CHAPTER 24

MANAGING THE PORT OF JAKARTA BAY: OVERCOMING THE LEGACY OF 400 YEARS OF ADHOC DEVELOPMENT

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1. INTRODUCTION

In the first comprehensive review of Indonesia's marine resources, Tomascik et al. (1997) noted that… "One of the many challenges facing Indonesia today is the reconciliation of development objectives and conservation aims in the marine and coastal sector". Nowhere are these challenges more evident than in Jakarta Bay. Since the decision by the Dutch East India Company to relocate the capital to Batavia (now Jakarta[1]) in the 1620s, Jakarta Bay (Figure 1) has served as the principal gateway to Indonesia and the lifeline for development of the Jakarta region. It continues play a pre-eminent role in the development western Java.

Over the subsequent 400 years of colonial rule and the nearly 60 years since Indonesia's independence, the bay and watershed have served as the hub for rapid national development. Jakarta is now the primary economic centre in Indonesia. Some 11.5 million people live in greater Jakarta, and an estimated 10 million more live in the exurban and rural watersheds that drain to the bay.

On a global scale, the bay is not a particularly notable harbour due to its shallow depth, lack of clear navigation channels and exposure to prevailing winds during the monsoon season. However, the combination of welcoming local leaders, adequate nearby water supplies and undeveloped land, strategic trade location at the centre of the Indonesian archipelago and ready military defensibility made Jakarta Bay an ideal focus for colonial rule. Jakarta Bay quickly rose to international prominence as a leading harbour in Southeast Asia. This strategic significance was reinforced during the rapid economic growth experienced during the l980s. Double-digit growth in GDP during that decade led to the rapid expansion of port facilities in the

[1] Also known as Djakarta

E. Wolanski (ed.), The Environment in Asia Pacific Harbours, 413–431

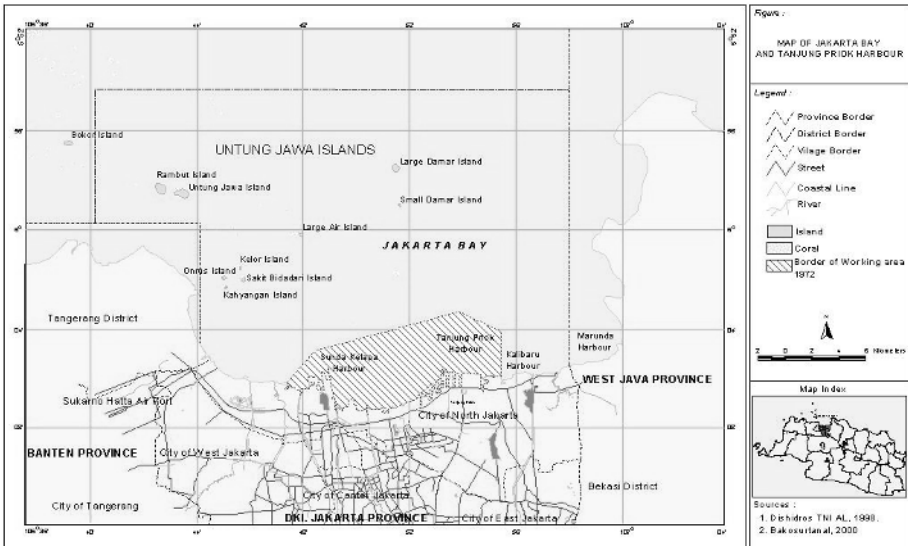

Figure 1. *Map of Jakarta Bay, DKI Jakarta Indonesia.*

suburb area of Tanjung Priok and the reclamation of large areas of the bay foreshore and wetlands to accommodate industrial and urban development.

This development occurred at significant ecological and social cost. Jakarta Bay is perhaps the most polluted harbour in Asia and has very little intact fisheries. What fisheries still exist have a non-original structure and are comprised of more opportunistic species that can exist in the now heavily polluted waters. The combination of inappropriate past development and continuing lack of coordinated bay governance has created a legacy of severe environmental damage – several of the former "thousand islands" that comprised a small archipelago of coral cays in the outer arc of the bay have disappeared due to sand mining and those that remain are among the most threatened coral reefs in Asia.

This chapter traces the development of the bay over the past 50 years and how, through a combination of neglect and ignorance, Indonesian society now faces major challenges to sustain the economic, social and ecological values of the bay. There are growing calls to reduce pollution, protect traditional fishing communities, restore coral reefs and mangrove systems and optimize bay use for industrial, urban, tourism and conservation uses. However, efforts to address bay management on a more integrated and long-term basis are only now emerging and will require a far greater level of political commitment if current degrading influences are to be reversed and an effective and comprehensive management regime introduced.

2. NATIONAL SETTING

2.1. Significance of coastal and marine resources

Coastal and marine resources obviously are of paramount importance in an archipelagic nation like Indonesia where more than 75% of the national area is sea and the 24% that is land is fragmented amongst more than 17,000 islands. The 81,000 kilometre shoreline is the world's second longest after Canada (Tomascik et al., 1997), but is the world's most usable in terms of overall accessibility. The Indonesian archipelago contains some of the world's largest remaining mangrove forests and has the largest area of coral reefs of any country (Hopley and Suharsono, 2000). Indonesia's waters are among the most productive of all tropical seas. They cover the epicenter of global marine biodiversity and provide globally significant corridors for migratory species (Rais et al., 1998; Kahn, 2003).

Coastal and marine industries such as oil and gas production, transportation, fisheries and tourism account for a quarter of Gross Domestic Product and employ more than 15% of Indonesia's workforce. Some 140 million Indonesians live within 60 kilometres of the coast; many of these within the large coastal cities that occupy a predominant position in the national economy (Dahuri and Dutton, 2000).

