Problems of Enclosed Coastal Seas Development: The Bintuni Case, Irian Jaya, Indonesia

EDY BROTOISWORO
Padjadjaran University, Bandung 40132, Indonesia

Irian Jaya is the Indonesian part of New Guinea. Bintuni Bay which covers about 8,200 sq.km. is located in the western part of the island extends about 200 km into the inland area. Almost the whole coastal area is covered by one of the best developed and most extensive mangrove areas of the Southeast Asian and Western Pacific regions. Some part of the mangrove area has been set aside as a nature reserve. Presently, a number of development projects are carried out in the bay area, i.e. fisheries with major products being prawns, mangrove exploitation with the particular purpose of producing chipwood, and several oilfield developments. The oilfield development projects are located onland, but the effluent water is discharged into the marine environment. The problem arose particularly due to the adverse impact of one development sector on the others. Yet, all of the development projects are important for supporting the economic growth of the country. The question is how to carry out integrated development in which the final goal is to achieve sustainable development of the area.

Most of Irian Jaya is still covered by natural areas. Luxurious and undisturbed rainforest occurs in the inland area, and mangrove forest hedges the coast. The Bintuni Bay is considered to constitute one of the best developed and most extensive mangrove areas of the Southeast Asian and Western Pacific regions.

Bintuni Bay (and the outer part Maccluer gulf) has been considered as one of the most pristine areas in Irian Jaya which is now undergoing increasing pressure of development projects, particularly in the sectors of forestry, fisheries and oil and gas developments. For a developing country like Indonesia, development programs in various sectors are essential to create a better quality of life for the people. However, often a development project may cause adverse impacts on the environment after which the allocation of the environment for other development programs is affected. This paper will discuss the case in Bintuni Bay where three major development projects are being carried out.

The Environment

Physical Environment

In this paper, the more popular "Bintuni Bay" will be used which includes also the Maccluer gulf at the outer side. The bay which extends from west to east for almost 200 km inland is about 8,200 sq.km. in area. The distance between the northern and southern coastal lines varies from about 25 to 50 km, while the depth near the coast ranges about 0-5 meters and that in the middle part is 15-100 meters with an average depth of 40 meters. Many rivers discharge their water into the bay bringing high concentrations of sediment which make the water of the bay highly turbid. Extensive mudflats which are exposed during low tide occur along the northern coast and are most extensive at the head of the bay. The mudflat varies in width from about 500 meters to about 1500 meters. It consists of silt and clay. The bay has a mixed semi-diurnal tide, with a tidal amplitude ranging from 1 to 5.6 meter, but it varies from place to place (Euroconsult, 1984). Such a high tidal amplitude may cause the saline water to penetrate far inland, for about 30 km as reported by Erftemeijer et al. (1989).

The area has a type A climate according to Schmidt and Ferguson's classification, and it has a monsoon climate, i.e. northwest monsoon from October to March and a southeast monsoon from April to September. The average annual rainfall is 2932 mm. Temperature ranges from 28°C to 32°C, with humidity about 65% to 85% (Brotoisworo & Hutomo, 1988).

Biological Environment

Mangrove forest fringes the northern coast of the bay and some parts of the southern coast. The extent of the mangrove forest in Irian Jaya is 2,943,000 ha which is almost 70% of the total mangrove area of

Marine Pollution Bulletin, Vol. 23, pp. 431–435, 1991.
Printed in Great Britain
0025-326X/91 $3.00+0.00

Indonesia (Ongkosongo et al., 1990). The total extent of the mangrove in Bintuni Bay (including the Maccluer gulf) is about 618,500 ha (Naamin, 1984), while for Bintuni Bay it is only about 260,000 ha (Erftemeijer et al., 1989). Mangrove is wellknown for its physical and biological functions. The importance of the mangrove forest as the nutrient supply for the marine environment is reflected by its production of organic debris (particularly leaves) which may reach 9 metric tons/ha/year or about 2.5 grams (11 kilo calory)/sq.mt./day (Odum, 1971). Most of the annual net production becomes widely dispersed by the tidal.

The fauna of the open bay is flourishly developed. Prawns and lobsters, which include *Penaeus semisulcatus, P. merguensis, P. indicus, P. latisalcatus Parapeneopsis sculptilis, Metapenaeus monoceros,* and the lobster *Panilurus ornatus* are the most commercially important species. Brotoisworo & Hutomo (1988) and Erftemeijer et al. (1989) stress the importance of Bintuni Bay for prawn production. Fish species of the Bintuni Bay are also potential resources, though commercially less important compared to prawns.

Resource Development in Bintuni Bay

The rich environment of the Bintuni Bay gives that the resources of the bay great potential to be developed. Three major developments which are presently being carried out are in the fishery, forestry, and oil and gas sectors.

