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Interdisciplinary Scientific Methodologies for the Sustainable Use and Management of Coastal Resource Systems

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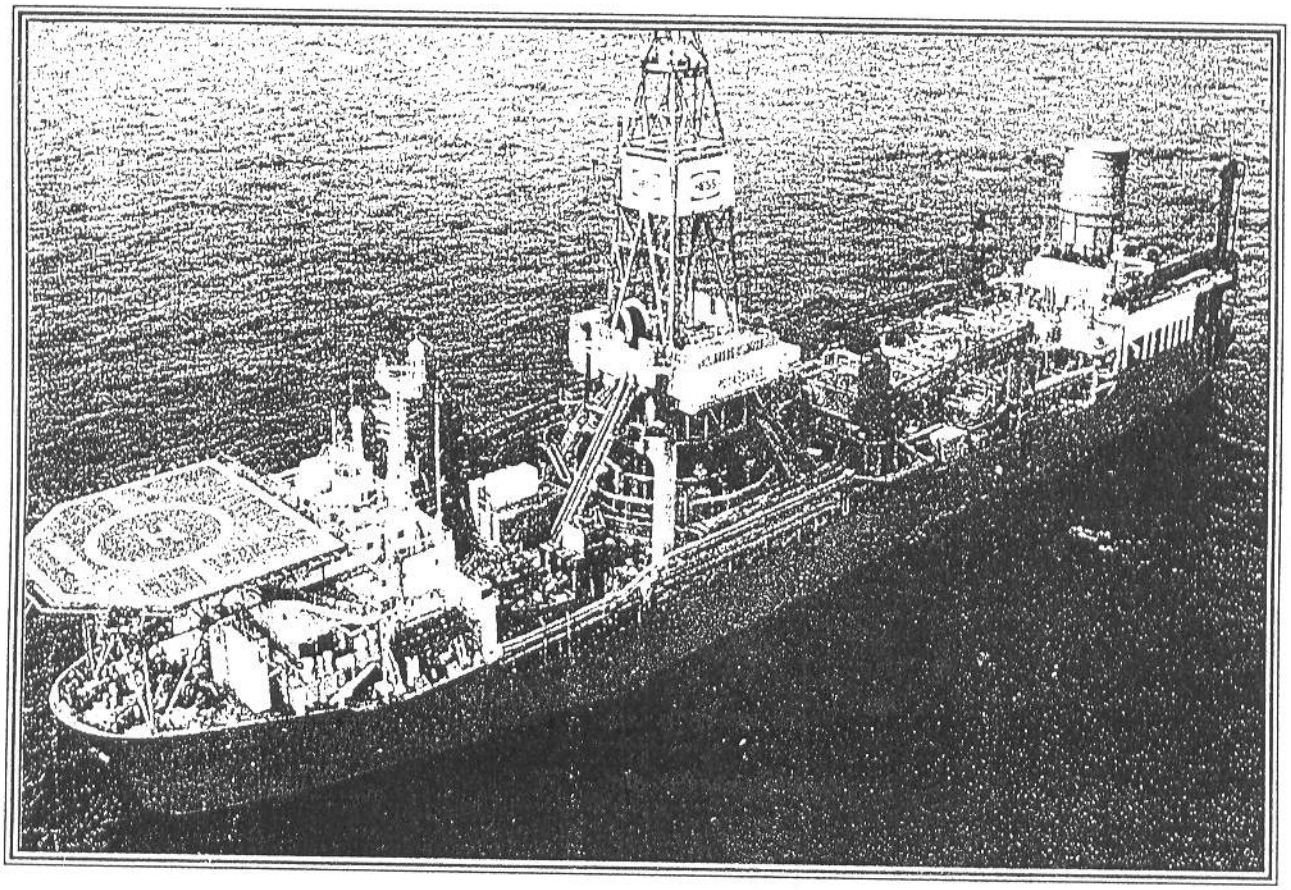

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"Major Environmental Inputs"

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ENVIRONMENTAL PROBLEMS OF AMBON BAY

By

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SUMMARY

Ambon bay is a semi enclosed coastal sea at Ambon Island. Rapid growth on land activities such as human settlements, land clearing road construction, and reclamation of coastal area for harbor increased recently. These activities have accelerated sedimentation process into the coastal into the coastal line of the bay. During the rainy seasons, siltation materials and domestic wastes were flowing into coastal sea via rivers in a large amount. Some oil spills from ships, boats, oil shipping and diesel power plants could detect also present in the coastal area. The most spectacular effect of the oil waste of the bay was the death of mangroves at the mouth of a river, in which oil based power plant spills its waste.