2.2. Development experience from 1969-1998

During the first 25 year development plan (PJP I – 1969-1993) and related five year development plans (Repelita), national planning policy placed considerable emphasis on terrestrial development, particularly in Java and Sumatra (Sloan and Sughandy, 1994; MOSE, 1996). The first marine protected area (Kepulauan Seribu in Jakarta Bay) was only formally gazetted in 1982 and it was not until the late 1980s that strategic attention was given to management at broader scales (Alder, et al. 1994; Sloan and Sughandy, 1994).

In the initial phase of PJP II (1993-1998), four goals for coastal and marine resources development were established:

- support expanded coastal and marine enterprises throughout Indonesia, especially in Eastern regions
- support offshore industries, especially oil and gas production
- strengthen national sovereignty and jurisdiction by mapping of continental shelves and the EEZ
- establish a coastal and marine geographic information network.

However, achievement of these objectives was limited by the lack of integrated management of coastal and marine areas. Under the "Wawasan Nusantara" (or archipelagic outlook) concept that Indonesia successfully championed in the formulation of the international Law of the Sea, decision-makers argued that all marine areas were deemed to be part of the national estate and thus indivisible for management purposes. Management in this case was interpreted as synonymous with "control", which also conflicted with the Indonesia constitutional view of the sea as common property and therefore equally open to every citizen user. These interpretations result in unclear responsibility for regulating access to marine

resources, for resolving conflicts between uses and for ensuring that marine resources are managed on a sustainable basis. No one agency was specifically responsible for coordinating between sectors or between the different levels of government.

There are some 22 statutes and literally hundreds of regulations and ministerial decrees that relate to coastal resources (Patlis et al., 2003). The consequences of this multiplicity of legislation were increasingly unclear (and often overlapping) jurisdictions and lack of coordinated policies. Through the mid 1990s, there were various efforts to stimulate increased local governance efforts in some provinces (Hunt et al., 1998; Crawford et al., 1998), including a model bay management program initiated in Balikpapan bay in east Kalimantan (Dutton et al., 2000). However, for the most part it was "business as usual" because most capacity building projects came into being through the central government. Local government remained dependent on central agencies to define their agendas.

Sofa (1998) undertook an evaluation of coastal management and related projects between 1987 and 1998. In that study she estimated that some US$ 400 million has been spent on coastal and marine resources management projects (excluding fisheries) during that period. Relatively few of these initiatives continued once direct funding via central government agencies ceased and very few of these projects directly impacted the quality of life of coastal communities or quality of marine ecosystems (Dutton, 2005).

Thus, despite a long history of investment in water resources development and more recently watershed, coastal and marine management programs, integrated management of watersheds with the coastal areas they drain to remain uncommon. Programs that address land-based impacts on marine ecosystems; a threat that Edinger et al. (1999) describe as the most critical facing Indonesia's coastal ecosystems, was non-existent. In greater Jakarta, with its rapid economic expansion and attendant population growth, the impact of this lack of integrated programming has been devastating to the Jakarta Bay ecosystem.

2.3. The reform era (1998 to Present)

In May, 1999, the passage of the landmark National Law No. 22 on Regional Autonomy (UU22/1999), moved responsibility for planning and management to local governments in all but a few keys areas such as religion, national defense, etc. Law No. 22 specifically made provision for Provincial governments to exercise authority over the territorial seas out to 12 nautical miles[2] and for District/City administrations to have authority for the first third of that area (up to a maximum of four nautical miles). Law No. 22 decentralizing management authority was made meaningful by passage of the National Law 25 on Fiscal Equalization (UU 25/1999) that transferred budgeting responsibility primarily to districts and city administrations. Suddenly, decision-making, management responsibility and financial resources was pushed to lower levels of government, closer to the users of coastal and marine resources.

[2] one nautical mile equals 1.9 kilometers

A further boost for the marine sector occurred in October 1999, when then newly elected President Abdurrahman Wahid established a Ministry specifically concerned with the identification and development of marine and coastal resources, particularly fisheries. He appointed a veteran and respected politician to lead the Ministry. This historic decision marked a true watershed in marine resource management and symbolised an increased level of political recognition of the significance of Indonesia's seas.

Improved fisheries and coastal management were two key priorities of the new Minister (Kusumaatmadja, 2000). A comprehensive review of fisheries development policy was quickly undertaken and the subsequent white paper proposed a series of sweeping reforms for fisheries management (PCI, 2001). Those reforms stimulated the Ministry to restructure and improve fisheries management in concert with marine and coastal resources management at large. For example, initial reforms redirected fisheries development policy towards two key objectives (MMAF, 2002)

- utilize fisheries resources to improve the welfare and prosperity for Indonesian people
- conserve resources for sustainable utilization.

Since 2000, the Ministry has been engaged in developing a draft National Coastal Management Act that seeks to empower local governments in implementing integrated land and marine management. This reform has long been proposed (see Rais et al. 1998) and development of the new law has employed an exemplary process of global learning and public engagement in legal drafting (Patlis et al., 2003). Several districts have now enacted regulations relating to integrated coastal management.

Despite these advances, many challenges remain (Dutton, 2005), including:

- a lingering overestimation of, and undue emphasis on, maximum sustainable yield (MSY) as a fisheries management tool;
- ineffective surveillance and regulation of offshore fisheries and illegal long-lining and trawl fishing efforts;
- little understanding of regulations at provincial and local levels and little capacity for implementation;
- inadequate data from which to make management decisions at all scales;
- inadequate integration of land and water management; and
- ongoing lack of inter-departmental coordination on marine conservation and resource management.