A large part of Irian Jaya is still covered by primary forest, while mangrove fringes most of the coastal line. The timber of the rainforest as well as the mangroves are considered to have high commercial value, which attract many timber companies to come in the area. Petocz (1987) mentioned that 66 proposed timber concessions were being considered in Irian Jaya, 14 of which have been approved. Figure 1a shows that the forest surrounding the bay area, including the mangrove, has been mostly allocated for timber concessions. Seven companies have their concessions in the catchment of the bay, three of which have been approved to operate producing plywoods, chipwoods from the mangrove logs, and other kinds of timber products. The concessions of several companies cover some portions of mangrove forest, one of which even holds concession of 137,000 ha exclusively for mangroves. The total mangrove area included in the concessions is about 240,250 ha (Erftemeijer et. al., 1989).

Irian Jaya is one potentially rich areas for the oil and gas sectors. Figure 1b shows the distribution of the concession areas of oil companies working in the Bintuni Bay. Petromer Trend is currently producing oil. The production activities of Petromer Trend are centered in Kasim, the western part of the Bird Head. Until December 1987, the company has produced 251.5 million barrels of oil and 29,925,642 MSCF of gas from 408 productive wells. The water cut reached 98% with about 10 ppm of oil by the end of 1987 (Petromer Trend, 1988). The other productive fields are on Salawati island and Klamono, which are run by Pertamina. The production rate of the latter two fields is low. Conoco found three productive wells in 1981 and 1985 from 20 wells that have been drilled. The company is presently constructing their production facilities and will soon begin production. The expected recoverable reserves amount to about 12.2 million barrels. Initial average production of 7600 BOPD is expected from the three wells. The average watercut during the first three months of production is 8% with steady increases reaching about 88% by the end of the third year. The effluent water containing oil less than 25 ppm is dumped into the bay (Brotoisworo & Hutomo, 1988). Total Indonesia is still carrying out exploration, but so far has not succeeded.

Indonesia shares about 9% of the world production of penaid prawns (after Djamali et al., 1989). Mollucca and Irian Jaya (particularly the Arafura sea) are the best prawn fishing grounds in Indonesia. The Bintuni bay is included in Zone II of the 6 zones in Irian Jaya (Figure 1c). Thirty percent of the Indonesian prawn export is coming from this region (Naamin, 1984), showing the economic potential of the area. He further estimated that the penaid production from Bintuni Bay area, with an effective catching area of 11,930 sq.km., is a maximum of 21% from the total production of Irian Jaya. Furthermore, he estimated that the maximum sustainable yield was $\pm$ 1,375 ton/year requiring approximately 4,685 vessel days. During the period of 1974 - 1981, the annual production in Irian Jaya ranged from 283 to 1,010 tons, which is still below the maximum sustainable yield. Presently, fishing pressure seems to be increasing. Care should be taken to not deplete the resources.

Inter-Sectoral Problems of Development in Bintuni

Looking at the three development sectors, it seems that one project may have adverse impact on the others. Naamin (1984), comparing several localities in Irian Jaya, indicated that there was a positive correlation between the extent of mangrove and the rate of prawn production. This situation is particularly important

if we consider the present activity of the forestry sector in Bintuni Bay, where a total of 240,250 ha of mangrove is included in the concession area though only 137,000 ha will definitely be logged. Considering the finding of Odum (1971), if the 137,000 ha is clear cut, it means the reduction of 1,233,000 metric tons of organic debris per year from the mangrove stand. This figure may indirectly explain the decrease of marine fish/prawn production due to the decline in the supply of nutrients into the open bay, beside the reduction of spawning/nursery grounds, and refuge for small fish/prawns from predator pressures. There is a contradicting situation where about 145,000 ha of the mangrove forest granted for timber concessions overlaps the proposed Bintuni mangrove reserve. In the country as well as internationally, attention is given to these problems. The Indonesian Forestry Department is currently reviewing the conflicting situation in this area.

The effluent water of oil and gas development may significantly affect the water quality and subsequently affect the mangroves and marine biota including fish and prawns. The present potential polluter is Petromer Trend located just at the mouth of the bay. Considering its location, the pollution potential on the bay environment is not very significant. However, care should be taken since the spring tide may bring polluted water far into the bay. However, long experience of production shows that there has been no complaint from the other sectors indicating that normal operation does not have a significant impact on the environment. Conoco's production field is located in the Wiriagar area. The oil properties which are light, non-waxy, and have 39.5°API makes the oil easily evaporate into the environment, while the aromatic concentration is low (2%), and the aromatics are monocyclic making the oil is less toxic (Brotoisworo & Hutomo, 1988). Serious problems will occur if there is a major accident such as a large spill of oil into the bay environment, since the vulnerable habitats such as mangrove, mudflat, and estuarine environments will be affected while clean up action is not possible, since the use of dispersant is not recommended. Therefore, oil and gas operation in this area should be done with extra care.