INTRODUCTION

Ambon Bay is a semi enclosed bay where consists of a V-shaped deeper bay at the front and so called outer bay and a nearly ellipsoidal bay, called inner bay (Figure 1). Maximum depth of outer bay is 600m and inner bay approximately 30m. Figure 2, shows bottom configuration and grain size composition of the inner bay that mostly consists of sand particles, and a few part composed of 50% mud (Susetiono, 1996). Outer bay and inner bay is connected by a narrow channel, 10m deep, 0.6km

wide, and 0.8km long approximately. The presence of this sill at the channel, which formed a barrier, restricts the horizontal and vertical water exchange and accelerates to the declining of water quality (Hamzah & Wenno, 1987; Rebert & Birowo, 1989).

Setyawan (1997, and references within) has reviewed several physical condition of the bay, such as geology, climate, wave and current. Volcanic rocks in condition deeply weathered are dominantly composing the hilly areas around V-shaped Ambon Bay (Figure 1). Also, some a sparse distribution of some coral reef limestone. The coastal plain composed a varied grain size of alluvial deposits that mostly derived from erosion of the hilly areas. Streams are relatively short, intermittent, are starting from the hilly area and open at along the surrounding of the bay. Climate of the Ambon Island is influenced by monsoon where belongs to tropical rain forest climate. Average cumulative precipitation is 2717mm per year. The first large wind through the year is a southeasterly wind (97.3%) with average velocity about 3.12knots; then a southwesterly wind (10.8%) where average velocity 3.76 knots. These two kind of wind are generating the presence of wave at Ambon Bay. The shape of bay and hilly coastal upland are providing the bay become sheltered.

Population density at Ambon Island is 303.814 persons (Maelissa, 1996). Increasing economic establishment will cause also increasing human activities and many other activities on road and building constructions, development of housing and markets. All these human activities are speeded up on natural resources exploitation and production of garbage and wastes as well. Among two parts of Ambon Bay only the Inner Ambon Bay is much susceptible to any kind of pollution.

On the other hand, coastal waters have contribute much support on fisheries production by offering nursery and spawning ground for small-scale fisheries and coastal agriculture. Mangroves at along the coast of the inner bay have detected decrease its distribution as the effects of deplantation for any purposes and also due pollution stress (Pramudji, 1987). However, replantation on mangrove has also been tried but it still not works out much because of declining on environmental condition. Seagrases are rare and sparse in its distribution, only four species could be found by Kuriandewa (1996), *Enhalus acoroides, Thallassia hemprichii, Halodule pinifolia*

and *Halophila minor* where *E. acoroides* predominant. Both mangroves and seagrasses communities are very important habitat for some commercial fishes and invertebrates. Based on the above of environmental condition of the bay that is being declining slowly and affects to the fisheries production and the beauty of the bay. Therefore, I do hope that the SimCoast workshop could give idea to solve a kind of environmental declination such as happen in the Ambon Bay.

FACTS OF ENVIRONMENTAL DEGRADATION

Recently, economic establishment at Ambon Island has enhanced progressively where the consequence of it increases human activities and urban population. Increasing urban area would promote land clearing at the hilly coastal upland for several uses such as road, houses, agriculture and other infrastructure (Figure 3). Mining activities on sand and gravel deposits could be exist on hilly area, stream courses, and along coastline. Land clearing as the effect of urban expansion and expansion of marine facilities, such as special purposes ports (Figure 5), are a major source for increasing sediment influx into the bay. Rain is the principal agent for sediment transport into the bay. Bay waters will change to brownish color because of suspension cloud of siltation (Figure 7e). Heavy sedimentation decreases light penetration and interferes with photosynthesis, same phenomenon also shown in the sand winning from the seagrass bed (Adam *et al.*, 1981). The silt flocculates planktonic algae and carries such organisms to the bottom. Also, sedimentation cause lowers primary productivity and oxygen levels in water column. The sinking sediment traps organic matter on the bottom and creates an oxygen demand that may result in gas ebullition and an objectionable anaerobic condition. Clearly, siltation does affect the species composition of particular aquatic community, sometimes from beginning of the food chain all the way to the end of products harvested by human being.

During the year of 1994 the principal harbor named Yos Sudarso (Figure 4) was visited by 262 large ships (cargo, tourist, oils tanker) with average increase

5.24% per year as started from 1990 where 192 times large ships visited (Manuputy, 1996). As if the visiting times increase then following by the increasing of oil content in the seawater as oil spills. The existence of hydrocarbon in the seawater of Ambon Bay is not only spillage from marine transportation but also from oil shipping (Figure 6) and from oil based diesel plant that located along the coast, such as shown by Figure 8b. Possible spillage at the port area are due to tank cleaning operations, malfunctions of sea valves, carelessness during the connecting and disconnecting of hoses, and sometimes by pumping bilge. Besides of the principal port, several special port have developed in order to fulfill the need for fisheries, oil tanker, and ship maintenance (Figure 4).