3. IAKARTA BAY SETTING AND SIGNIFICANCE

3.1. Overview

Since the earliest day of Dutch colonial settlement, Jakarta Bay has played a critical role as Indonesia's main gateway. The principal port in Jakarta Bay, Tanjung Priok, acts as the direct conduit for goods and services to an estimated 25% of Indonesia's population. Exports and imports through the port represent almost 30% of total

GDP (Batubara, 2005). Jakarta Bay is thus a key engine of national economic development.

Jakarta Bay is bordered by three provincial administrations i.e. DKI Jakarta Province (Indonesia's capital city), Banten Province, and West Java Province – the combined population of these areas is around 35 million and it is estimated that 21 million of these live in watersheds that drain directly to the bay.

3.2. Geography of Jakarta Bay

Geographically Jakarta Bay is located between 106°40'45" - 107 ° 01'19" East longitude and 05°54'40" - 06°00'40" South latitude, and spreads from Tanjung Kait (Banten Province) at the west, to Tanjung Karawang (West Java Province) at the east. Jakarta Bay has an area of 514 km^2. There are 105 small islands in the Jakarta Bay area, known as Kepuluan Seribu (literally Thousand Islands) group. This group of islands recently was set aside as its own regency administration. Although currently still assisted by the DKI Jakarta government, the Thousand Islands Regency is rapidly developing its own governance capacity. Among the most important islands in the Thousand Islands are Nyamuk Besar, Nyamuk Kecil, Damar Besar, Damar Kecil, Anyer Besar, Kelor, Untung Jawa, Rambut, and Ubi Besar islands (UNESCO, 2003).

3.4. Topography and hydrology

The Jakarta Bay coastal area topography is low and flat. In general, the ground surface elevation is less than 5 metres. The shoreline and adjacent sea floor are very much affected by the tides and seasonal flooding, and experience a high level of sedimentation from the big rivers that flow into the Jakarta Bay. The average Jakarta Bay coastline surface slope is less than 2%.

There are thirteen rivers that flow into Jakarta Bay. Some are relatively big rivers such as the Cisadane at the Western part, Citarum and Bekasi at the Eastern part and Ciliwung at the Central part. These rivers have large watershed areas (Indonesian 'daerah aliran sungai) that start from the volcanic mountain ranges south of Jakarta. Several smaller rivers, including Kali Angke, Sungai Grogol, Sungai Mookervart, Kali Krukut, Kali Sunter, Kali Ancol, Sungai Blencong, and Kali Cakung also have large affects on the overall hydrology of Jakarta Bay (Batubara, 2005). All these rivers provide both the initial means of access and transport in the lower floodplain and more recently have become the principal pathways for aquaculture pond development and industrial and urban waste disposal.

3.5. Hydro-oceanographic characteristics of Jakarta Bay

Tides in the bay are diurnal. The surface current in Jakarta Bay is mostly affected by the wind and tides. Basically, the affect of tidal currents is not significant as the maximum spring tide is only 110 cm. During the west monsoon season from November to March, the sea current in north Jakarta Bay flows to the Southeast and

East with the average velocity of 0.4-0.6 m s^{-1} (Figure 2A). In the east monsoon season from May to September the sea water current turns to run generally the opposite way to the northwest, with average velocity at 0.5 m s^{-1} (Figure 2B). Near the shoreline, Jakarta Bay waters reveal a relatively complex pattern as water movement is influence by seashore constructions such as jetties, breakwaters and reclamation areas in the Cengkareng, Muara Karang, Pantai Mutiara, Muara Baru, East Ancol, Tanjung Priok and Muara Cakung drainage areas. The influence of tides is more important, and potentially destructive and dangerous, in areas where interaction with rivers can cause rapid flooding in coastal areas. The current velocity in the internal area of Jakarta Bay ranges between 0.25-0.5 m s^{-1}.

