform bacteria at four location in Aceh waters and its vicinity (eastern, northern and western part of Aceh and Simeuleu Islands) in the period of August - September 2006

areas of Aceh waters are illustrated in Figure 2 and listed in Table 2. The higher count was found at the eastern part of Aceh waters with the values ranged from 400 to 1055 CFU/100 ml with the average of 611 CFU/100 ml. The lower count was found at the western part of Aceh waters, the values being from 120 to 645 CFU/100 ml with the average of 348 CFU/100 ml. Lower count with values from 180 to 745 CFU/100 ml with the average of 462 CFU/100 ml was also found in Simeuleu waters. Of the four areas studied the higher average number of coliform bacteria was found at the eastern part of Aceh waters (611 CFU/100 ml), and the lowest average value (348 CFU/100 ml) was obtained from the western part of Aceh waters (Fig. 3).

The pathogenic bacteria isolated from seawater and sediment samples, are listed in Table 3. Generally, the pathogenic bacteria isolated from sediment were more diverse than those from seawater samples. The pathogenic bacteria isolated from seawater samples consisted of four genera, i.e. *Pseudomonas, Citrobacter, Aeromonas* and *Proteus,* and from the sediment samples were 6 genera i.e. *Pseudomonas Citrobacter Aeromonas Yersinia, Proteus* and

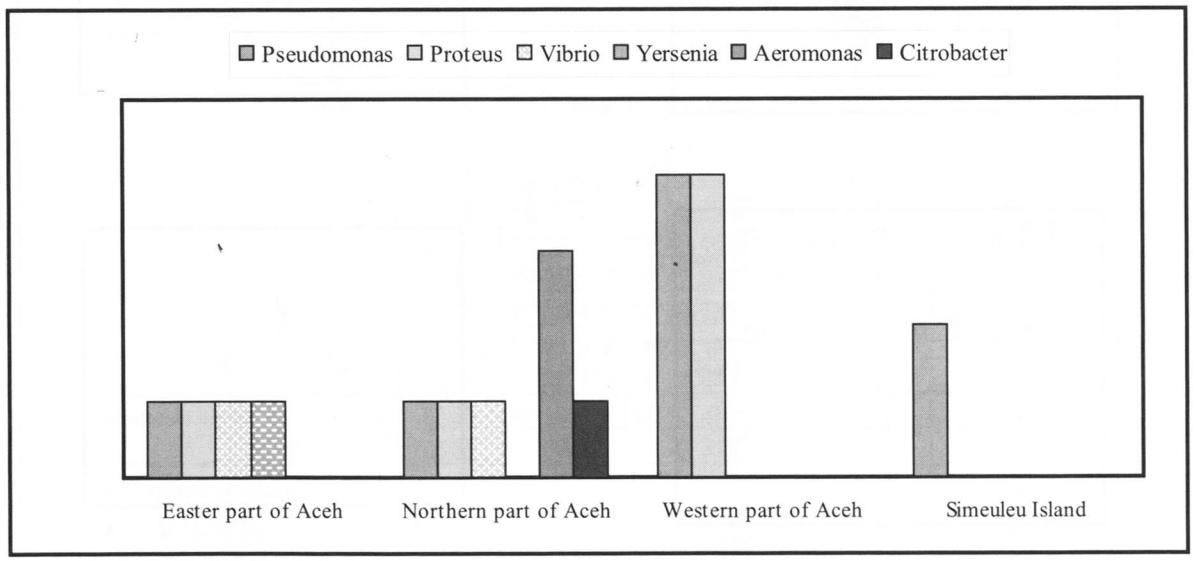

Figure 4. The comparison of pathogenic bacteria isolated from sediment sample at four location in Aceh waters and its vicinity (eastern, northern and western part of Aceh and Simeuleu Islands) in the period of August - September 2006

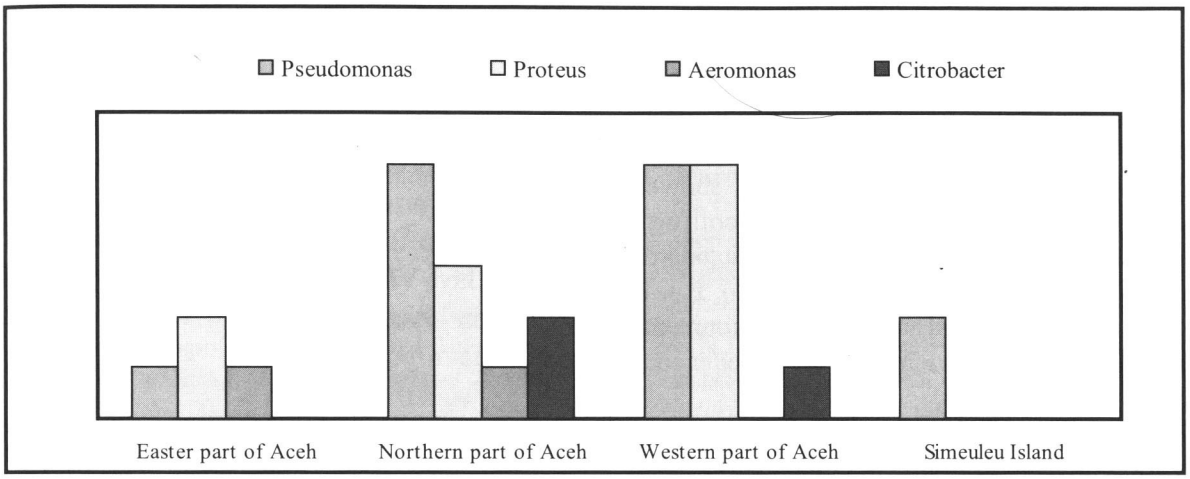

Figure 5. The comparison of pathogenic bacteria isolated from seawater sample at four location in Aceh waters and its vicinity (eastern, northern and western part of Aceh and Simeuleu Islands) in the period of August - September 2006