Mangroves are outstandingly adapted to growing in seawater. Mangrove roots typically grow in anaerobic muddy sediment and receive oxygen through aerating tissue which communicates to the air via small pores, called lenticels on the stilt roots or pneumatophores. The impact of oil spillage to the mangroves possibly by blocking the air pores of the lenticel and/or pneumatophores with oil subtances. Many mangrove vegetation death can be seen at the coast nearby to a diesel power plant (Figure 8b). Still at the similar place of the death mangrove, a study on meiofauna was done and indicated that density and diversity of meiofauna counted was very low where only 367ind.100cm^{-2} (Figure 8a, *see Site 2*). Vanishing interstitial meiofauna as the effect of oil pollution can be happen rapidly or delayed depend on type of sedimented oil and its byproducts, and the strength of meiofaunal taxa itself (Susetiono, 1996).

Increasing population at along the coast line causes problems on coastal water quality due to increasing amount of garbage, oil, and bacteria. After heavy rain a lot of domestic wastes are floating at the surface of Ambon Bay (Figure 7b), then is stranded at along the coast line during low tide. Both of floating and stranded domestic wastes are damaging replantation of mangroves (Figure 7c and 7d). According to Setyawan (1997, and references within) the appearance of the floating garbage is tend to increase year by year. Domestic wastes production of Ambon is about 693.9m^3.day^{-1} where 596m^3.day^{-1} from product of urban housing, 51.1 m^3.day^{-1} from market, 36.9 m^3.day^{-1} from various institutions and 9.9 m^3.day^{-1} from other

sources. Nearly, 66 $m^3.day^{-1}$ (18.12%) of garbage runs into Ambon Bay waters. Organic enrichment that frequently as small particles onto sediment surface will create low permeability and restricts penetration oxygen into the substrate. Further, sediment become black in color with a very strong odor of H_2S reflects an anoxic condition (Figure 8c).

Based on the facts as mentioned above that environmental degradation is strongly related to the increasing of economic establishment and inhabitant population. A strong effort to eliminate pollution, siltation, and coastal line erosion needs to be performed perhaps by applying appropriate technology and law enforcement.

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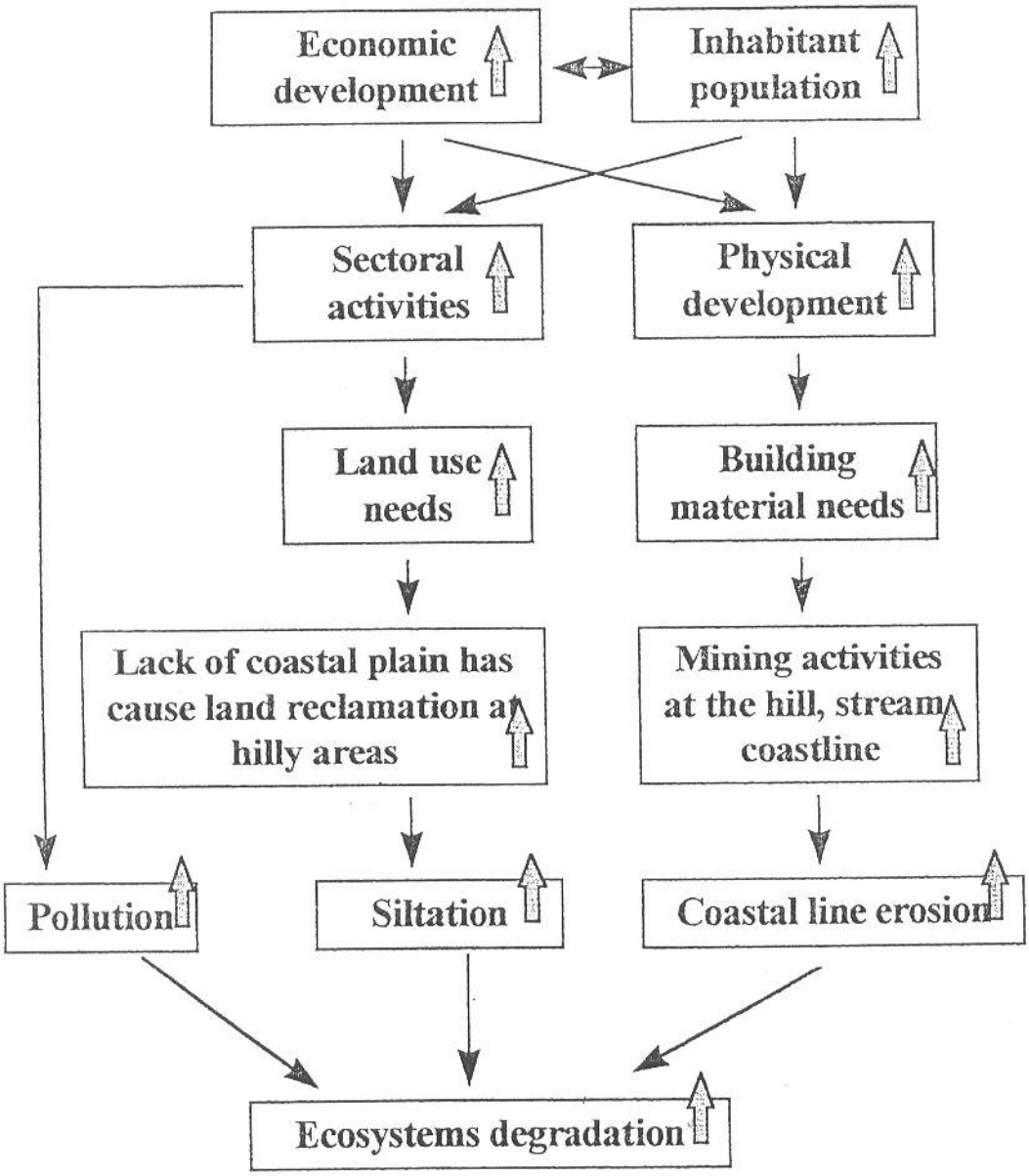