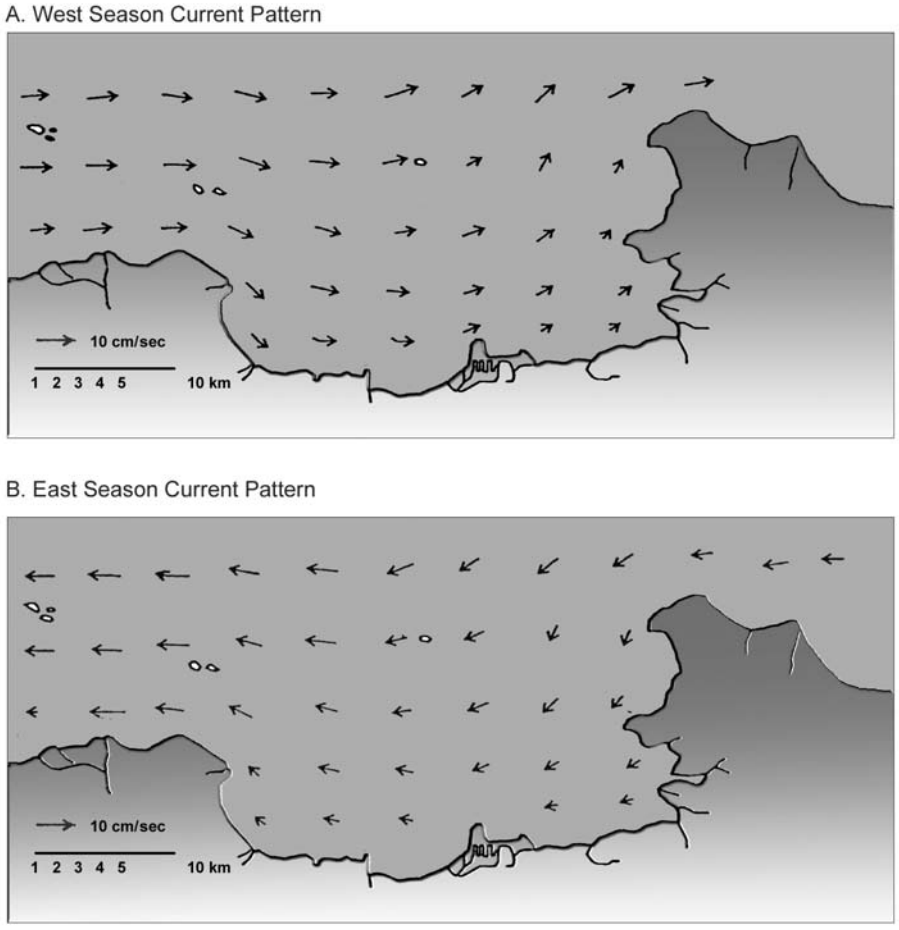

Figure 2. *Jakarta Bay current pattern in the West Season (A) and East Season (B).*

3.6. Water quality of Jakarta Bay

With no effective sewage treatment capacity in any of the large cities in the watershed and largely unregulated industrial waste disposal into rivers directly draining to the bay pollution loads in near shore waters are very high – a Ministry of Environment study of the Jakarta Bay watershed estimated that some 370 kg of mercury enters the bay every hour (MOSE, 1996). The pollution load has increased in line with the increased population in the watershed and largely unregulated industrial development in many urban and suburban areas. Research conducted by Anna (1997) concluded that some specific parameters i.e. COD, phosphate, nitrate, Zn all exceed the regulatory thresholds value.

The sanitation sector is one of the weakest in Indonesia (World Bank, 2004) and nowhere is this more evident than in Jakarta Bay. In Jakarta coverage is negligible with only approximately 2.8% of the population connected to any type of sewerage system and even that infrastructure is of low quality and reliability. Septic tanks are used by about one million people in Jakarta but with a bay watershed population estimated at 21 million, most of which drain household wastes directly into canal and rivers draining to Jakarta Bay, the daily bay waste loading is enormous.

Obviously, port activity at Tanjung Priok also contributes to the decrease of Jakarta Bay water quality. The result of the research carried out by the DKI Jakarta in 1998 at Tanjung Priok Port indicated that Oxygen, Chemical Oxygen Demand (COD), phenol, ammonia, nitrate, sulfide, cadmium, copper, tin, lead and chromium have far exceeded global seawater threshold values for marine biota.

3.7. Ecosystem and natural resources uses of Jakarta Bay

3.7.1. Mangrove ecosystem

Figure 3. *Mangrove ecosystem at Kamal Muara, coast of West Jakarta.*

The Jakarta Bay foreshore and some of the offshore islands still have remnant mangrove ecosystems. The largest and most intact areas are found at Kamal Recreation Forest, Muara Angke Fauna Reservation, Angke Kapuk, Kemayoran Protected Forest and in the Cilincing – Marunda vicinity (DKI Jakarta Forestry Services, 1996) (Figure 3). Within the Kepulauan Seribu Islands group, islands such as such as at Rambut, Bokor, Untung Jawa, Lancang, Lancang Besar, Peteloran Barat, Penjaliran Barat, and Penjaliran Timur have the most intact forests. A study carried out by the DKI Jakarta Forestry Services in year 1999 indicated that mangroves growing in the western part of Jakarta Bay are still in relatively good condition, while in the Cilincing-Marunda vicinity, growth is relatively poor, with large tracts of forest now fragmented.

Mangroves in the Kamal Recreational Forest, Muara Angke Fauna Reservation, and Angke-Kapuk Protected Forest are relatively homogenous and dominated by mangrove of Avicennia spp, while Rhizophora spp is found in relatively smaller numbers and in sporadic growth patterns. Tree vegetation is Avicennia marina, A. officinalis, and A. alba (BAPEDALDA DKI, 2001). The mangrove vegetation at Kepulauan Seribu Islands group has been damaged from abrasion, pollution, solid waste and illegal logging. Mangrove species and areas found in Kepulauan Seribu Islands group are presented in Table 1.

Table 1. *Mangrove vegetation at Seribu islands group reservation area. (Source: BAPEDALDA DKI, 2001).*

No	Location	Area (ha)	Number of Species	Species
1	Fauna Reservation Rambut Island	27.00	9	Rhizophora stylosa, R. mucronata, Sonneratia alba, Bruguiera gymnorrhiza, Avicennia marina, A. alba, Ceriops tagal, Excoecaria agallocha, Xylocarpus granatum
2	Nature Reserve Bokor Island	25.23	2	Rhizophora mucronata, Sonneratia alba
3	Untung Jawa Island	31.00	2	Rhizophora mucronata, Avicennia alba
4	Lancang Besar Island	16.50	3	Rhizophora mucronata, Sonneratia alba, Avicennia marina
5	Nature Reserve Peteloran Barat Island	11.30	3	Rhizophora mucronata, Ceriops tagal, Avicennia marina
6	Nature Reserve Penjaliran Barat Island	8.30	4	Rhizophora stylosa, Ceriops tagal, Sonneratia alba, Avicennia marina
7	Nature Reserve Penjaliran Timur	6.80	4	Rhizophora stylosa, Ceriops tagal, Sonneratia alba, Avicennia marina

3.7.2. Coral reefs

In the "Reefs at Risk" study, Burke et al. (2002) noted that when naturalist J. Umbrove arrived in Jakarta Bay in 1928 he was struck by the beauty of the coral reefs in the bay and yet, even in those days, development impacts in the reefs were already very evident. Today, due to pollution, mining, destructive fishing, shipping, tourism, private residential development, oil and gas development and coral bleaching, average coral cover in the area is just five percent, making these some of the most degraded reefs in Indonesia (Tomascik et al., 1997) (Figure 4). The coral reefs closest to Jakarta are most affected, but over fishing and destructive fishing practices have also devastated the outermost reefs. The El Nino episodes of 1982 and 1998 further stressed the reefs, causing 90-95 percent mortality.