Fisheries is becoming the most vulnerable sector of the three. It depends on the mangrove habitat, while its sensitivity to oil pollution is very high. Therefore, a holistic approach should be used in the development of the Bintuni Bay resources. There should be an inter-sectoral approach to reconcile the development plan of the area to achieve integrated and environmentally sound development.

Concluding Discussion

Exploitation of a given resource may cause unexpected adverse environmental impacts. A more serious problem occurs if the impact causes the allocation of other resources for further development to be adversely affected. Such a problem occurs in the Bintuni Bay area. Among the three major components of development, two (forestry and fisheries) use renewable resources.

Mangroves clearly represent an essential component of the enclosed Bintuni Bay ecosystem particularly for fisheries and wildlife. On the other hand, the mangrove also represents as potential natural resource of its own. Therefore, it is not a question of choosing between preservation or development of the mangrove, but rather how to carry out sustainable development in the forestry sector. Calculation should be made of the maximum sustainable yield of the Bintuni Bay mangrove. Besides, the present problem of overlapping granted timber concessions and the proposed reserve should be seriously considered. If necessary, concession areas should be excluded and then relocated elsewhere. The present problem is also due to the cutting method which does not follow existing regulations, i.e. preserving a mangrove belt of 200 meter in width along the seacoast and 50 meters along both sides of rivers, leaving a given number of mother trees in the logged area. After cutting the area should be replanted with seedlings which are specially prepared for this purpose. Law enforcement and control seems to be lacking in such a remote area. However, since the Bintuni bay area has a fragile environment, the logging methods shall be modified and adjusted more strictly to ensure the continuous functioning of the mangroves as a component of the Bintuni Bay ecosystem.

The oil and gas sector is relatively unaffected by forestry and fishery development, but the latter two sectors dependent strongly on the operation of the oil and gas sector, particularly for the quality of effluent water. The current regulation for oil concentration in the effluent water is 25 ppm. A more stringent standard should be considered for oil and gas operation in the Bintuni Bay area. Besides, a detail contingency plan for abnormal operation which may cause a major oil spill should be carefully planned. Once a major oil spill occurs during the course of high tide, the spilled oil may be brought to the bay causing considerable damage to the environment. Larger damage may occur following the spills, since cleaning operations in mangroves and mudflats are not possible.

Presently, the Secretariat of the Ministry of State for Population and Environment of Indonesia gives particular attention to the problems of the Bintuni Bay area which aims to achieve an inter-sectoral cooperation in the development program, with a final goal of achieving sustainable development of the area based on maximum sustainable yield of the various sectors of development operating in the Bintuni Bay area.

Acknowledgement

The author wishes to thanks to Conoco Indonesia for the facilities which made it possible for the author and his team to do the study on the environmental impact assessment of the Wiriagar oilfield development in 1986, during which time the author had the opportunity to look at the problem of resource development in Bintuni Bay area. Besides, the author wishes to extend his thanks to the Organizing Committee EMECS '90 who kindly granted travel funds to the author to attend the EMECS '90 conference in Kobe. Special thanks are also addressed to Prof. Dr. Otto Soemarwoto who kindly read the manuscript, to Mr. Asikin Djamali (National Institute for Oceanography) for his kind assistance in providing various data, and to Mr. Yedi Arifin who drew the maps.

References

Brotoisworo, E. and P. Hutomo (1988). Environmental Impact Assessment of the Wiriagar Oilfield Development. In: *Proc. Indonesian Petroleum Association, Seventeenth Annual Convention*, October 1988. Jakarta, Indonesia.

Djamali A., M.K. Moosa; Dwi Hindarti and K. Romimohtarto (1989). Brackish water fond resources. *Seri Sumber Daya Alam, No. 146.* Indonesian Institute of Science. Jakarta. (in Indonesia).

Erftemeijer, P., G.R. Allen and Zuwendra (1989). Preliminary resource inventory of Bintuni bay, Irian Jaya, and recommendations for conservation and management. AWB-PHPA report, No. 8. Bogor, July 1989.

Euroconsult (1984). Nation wide study of coastal and near coastal swamp land. Ministry of Public Works, Jakarta.

Naamin, N. (1984). Population dynamic of Banana Prawns (Penaeus merguensis De Man) in Arafura sea and alternatives for its management. Ph.D. Dissertation at Bogor Agricultural Institute. Bogor, Indonesia. (in Indonesian)

Odum, E.P. (1971). *Fundamentals of Ecology.* W.B. Saunders Co. Philadelphia and London.

