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Environmental Contamination and Toxicology

Mercury Content in the Water and Marine Organisms in Angke Estuary, Jakarta Bay

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The first experience with methyl-mercury poisoning caused by man-made pollution was Minamata disease. In the area of Minamata,Japan, more than 100 persons were killed or disabled as a result of eating fish and shellfish contaminated by methyl-mercury between period 1953-1960 (Irukayama 1966 in Bryan 1976). In regard to this disaster, the mercury pollution has also been reported occuring in several countries, e.g. Venezuela in 1974 (Harada et al., 1980) Iraq in 1971 (Bakir et al., 1973); Canada in 1975 (Harada et al 1977); Sweden, United States and some European countries (Harris , 1971 in Bryan 1976). Therefore, the methyl-mercury poisoning is still a serious worldwide problem.

The methyl-mercury pollution in the marine as well as in estuarine or brackish water environment usually due to industrial waste. In some locations of the Jakarta Bay, the mercury content in sea water was in the range 2.8 to 35.2 ppb and tends to be increase with the rapidly industrial growth in the Jakarta (Yatim et al., 1979).These values was higher than the normal level of mercury in sea water which usually not more than 0.15 ppb (Waldichuk 1974). The Angke Estuary is one of the fishing area especially for the Jakarta Brackish water culture. This estuary received many industrial wastes from the Jakarta city and their neighbouring areas, of which it can be assumed that those estuary has been contaminated by methyl -mercury. In the present paper I report the result of observation of mercury content in the river water, sea water and marine organisms in Angke Estuary, Jakarta Bay.

MATERIALS AND METHODS

Water samples were collected in October 1980 and February 1981 from 3 locations in estuary and 1 location in the river (Fig.1).All samples stored in the polyethylene bottle and acidified with concentrated nitric acid to pH $\leq$ 2. Phyto and Zooplankton were collected by Kitahara net (80 um for phyto and 300 um for zooplankton).

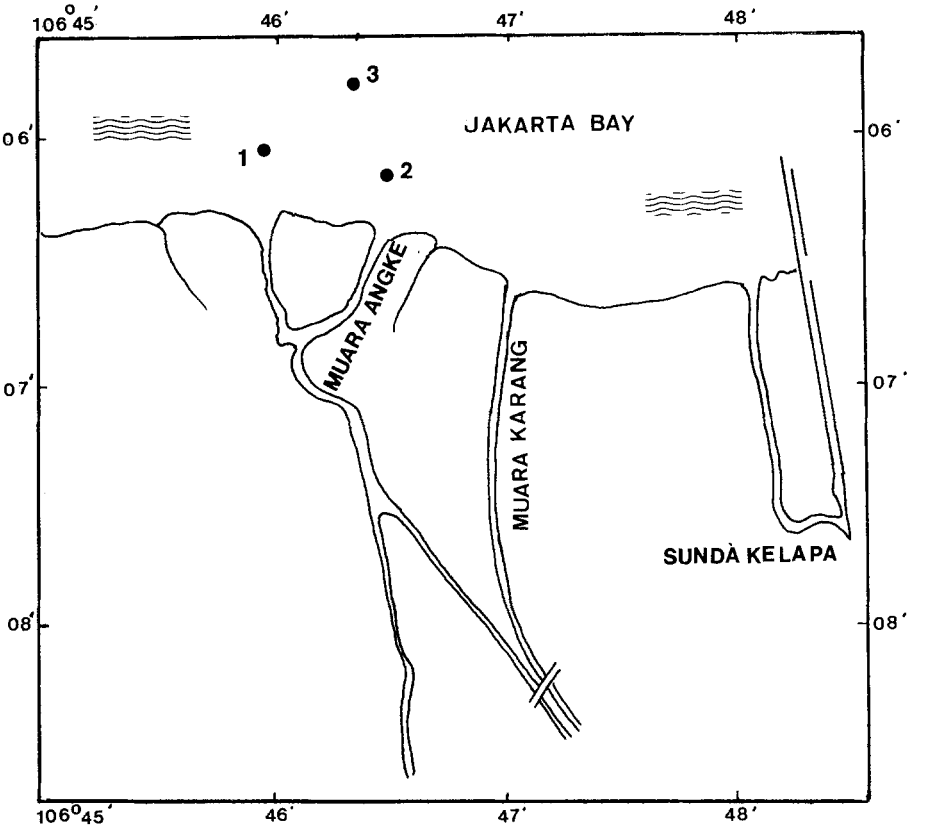

Figure 1. Location of the sampling stations.