The most rapid decline in reef condition occurred since 1970. UNESCO (2003) notes that on Pari Island and Air Island reefs, where good benchmarks of coral condition existed, coral cover declines from 80% to 15% and from 70% to 30%, respectively, were recorded between 1970 and 1996.

Figure 4. *Coral reef at Pramuka Island, Kepulauan Seribu Islands Group, Jakarta Bay.*

3.7.3. Seagrass Ecosystem

Another key ecosystem found in Jakarta Bay waters is seagrass. Usually this ecosystem is found close to coral reefs and supports the coral reef ecosystem as nursery, feeding and spawning areas for fish species and other marine biota. The most common types of seagrass found in Jakarta Bay comprise Thallasia, Syringodium, Thalasodendrum and Cymodocea genera. There are also various genera of seaweed such as Halimeda, Padina, Caulerpa, Sargassum, Turbinaria and Euchema.

3.7.4. Conservation areas

The Kepulauan Seribu National Park (Thousand Islands National Park) is one of the pioneer conservation areas in Indonesia. In 1931, Bokor Island was declared a wildlife reserve through Letter of Decree No. 6 Year 1931, by the Dutch Indies Governor General. This island was set aside as a botanical sanctuary to protect mangroves (i.e. Rhizophora mucronata and Sonneratia alba), rare birds (e.g. Ducular bicolor, Fregata ariel, and Oriolus chinensis) and the long tailed monkey (Macaca fascicularis).

In 1970, in response to concerns about sand mining, the Governor of Jakarta issued a protection order for coral reefs and some islands in Jakarta Bay that eventually led to the formal declaration of a National Park in 1982. As Alder et al. (1994) note, the subsequent process of establishing a management plan for the park that accommodated the disparate interests of key stakeholders proved a very challenging task. Even today enforcement of park regulations is low and there is clear evidence that the park has not achieved intended conservation objectives. Thus while the park covers some 108,000 hectares, it has almost no areas that are "self-protected" (by access restrictions) or effectively managed (to limit destructive uses), with the exception of small islands and adjacent areas that are under private ownership.

On some of the small islands and foreshore areas where more intensive conservation management has been implemented, results are mixed. For example in the Muara Angke Fauna Reservation, the mangrove ecosystem has degraded into swampy forest with significant canopy cover loss. The fauna reservation was intended to protect the birds that depend on similar species at Rambut Island for feeding grounds. Populations of the long tailed monkey (Macaca fascicularis) in the reservation have now declined to unviable levels due to poaching and urban encroachment.

4. COASTAL AND MARINE BASED ECONOMIC ACTIVITIES OF JAKARTA BAY

4.1. Urban and Industrial Development

Approximately 60% of the bay shoreline has been modified for urban, industrial or infrastructure development, with a further 30% developed for agricultural or aquaculture. In recent years there has also been an extensive reclamation program to create new land for port, urban and recreational (including golf and hotel) facilities.

Some 17,000 people live on the islands within the bay and most of these depend directly on fisheries, tourism and industrial (including shipbuilding and port labor) activities.

4.2. Fisheries Activities

Indonesia's fisheries produced an estimated 4-5 million tonnes per annum, although reliable data are hard to obtain on actual landings and trade. Marine fisheries comprised the majority of total fish production and the major types of fisheries are (in order) purse seine, lift net, trammel net and pole and line tuna fisheries. Some 94% of this estimated production is reported to be captured by small scale fishers (Dutton, 2005). However, because overall catch is significantly under-reported that figure is misleading. There was been a sharp increase in subsistence and export fisheries in most areas as a result of the Asian monetary crisis due to both the high value of capture fisheries and the increased costs of alternative protein sources.

In Jakarta Bay, once strong commercial fisheries are in serious decline (Yowono, 1998), with most fishers struggling to cover fuel, equipment and labor costs. There mainly are two kinds of operations still continuing in the Jakarta Bay capture fishery sector, namely

(1) fixed fishing activity generally is dominated by fish traps (bagans). There are some 850 of these structures in the shallow waters of Jakarta Bay, but less than 30% of these are maintained and used regularly (Figure 5); and,

(2) mobile fishing activity generally dominated by net and fishhook/fishing rod fishing. It is estimated that there are around 2600 fishers in the various Jakarta Bay coastal communities who derive their principal source of income from fishing.

Figure 5. *Fish trap ('bagan') distribution in Jakarta Bay*

Increasing numbers of Jakarta area residents also engage in fishing for occasional subsistence and recreational purposes. This additional activity is more significant than previously thought, with some 2500-5000 fishers engaged in "recreational fishing" activity in the wetlands around Jakarta bay on holidays.

In addition to marine capture fisheries, aquaculture is an increasingly important component of Indonesia's fisheries. The most commonly cultured fish species are the ubiquitous milkfish (73%), tilapia (12%) and mullet (6%). Some 2.05 million fish farmers were employed in 1998, with the majority (65%) in Java.