Trends of present condition at coastal area of Ambon Bay
(*redraw from* Setyawan, 1997)

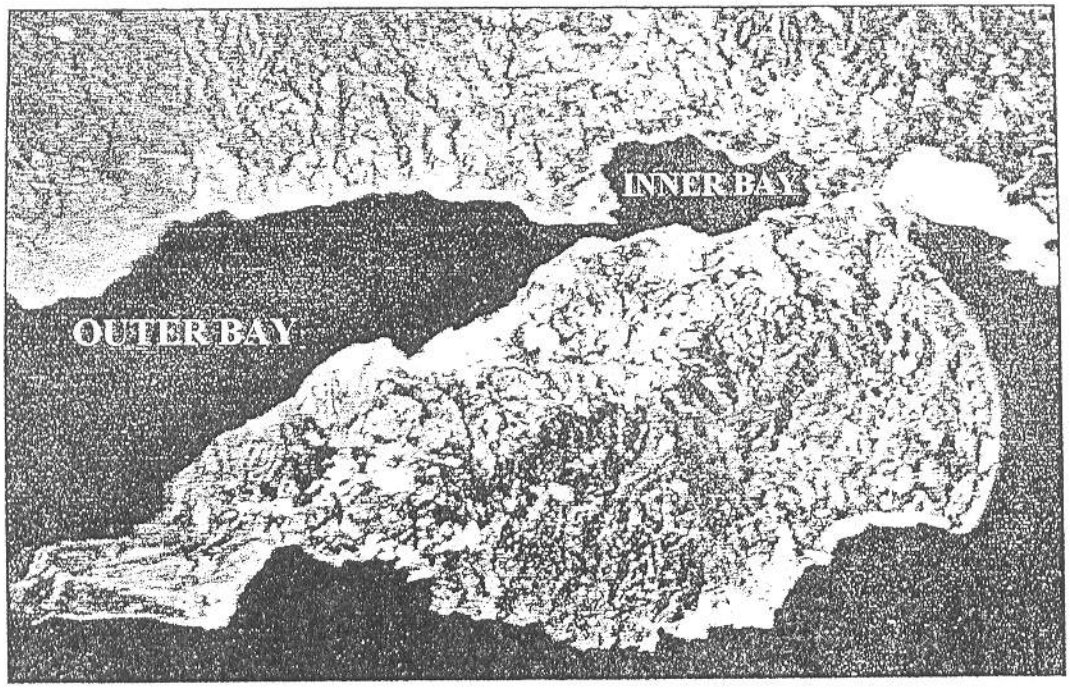

Figure 1. Aerial photograph of Ambon Bay.