Fishes and shellfish were purchased from the fishermen directly in the field. The specimens were then packed in polyethylene bags and brought in directly to the laboratory for analysis. The sample of sea water and marine organisms from Cengkok Estuary, Banten Bay, lies about 90 km on Western Jakarta were collected as a control, due to no industrial disposal found in the Cengkok River.

Homogenated composite sample of fish meat were wet digested in concentrated sulfuric-nitric acid (4+1) (Hatch and Ott 1968). Mercury ions in the water and marine organisms samples were then reduced to elemental mercury (Hg^0) with stannous chloride solution. Total mercury content in all samples determined by Flameless Atomic Absorption Spectrophotometer. Mercury content in water are expressed as mg/l, while in marine organisms as ug/g wet weight.

RESULTS AND DISCUSSION

The analysis of mercury content in the river water (S=0‰), sea water and marine organisms are presented in Table 1. It was found that the concentration of mercury in the sea water ranged between

Table 1. Mercury content in the water (mg/l) and marine organisms (ug/g on wet weight basis) in Angke Estuary.

Sample	October 1980	February 1981
River water	0.023	0.027
Sea water	0.010	0.016
Phytoplankton	0.180	0.200
Zooplankton	0.300	0.380
Arius sp.	1.020	1.055
Anadara granosa	1.200	1.288
Eleuteronema tetradactylum	0.800	0.920
Arius utik	1.180	1.080
Mugil cephalus	0.510	0.600
Johnius dussumieri	0.483	0.660
Penaeus sp.	0.880	--

0.007-0.018 ppm ($\bar{X}$ = 0.013 ppm). These values are higher than the standard maximum of mercury concentration in sea water for fisheries which proposed by the Indonesian Government i.e. 0.006 ppm (LON-LIPI and Kantor Meneg KLH 1984). This concentration is higher than that found in Cengkok Estuary at Banten Bay. It is also higher compared to those of the other localities such as Cirebon (West Java), Cilacap (central Java) and Surabaya (East Java). All of those areas often have concentration of Hg below the instrumental detection limit (0.002 ppm).

Gardner (1978) reported that mercury concentration in the fish was seen to be correlated with mercury concentration in the water. It was also occurs in the Angke Estuary. The analyzed of mercury content in the marine organisms are higher than that in ambient water. It is clear that the mercury has been accumulated by marine organisms. Based on the analysis of seven commercial marine organisms collected from Angke Estuary, it was shown that the highest concentration of mercury found in bivalve mollusc i.e. *Anadara granosa* (Fig.2). High mercury content in the *Anadara granosa* is considered to be due to their large consumption of phytoplankton. This result indicate that the *Anadara granosa* has more ability than those of the other species to accumulate mercury. In Derwnt Estuary, New Zealand, Eustace (1974) reported that the highest concentration of mercury are also found in bivalve molluscs which has same feeding habits with *Anadara granosa* as a filter feeder.

From a hygienic point of view, all of the commercial fishes analyzed showed higher mercury level than the limit permitted by W.H.O.