In the Jakarta Bay area, the estimated 1500 ha of aquaculture ponds are mostly "sour" and unproductive due to mismanagement of ponds, pollution from nearby development, flooding and lack of technical skills (Animation 1). Many ponds, developed during the peak of aquaculture development in the bay area in the 1970s, have now been reclaimed for housing, industrial, leisure (golf course) and infrastructure development (Figure 6).

Animation 1. *Green mussels (Mytilus edulis) raft spreading at Jakarta Bay.*

Figure 7. *Fish pond area at Kamal Muara, coast of West Jakarta.*

5. TANJUNG PRIOK HARBOUR ENVIRONMENTAL SETTING

5.1. Indonesian harbour and navigation characteristics

According to National Law No. 21 of 1992 (UU21/1992) and Government Regulation (PP) No. 69 Year 2001, a harbour is defined as a place that consists of land and surrounding specified border waters, as a place for ships to anchor and harbour, passengers to embark and disembark and/or goods loading and unloading, is equipped with navigation safety facilities and port activities support, and also a place for various intermodal transportation activities. "Harbour affairs" covers everything related to port operational and other activities in the framework of carrying out its function.

Ports are differentiated into two main categories, i.e. public ports and special ports. A public port serves public/community interests while a special port is only to support specific activities. Based on its role and function, ports are further differentiated into five hierarchies: (1) hub international ports are main primary ports, (2) international ports are main secondary ports, (3) national ports are main tertiary Port, (4) regional ports are primary feeder ports, and (5) local ports are secondary feeder ports. Jakarta Bay includes all these types of ports when including the small port facilities on the islands and along the bay coastline.

Navigation is defined as every activity related to navigation including supporting facilities, communication, hydrographic characteristics, channels, ship draft/construction management, salvage and underwater works to secure navigation safety. Government Regulation No. 81, 2000 (PP81/2000) on navigation states that navigation channels, natural or man-made, are defined in terms of depth, width, navigation obstacles and other aspects that define and relate to navigation safety. It further states that to maintain navigation safety, clear safe and secure zones within and in the vicinity of navigation channels need to be established. For Jakarta Bay, navigation requirements are well established and regulations enforced by the Indonesia Navy, as well as other sector specific enforcement authority such as the Ministry of Marine Affairs and Fisheries patrol boats.

5.2. Harbour hydro-oceanographic factors

As described above, wind is one of the hydro-oceanographic factors that influence port activities in Jakarta Bay. Besides as a wave stimulant, wind plays an important role in dispersal of pollutant and waste loading in the bay. Current is also a hydro-oceanographic factor that influences port water quality conditions. Waters depth is also an important factor affecting Jakarta Bay water quality. The overall depth of Jakarta Bay is shallow and combined with the rather slow speed of currents, and the often prevailing landward wind direction, sediment deposition is high.

5.2.1. Harbour development needs

At present Tanjung Priok Port has an area of 1028 ha consisting of 424 ha of deep-water harbour or waters that is bordered by breakwaters and 604 ha of land. (Figure 1). Tanjung Priok deep-water harbours are divided into five (5) navigation channels and seven (7) harbour basins of 9,507m breakwater. Tanjung Priok Port has 10,597m wharf facility with seventy (70) berths for various ship tonnage and draft. In addition, there are other available facilities such as 45 warehouses, open piling areas, stock tanks and container areas.

The number of ships calling at Tanjung Priok Port has increased from year to year. Calls reached 17,086 in 2001 or an average of 47 calls per day, an increase of 41% compared to ship calls in 1991. The tonnage of ships tends to be bigger, as well. In 1991, average ship tonnage was 3,487 GRT. In 2001, average ship tonnage was 5,226 GRT showing an average increase of 1.5 % over the preceding ten year period. The loading and unloading activities at Tanjung Priok Port showed a corresponding increase, with the yearly loading and unloading average increases at 8.7% for general cargo, 2.2 % bag cargo, 2.6 liquid bag cargo, 7.9 % dry bulk cargo and 11.9 % for containers (Batubara, 2005).

Capacity estimates indicate that Tanjung Priok Port can serve cargo ships at the maximum rate of 16,000 – 16,500 calls per year, or at the average of 45.2 ships per day – a level already exceeded. To mitigate and manage expected continuing increases in ship calls, and the resultant impacts on Jakarta Bay, expansion and improvement of Tanjung Priok Port will be compulsory. The present channel and harbour basins are very narrow and can only serve one-way traffic with limited area within the turning basins. This is already restricting ship calls due to safety concerns. To increase the capacity and efficiency of the port, and increase safety two-way channel traffic must be developed.

5.2.2. Environmental impact of harbour development

There are significant conflicts in bay utilization between port and fishery activities. In general, environmental impacts from Tanjung Priok port falls largely on fisheries and conservation areas through increased water pollution. Port and navigation activities negative impact fisheries through pollution from ships liquid waste such as ballast discharges, fuel and petroleum product spills, and other waste discharges. The range of discharges affecting Jakarta Bay includes ship movement and resulting turbidity increases, liquid waste such as wastewater such as ballast water, fuel spills, accidents related to transportation and storage of fuels and oils, solid waste produced during ship loading and unloading, and other storage and transportation activities. Additional impacts come from ship building, repair and maintenance activities and dredging and dumping of dredged material.

This range of impacts has resulted in decreased overall fish stock because of damage to spawning and nursery grounds, and loss or damage to mangrove, coral reef, and sea grass ecosystems. Pollution and contamination of habitat has led to replacement of original species with species able to withstand more polluted habitats. In addition, financial losses are significant as a result of decreased quality

and aesthetic values in recreational areas and water sports such as scuba diving and swimming. Particularly worrying are potential health impacts to populations relying on fish caught in Jakarta Bay, although little research has been done in this area.