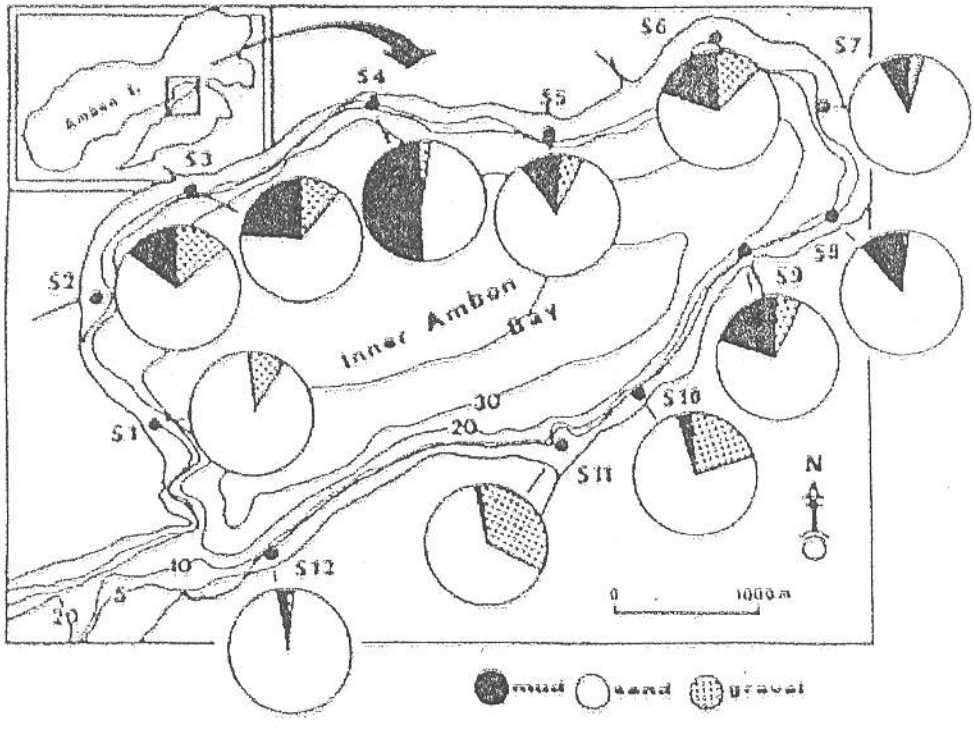

Figure 2. Ambon Island (inset) shows bottom configuration and grain size composition of Inner Ambon Bay (*from* Susetiono, 1996).

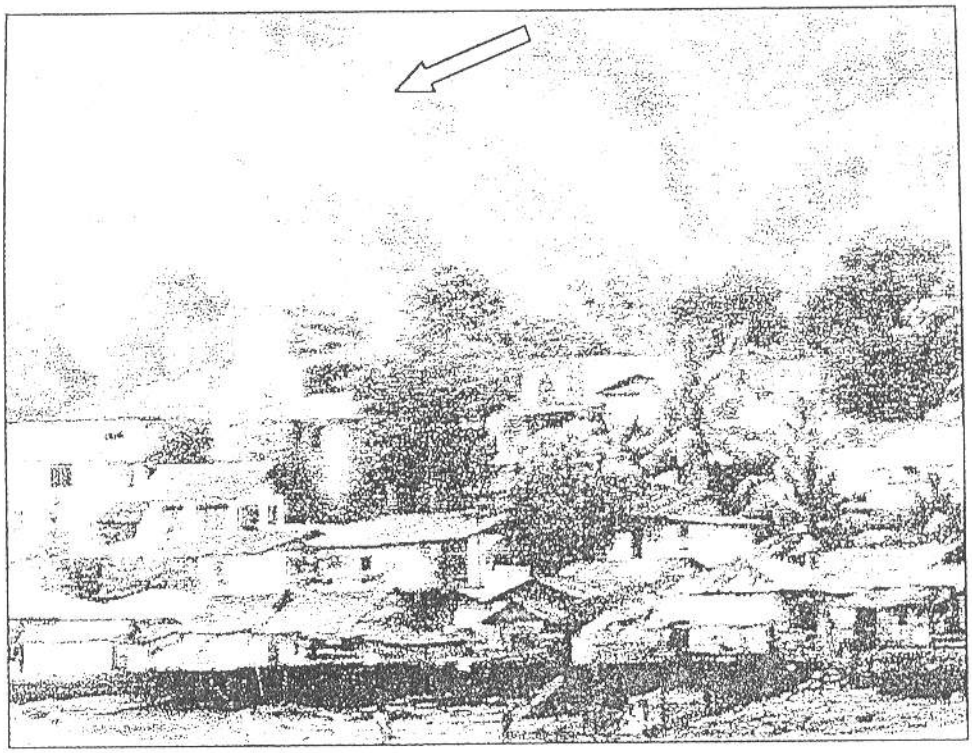

Figure 3. Land clearing for agriculture.