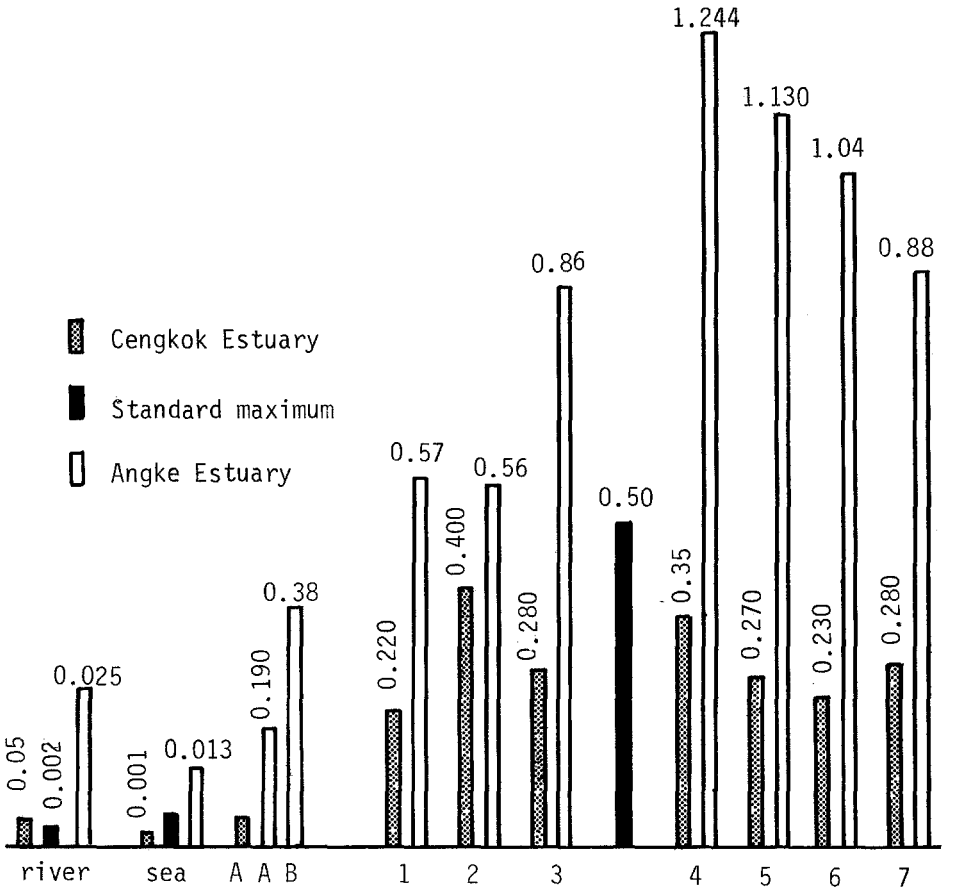

Figure 2. The mercury concentration (ppm) in the river water, sea water and marine organisms in Angke and Cengkok Estuaries.

1. Johnius dussumieri 2.Mugil cephalus 3.Eleuteronema tetradactylum 4.Anadara granosa 5.Arius utik 6.Arius sp. 7.Penaeus sp.

for human consumption i.e. 0.5 ppm. People accumulate mercury in their bodies mainly by absorption of mercury from their diets, especially from fish (Airey 1983). Ohno et al., (1984) found that the mercury content of head hair from resident on the coast of Jakarta Bay are significantly exceeded from those reported in Switzerland and Scotland. It was may be due to the absorption of mercury by the resident on the coast of Jakarta Bay from fishes which contain high concentration of mercury. FAO/WHO also decided that the Acceptable Dayli Intake of mercury was 30 ug per 70 kg body weight (Broek et al., 1981), of which in order to protect the healthy of human from the Minamata disease, the amount of fish consumed must be reduced. For example, Arius utik from Angke Estuary Jakarta Bay should not be consumed more than 26.5 g per day per 70 kg body weight (calculated from 30 ug divided by the mercury concentration in Arius utik i.e. 1.13 ppm.

The concentration of mercury in the Angke River ranged between 0.023-0.027 ppm ($\bar{X}$= 0.025 ppm). It was higher than the standard maximum of mercury concentration in river water for fisheries which proposed by Indonesian Government i.e. 0.002 ppm (Kantor Meneg KLH, 1981). These mercury level are very harmful for the organisms living in the river. The mercury content in the Angke River is much higher compared to that of Cengkok River at Banten and those of the other rivers in Central and East Java. This result indicate that the mercury wastes enter to the Angke River is very high quantity. There are 2000 industries were found in Jakarta and their adjacent area, and neglect the waste pretreatment process. The Indonesian Government decided that the maximum level of mercury for industrial waste-water is 0.1 ppm. In fact the analysis of the waste-water taken from the six battery industries shown that 30% of their disposed waste contain of mercury more than 0.1 ppm (Kantor Meneg KLH 1981). The industrial contribution to the increasing of mercury content in the Angke River still in the progress of evolution. Moreover, Hutagalung and Razak (1982) reported that the first contamination of Pb and Cd in the Angke River also attributed the industrial wastes. The mercury content in the Angke Estuary is less than found in Angke River, due to the dilution effect of sea water. It means that the high mercury content in the Angke Estuary is originally brought in from the land by the river.

In Figure 2, it can be seen that the mercury content in all samples taken from Angke Estuary, Jakarta Bay, were higher than those found in Cengkok Estuary at Banten, West Java. The increasing of mercury content in the sea water as well as in the marine organisms in Angke Estuary was attributed to the high concentration of mercury in the river water. Based on the above discussion it can be concluded that the Angke Estuary has been contaminated by mercury and not recommended for mariculture area.

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