Table 2. *Port and other activities interaction. (Source: Batubara, 2005)*

Activity Component	Description	Impact on the Navigation Activity	Sensitivity towards Navigation activity
Cultivation	Fish and green mussel culture, catching green mussel fingerling, rearing and harvesting.	The presence of raft disturbs the navigation channel and harboring area.	Sensitive toward pollution due to the port and ship activities.
Catching	Set catching device and catch fish within a certain cycle	This activity could prevent the ship's movement, while catching device such as net and long line could endanger a ship's safety	Navigation activity could damage the fishing gear.
Fishery Harbour	In and out of fishery vessels to the fishery harbour.	Fishing vessels increase the crowded traffic	This activity is not sensitive towards Port activities
Tourism	Tourism object could be waters of natural resource with aesthetics value.	There is no impact towards port activities	Sensitive to pollution due to the port and ship activities
Conservation Area	Natural Conservation such as natural reservation, national park, protected area etc.	Have no impact on the port and navigation activity	Sensitive to pollution due the port and ship activity

5.2.3. Environment Management Implication of harbour development

Given the impending need to upgrade Tanjung Priok Port navigation channels, turning basins and harbour facilities, there is an opportunity to minimize environmental impacts while securing optimal harbour functions. Management implications for Tanjung Priok Port development can be differentiated into three categories: (1) adjusted management of port activities, (2) management related to legal requirements, and (3) management related to spatial utilization conflicts.

Adjusted management of port activities

Socialize new management regimes among stakeholders utilizing the port and Jakarta Bay to modern management principles and establish Jakarta Bay as a Port Activities Zone governed by minimal performance standards.

Control ship activities in areas that provide maximum security, safety and protection against environment pollution.

Maintain navigation channels, turning basins and harbour waters using environmentally based systems to maintain bay functions, including dredging and disposal of dredged materials in environmentally safe disposal. Prevent pollution from ship waste through establishment of appropriate regulations and an effective monitoring and control program. Establish and require use of solid and liquid waste reception facilities for port calls.

Improved management of legal aspects
Declare within Jakarta Bay a new Tanjung Priok Port Working Area (DLKR) and Jakarta Bay Environmental Necessity Area (DLKP) to establish clear guidelines for activities in various areas within the port, i.e., permit only designated activities in specific use areas. Implement existing laws and regulations governing discharges to river systems by industries and municipalities.

Resolve conflicts through improved marine and land spatial zoning
Allow fishing in DLKP using only mobile fishing gear and zone the bay to establish an appropriate spatial balance of protection and use areas Allow use of fish traps only outside of DLKR. Work with private landowners and the tourism sector to better define property rights, obligations and opportunities for co-management of areas to be protected. Work with provincial and municipal administrations within the Jakarta Bay watershed to develop integrated coastal and marine management plans that reduce pollutant loads entering Jakarta Bay and establish a more coordinated framework for bay management.

6. CONCLUSION

Recognition of the need for better management of the economic, social and ecological assets of Jakarta Bay, and for improved integration of management of land and water generally, is increasing amongst resource users and resource managers. On February 3, 2000, at the first seminar on integrated management of Jakarta Bay, the Governor of Jakarta acknowledged that the traditional sectoral approach to management of the city and Jakarta Bay was the root cause of such diverse problems as flooding, pollution, poverty and health problems, and natural resource depletion.

Surprisingly, it was in the Segara-Anakan region (of south Java) that integrated watershed and coastal area management was first pioneered in Southeast Asia. However, those efforts were mostly academic and until recent efforts in the Balikpapan Bay area of East Kalimantan there have been few working models of effective integration of bay and watershed management (Proyek Pesisir Kalimantan Timur, 2002).

The lack of an integrated approach to pollution management has had profound, but inadequately documented, effects on the health of coastal communities and ecosystems in the Jakarta Bay area and has resulted in significant economic disruption and inefficiency. The net economic loss to Indonesia from the types of

coral reef degradation that has occurred in Jakarta Bay amounts to a staggering $30 billion over the next 25 years (Cesar et al., 1997). If one extrapolates the total amount of restoration and rehabilitation needed to recreate healthy and functional ecosystems in Jakarta Bay, and the costs of protecting human health from the impacts of current and future pollution, that figure may well under represent the true cost to the country of the legacy of past inappropriate development.

All stakeholders in Jakarta Bay managers urgently need to review how the bay is valued and used. A fundamentally new approach to bay management is needed. Central to that approach are three governance requirements:

(1) Establish a long-term plan for bay and port development that identifies optimal areas for port and transport facilities, as well as other land and sea uses, and that protects key areas that need to remain off limits to development in order to sustain natural systems and ecosystem processes that a healthy bay requires;

(2) Establish a financial management system that enables a "user pays" system to generate appropriate levels of funding for Jakarta Bay management. Currently, most users of Jakarta Bay resources pay only a modest proportion of total costs of operations and there is no "operational fund" for bay management; and

(3) Establish a seamless intersectoral and hierarchical structure for bay governance that involves all levels of government. Given the importance of the bay to the national economy, we recommend the establishment of an independent port and bay management authority including representatives of government, industry and the community comprising an executive body and reporting directly to the President.

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8. REFERENCES

Alder, J., Sloan, N.A., Uktolseya, H., 1994. A comparison of management planning and implementation in three Indonesian marine protected areas, Ocean and Coastal Management 24, 179-198.