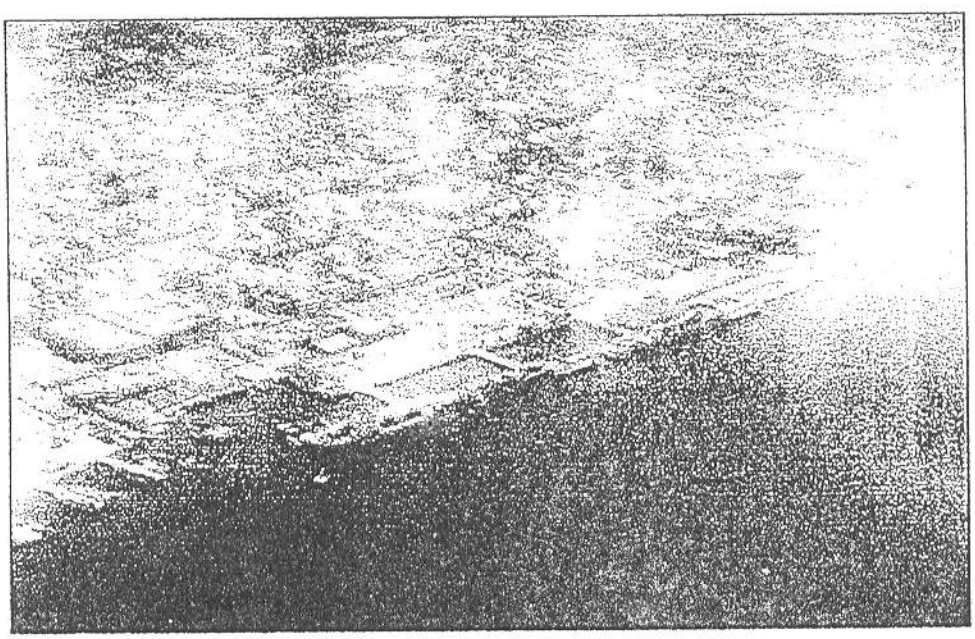

Figure 4. A main harbor of Ambon

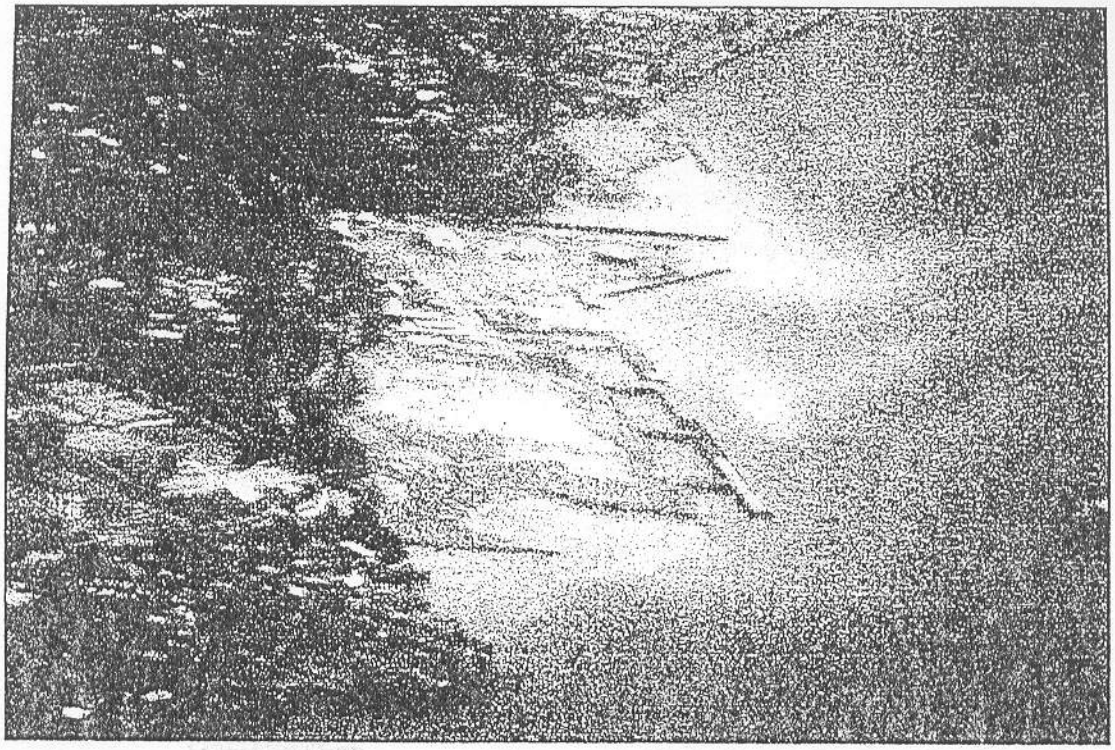

Figure 5. Fisheries port being built.