Ongkosongo, O.S.R., S. Soewasti, H.H. Amir, N.P. Zamani, and T. Tugaswati, 1990. Coast and Sea. In: *Environmental Quality in Indonesia 1990.* PT. Intermasa, Jakarta. (in Indonesian)

Petocz, R.G. (1987). *Conservation and development in Irian Jaya, a strategy for rational resource utilization.* WWF/IUCN. Gland, Switzerland.

Petromer Trend (1988). Environmental evaluation study of oil and gas exploration and expoitation project of the Petromer Trend's concession area in Sorong district, Irian Jaya. Petromer Trend. Irian Jaya, Indonesia. (in Indonesian).

Fig. 1a. Timber Concession in Bintuni Bay Area Irian Jaya (After Petocz, 1987)

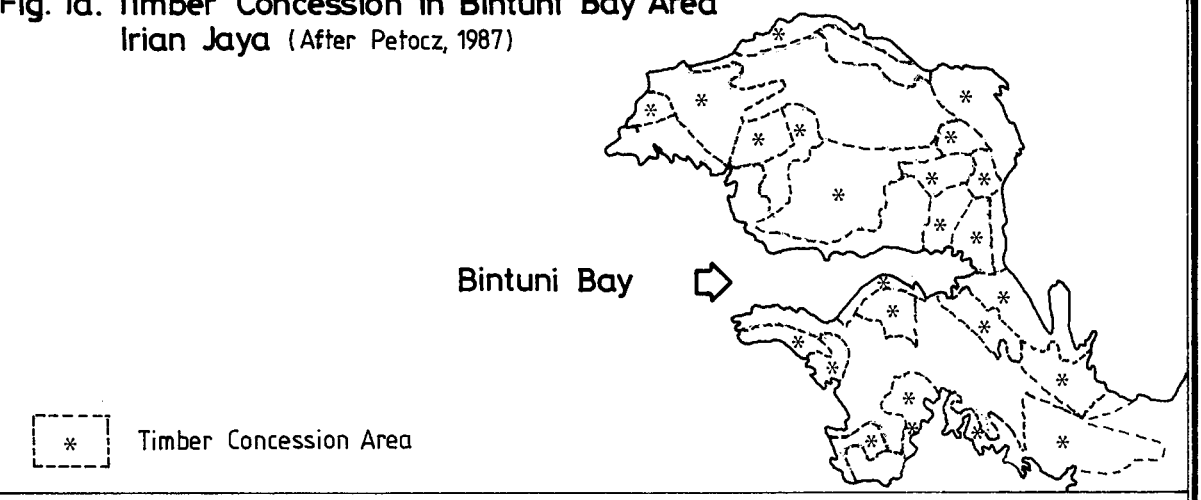

Fig. 1b. Oil and Gas Concession in Bintuni Bay Area, Irian Jaya (After Petocz, 1987)

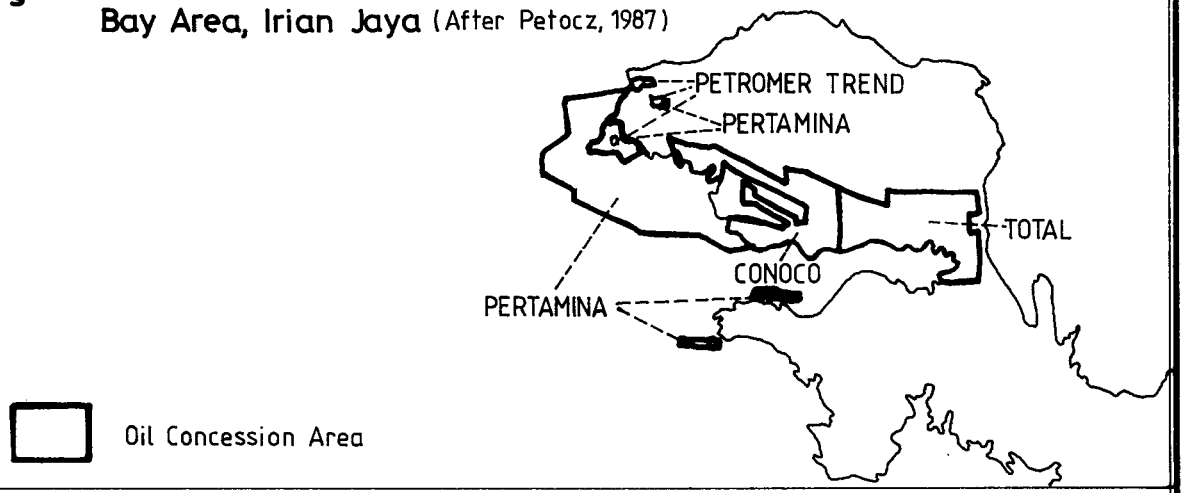

Fig. 1c. Fishery Zone in Bintuni Bay Area Irian Jaya (After Naamin, 1984)