Anna, S., 2003. Model Embedded dinamik ekonomi interaksi perikanan-pencemaran. Disertasi. Sekolah Pascasarjana IPB, Bogor.

BAPEDALDA DKI, 2001. Pengelolaan laut lestari: pendataan dan pemetaan potensi sumberdaya alam kepulauan Seribu dan pesisir Teluk Jakarta. BAPEDALDA, Jakarta. In Indonesian.

Batubara, E., 2005. Penetapan dan pengelolaan alur pelayaran dan perairan pelabuhan (studi kasus Teluk Jakarta). Tesis. Sekolah Pascasarjana IPB, Bogor. In Indonesian.

Burke, L., Selig, E., Spalding, M., 2002. Reefs at Risk in Southeast Asia, WRI, UNEP, WCMC, ICLARM, ICRAN, Washington DC.

Cesar, H., Lundin, C.G., Bettencourt, S., Dixon, J., 1997. Indonesian coral reefs – an economic analysis of a precious but threatened resource. Ambio 26, 345-350.

Dahuri, R., Dutton, I.M., 2000. Integrated coastal and marine management enters a new era in Indonesia. Integrated Coastal Zone Management 1, 11-16.

Dutton, I.M., Tilley, S., Malik, R., 2000. Towards integrated watershed and coastal management in Indonesia. InterCoast 36, 10-11.

Dutton, I.M., 2005. If only fish could vote: the enduring challenges of coastal and marine resources management in post-reformasi Indonesia. In Resosudarmo, B. (ed.), The Politics and Economics of Indonesia's Natural Resources. ISEAS, Singapore, pp. 162-178.

Edinger, E.N., Jompa, J., Limmon, G.V., Widjatmoko, W., 1999. Reef degradation, coral biodiversity and reef management in Indonesia. Pesisir dan Lautan 2, 17-28.

GIBB, 2000. Ports and harbours environmental integration manual. http://www.gibbltd.com

Hopley, D., Suharsono, M., 2000. The status and management of coral reefs in Eastern Indonesia. David and Lucille Packard Foundation, U.S.A. Australian Institute of Marine Science, Townsville, Queensland, Australia (ID 2989).

Kahn, B., 2003. Conservation, socio-economic and policy benefits of Indonesia's protected marine mammal fisheries area (PMMFA) – A national conservation and management initiative for Indonesia's marine mammals. The Nature Conservancy, Jakarta.

Kusumaatmadja, S., 2000. Coastal and marine management enters a new era in Indonesia. Presentation by the Honorable Indonesian Minister of Marine Exploration and Fisheries, September 14, 2000, Hart Senate Building, Washington, D.C.

Lewis, E. V., O'Brien, R., 1983. Kapal. PT. Tira Pustaka, Jakarta

MMAF, 2002. Pedoman umum pengelolaan pesisir terpadu Kep.10/Men/2002 (General Guidelines for Integrated Coastal Management), Directorate General for Coasts and Small Islands, Ministry of Marine Affairs and Fisheries, Jakarta.

MOSE (State Ministry for Environment), 1996. Indonesia's marine environment: A summary of policies, strategies, actions and issues. State Ministry for Environment. Jakarta.

Pacific Consultants International (PCI), 2001. Study on fisheries development policy formulation. Directorate General of Capture Fisheries, Ministry of Marine Affairs and Fisheries, Jakarta.

Patlis, J., Knight, M., Silalahi, D., Ginting, S.P., Siahaan, W., Hendrarsa, G., Wiyana, A., 2003. The process of developing coastal resource management laws. In Knight, M., Tighe, S. (eds.), Coastal legal reform series. Coastal Resources Center, University of Rhode Island.

Proyek Pesisir Kalimantan Timur, 2002. Rencana strategis pengelolaan terpadu Teluk Balikpapan. Kerjasama Pemerintah Propinsi Kalimantan Timur, Pemerintah Kota Balikpapan, Pemerintah Kabupaten Pasir, Pemerintah Kabupaten Penajam Paser Utara dengan Proyek Pesisir Kalimantan Timur, Indonesia. In Indonesian.

Rais, J., Dutton, I.M., Plouffe, J., Pantimena, L., Dahuri, R. (eds.), 1998. Proceedings international symposium on integrated coastal and marine resources management, Malang, 25-27 November, 1997. Proyek Pesisir, BAKOSURTANAL and ITN Malang, E. Java.

Sloan, N.A., Sughandy, A., 1994. An overview of Indonesian coastal environmental management. Coastal Management 22, 215-233.

Sofa, F., 1998. Coastal management projects in Indonesia 1987-1998. Proyek Pesisir Working Paper, Coastal Resources Center, University of Rhode Island, Jakarta.

Tomascik, T., Mah, A.J., Nontji, A., Moosa, M.K., 1997. The ecology of the Indonesian seas. Parts One and Two. EMDI and Periplus, Singapore.

UNCTAD, 2000. Port development: a handbook for planner in developing countries. Geneva, Switzerland.

UNESCO, 2003. Biophysical assessment of the Jakarta Bay and Seribu Islands. Environment and Development in Coastal Regions and Small Islands Program, *http://www.unesco.org/csi/pub/papers/mega8.htm*

World Bank, 2004. Indonesia-Averting an Infrastructure Crisis: A Framework for Policy and Action. The World Bank Indonesia Infrastructure Department - East Asia and Pacific Region.

Yowono, F.D.H., 1998. Community-based fishery management. In Bengen, D. (ed.), Proceedings First National Coastal Conference, 19-20 March 1998, Institut Pertanian Bogor (IPB), Bogor, C68-C85.