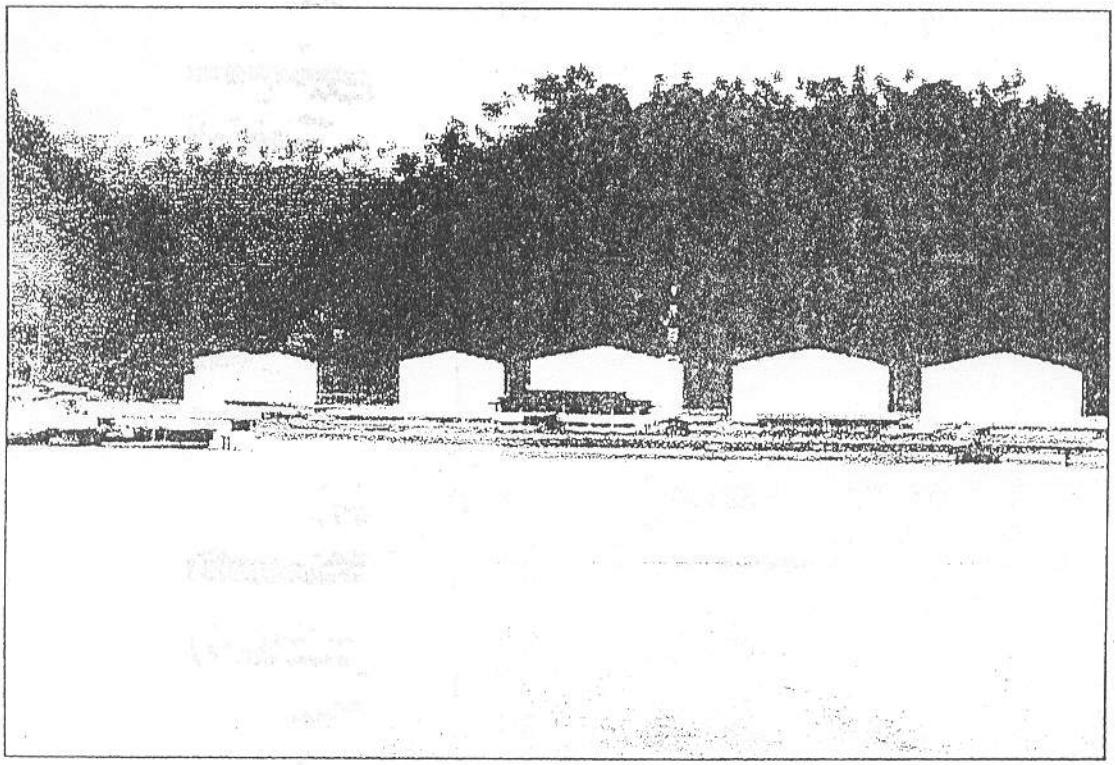

Figure 6. An oil shipping harbor.

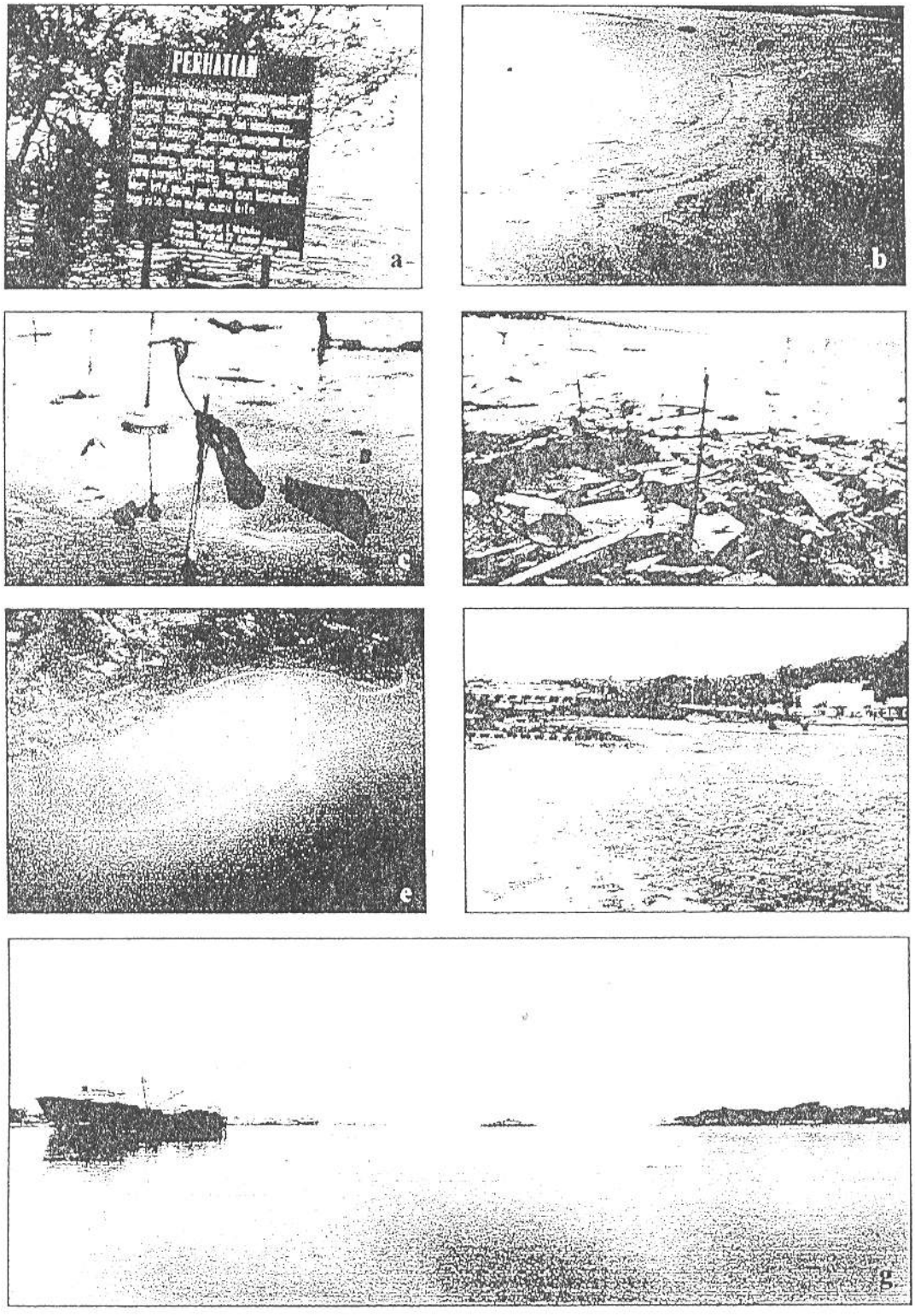

Figure 7. Major possible pollution at Ambon Bay.