Vibrio. The *Pseudomonas* bacteria isolated from the sediment and seawater samples was the dominant one. *Aeromonas, Yersenia* and *Vibrio* bacteria collected from seawater sample were rare and the same for *Yersinia, Citrobacter* and *Vibrio* bacteria collected from sediment. The pathogenic bacteria of *Salmonella* was not found in Aceh waters and its vicinity (Table. 3).

Figure 4 and 5 present the comparison between number of pathogenic bacteria isolated from sediment and seawater samples. In the northern part Aceh waters five genera of pathogenic bacteria were obtained from sediment sample, namely *Aeromonas, Pseudomonas, Citrobacter, Proteus* and *Vibrio.* Meanwhile, in Simeuleu islands waters only one genus of pathogenic bacteria was isolated viz. *Pseudomonas* bacteria (Fig. 4). From seawater samples higher number of isolated pathogenic bacteria was found in the northern part of Aceh waters, namely *Aeromonas, Pseudomonas, Citrobacter* and *Proteus.* And the low number of isolated pathogenic bacteria was found in Simeuleu islands waters (Fig. 5).

DISCUSSION

Utilization of coastal resources in NAD Province after the tsunami has intensified significantly due to the growing population pressure, increase industrial and commercial activities and rapid development of infrastructure. These have resulted in severe degradation of coastal water quality and resources. These are caused by the discharge of wastewaters from human settlements, farming or agricultural activities, industrial and shipping activities into coastal waters. Coliform bacteria is one of the bacteria that can be used as indicator of the degree of pollution (Nix, 1993; Lee, 2004). In addition the most frequently used indicator to assess the health risk posed by pathogenic bacteria in the marine environment, are bacteria *Salmonella typhi, Vibrio parahaemolyticus* and *Clostridium perfringens* (Poole and Hobson, 1979; Chua *et al.*, 2000).

The coliform bacteria in the eastern part of Aceh waters was the highest in number with the average of 611 CFU/100ml, which is expected since the area being a part of the most commercially busy Malaka Strait. Moreover this case is related to the land-based activities such as poultry, agriculture, human settlements, fertilizer factories etc. Lee (2004) explained that the seawater enriched by the fertilizer would accelerate the multiplication of the marine microorganisms such as bacteria and plankton.

In general, in the eastern part of Sumatera the industries and infrastructures are mostly located in coastal areas or along a major river. Most of them discharge untreated effluents directly to the coastal ecosystems. Whereas in the western part of Aceh and Simeuleu Island the infrastructures are not yet fully developed (Anonymous, 2004a). Therefore, the total number of coliform bacteria

was relatively low. The average total number of coliform bacteria in the Malaka Strait and Riau Island waters is 753 CFU/100ml as previously reported (Anonymus, 2001), which was higher than that in the eastern part of Aceh waters (611 CFU/ 100 ml). The result of the present study showed that in Aceh waters the numbers of coliform bacteria did not exceed the Indonesia standards (1000 CFU/100 ml) (Anonymous, 2004). It was expected that the coastal and marine environments in Aceh waters and its vicinity is still in better condition.

The pathogenic bacteria of the area studied are more diverse in sediment compared to those in seawater. *Pseudomonas* are the common bacteria collected from both sediment and seawater. *Vibrio* and *Yersenia* bacteria are the most rare species collected from sediment and seawater. *Aeromonas* is the most rare bacteria sampled from seawater. The result of the present study showed that Aceh waters is relatively free of pathogenic bacteria. Due to the existence of *Vibrio* bacteria in the sediment sample of eastern part of Aceh waters it was considered that this fact indicates some contamination. So far, the pathogenic bacteria has no negative impact on the vertebrates and human being (Poole and Hobson, 1979; Anonymus, 2006).

Five species of pathogenic bacteria are identified from sediment samples and four species from seawater samples of the studied area, i.e. bacteria *Pseudomonas, Citrobacter, Aeromonas, Proteus, Vibrio* and *Pseudomonas, Citrobacter, Aeromonas* and *Proteus* respectively. Only one species of pathogenic bacteria is identified from Simeuleu Island i.e, *Pseudomonas* bacteria. It was due to the development of human settlements and industries that result in the increasing of high fecal microorganisms. The pathogenic bacteria collected from northern part of Aceh waters is less divers than those in Riau Islands waters (Kunarso, 2003). It is suggested that in Aceh waters the sea water is relatively clean. Nevertheless, the increasing human activities due to the rehabilitation of all aspects of life in NAD Province will surely degrade coastal water quality if it is not properly manage. Therefore the monitoring activity should be continued to ensure the achievement unpolluted condition of the waters of NAD Province.

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