a. A site for mangrove replantation.

b. Floating fine material from domestic sewage.

c and d. Domestic waste on mangrove replantation area.

e. Siltation. f. Oil spill from a power diesel plant.

g. Possible oil spill from marine transportation.

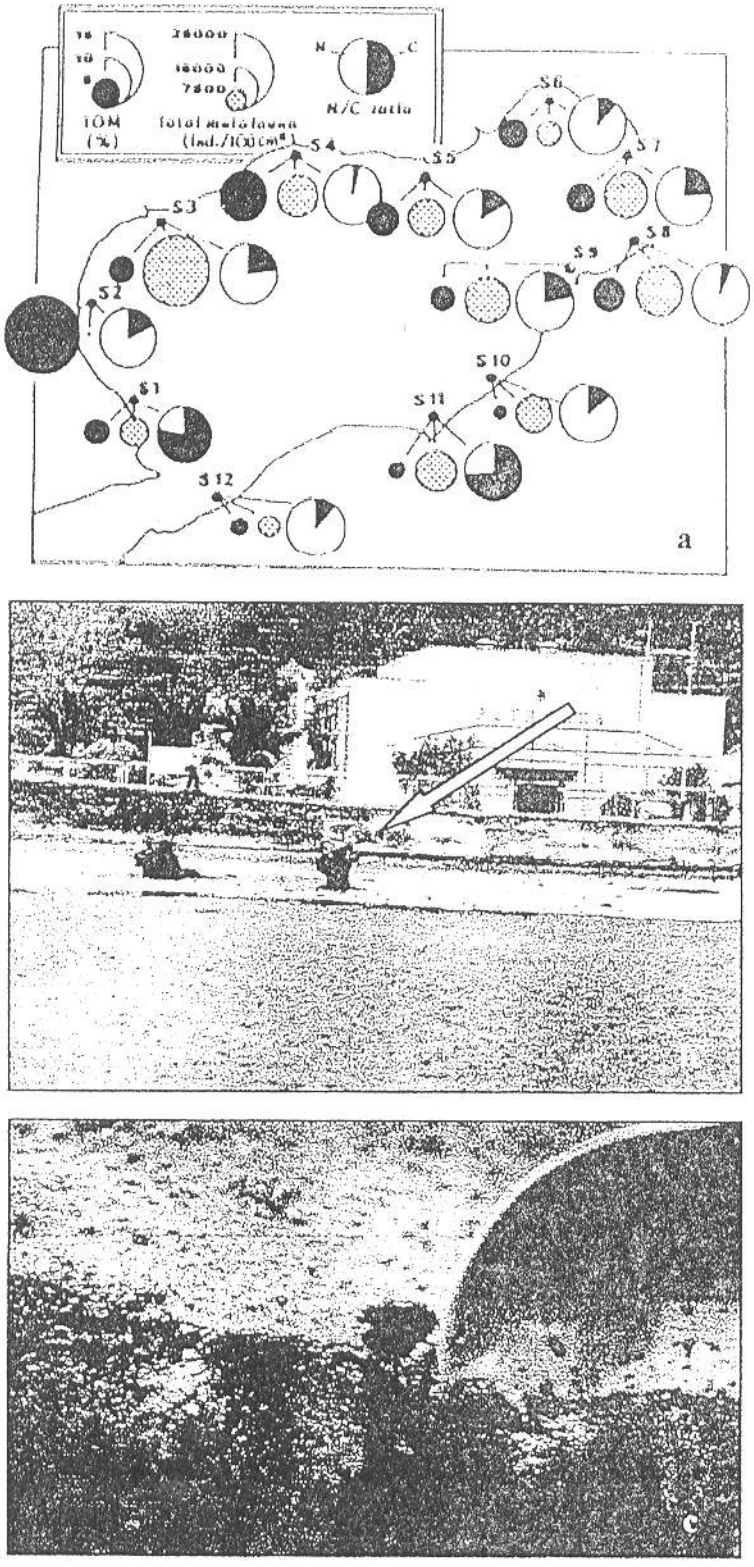

Figure 8. Major possible effects of pollution at Ambon Bay.
a. Less in number of meiofauna. b. Death of mangroves
c. Less oxygenated sediment.