HEALTH ASPECTS OF MANGROVE ECOSYSTEM
WITH REFERENCE TO MALARIA

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ABSTRACT

In Indonesia, most of the malaria outbreaks reported in the coastal regions were transmitted by *Anopheles sparkesi*. This species of mosquito breeds in lagoons, man-made brackish water ponds formed due to uncontrolled mangrove deforestation or in not-well-maintained brackish fish ponds.

A new perspective in management of the mangrove ecosystem as creating a mangrove green belt of 4-5 km distance from human settlement, is essential to minimize man-mosquito contact.

INTRODUCTION

Malaria is still one of the most important parasitic diseases in Indonesia. Before control programmes have been initiated there were 30 million malaria cases with 280,000 deaths every year (A'wati, 1980). Control programmes started in 1959, and since then, fatality cases were significantly reduced except in some sudden outbreaks in hypo-endemic areas where the mortality rates could reach more than 2% of the total population.

Control of malaria, such as drug treatment, surveillance, vector control are more intense in Java and Bali compared to the other islands. In these two islands the annual parasite rate per 1000 people in 1979 have been suppressed to less than 1% (Adnyatma, 1980). Despite these, there are still sporadic outbreak in Java, and in some coastal and island areas high case incidence occur.

In the coastal areas of many islands in Indonesia, including Java and Bali, *Anopheles sparkesi* is known to be the main malaria vector. It breeds in lagoons and brackish water ponds, especially during the dry season. These suitable breeding sites are usually situated on sand banks created by the action of waves and/or high tides (Bundara-Raman, et al., 1997). In some of the coastal areas, artificially created brackish fish ponds are abound in which *A. sparkesi* and *A. subjicitus* breed there.
Illegal cutting of the mangrove forest and uncontrolled establishment of brackish fish ponds along the coastal regions have not only caused considerable damage to the mangrove ecosystem but also created suitable man-made habitats for An. sundaisicus, the most important malaria vector in the coastal areas.

MANGROVE AND THE MALARIAN VECTOR

In the mangrove ecosystem, various genera of non and malaria vectors mosquitoes are found, due to provision of some suitable microhabitats for the mosquitoes to breed (Cruz, 1979). Anopheles sundaisicus larvae are found in the brackish water with salinity between 0.5%-5.0%. They need surface vegetation and direct sunlight. In the delta mangrove forest with less penetration of sunlight An. sundaisicus larvae is hard to be found (Swelingrebel & Swellingrebel de Graaf, 1919).

Anopheles sundaisicus has high preference for human blood (Walsh, 1922), up to 80%. The flight range is between 0.4 km to 4-5 km (Salim, 1986) but van Breemen (1980) found them as far as 6 km. The population density of this species reached the peak in June or July in an area of brackish water fish ponds near Tanjung Priok, Jakarta (Zin, 1939) and in May in the northern coastal area of Bali (Goerino, et al., 1981).

MALARIAN TRANSMISSION BEKASI AN. SUNDAINCUS

In conformity with An. sundaisicus distribution along the coastal region most of the malaria outbreaks reported in the coastal region were transmitted by this species of mosquito. Mangrove forest cutting for post development usually caused malaria outbreaks, e.g. in Teluk Betung in 1918 and in Banten and 1921, Sumatra (Heyden, 1918; Schuffner & Hjikom, 1922). Deforestation of mangrove to establish human settlements also resulted in malaria outbreaks, such as in Jakarta of 1919 (Breeman, 1919), Borneo. West Sumatera in 1921 (Schuffner & Hjikom, 1922). Malaria outbreaks also occur after cutting of mangrove forest to establish fish ponds. In 1939 malaria incidence were very high near the new brackish fish ponds in Jakarta (Zin, 1939).

Anopheles sundaisicus is an indoor biter and is more anthropophilic. Thus, a titter increase of the population of this vector would support a malaria outbreak because of their indoor habits resulting to majority of human population in the area could expose to their bites.
A CASE STUDY OF MALARIA PROBLEM IN MANGROVE FOREST OF CILACAP, CENTRAL JAVA

One of the most malarious area near the mangrove forest is Cilacap situated in the southern part of Central Java, which has been reported as a malaria focus since 1952 (Kliwet, 1952). In 1984, extensive malaria outbreak occurred which resulted with many fatality cases.

Segara Anakan in Cilacap is known as a malaria endemic focus since a long time ago. The recent severe malaria outbreaks in 1984 and in 1985 further confirmed that Segara Anakan is a hyper-endemic malarious area, with An. bancanus as vector (Kornwardjo & Gamaio, 1985). Malaria cases occurred in three villages around the area throughout the year in 1984 and up to August in 1985 and reached a peak in November 1984 (Table 1).

This situation causes panic among the government official as well as the community, and control measures were initiated i.e. mass drug treatment, vector control and intensive surveillance. After control measures taken malaria cases subsided in December 1984, but slide positive rate (SPR) rose again to 53.3% in these three villages in January 1985.

Follow-up control measures were made and SPR dropped to 2.5% in Ujungalang, 0.3% in Ujungpaku, and 0% in Panikel. Ideally, SPR should be suppressed to at least less than 1% in these affected villages to prevent malaria transmission among the people. This target probably could be achieved if environmental development to reduce the suitable mosquito breeding places in the mangrove forest is carried out and follow-up with a good management of the malaria cases.

The malaria outbreaks in Cilacap were the results of uncontrolled deforestation of mangrove forest used for various amenities for development of the villages. To protect some of these villages from being flooded by high tide, soils or earth were excavated to elevate higher ground of the houses, resulting in many man-made pools. These pools are always filled with palm water after a high tide. In addition, broadish fish ponds are common, and most or all are not properly maintained. Algæ are blooming in all these pools which form a very suitable micro-habitat for An. bancanus breeding environment.

To control An. bancanus in Cilacap is rather difficult because this species has been resistant to DDT (Kornwardjo, 1985). To overcome the problem, the government has initiated Fenitrothion spraying which is very effective. Due to numerous suitable man-made habitats of An. bancanus distributed through-
hout a vast area, however effective the insecticide may be, it will still not be possible to control infestation of this mosquito in the area. To effectively control the malaria vector, apart from selective effective insecticide, it should also be supported by proper management of the mosquito ecosystem. Thus, the role of mosquito control is very important to prevent malaria outbreak especially along the coastal regions of Indonesia.

**TABLE 1 MALARIA SLIDE POSITIVE RATE (S P R) IN THE VILLAGES OF SEGARA AMARAN, CILACAP (1984/1985)**

<table>
<thead>
<tr>
<th>NO</th>
<th>UJUNJALANG</th>
<th>UJUNUGAHS</th>
<th>PANTEL</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BS</td>
<td>POS</td>
<td>BS</td>
<td>POS</td>
</tr>
<tr>
<td>Jan. 1984</td>
<td>114</td>
<td>19</td>
<td>85</td>
<td>9</td>
</tr>
<tr>
<td>Feb.</td>
<td>315</td>
<td>16</td>
<td>57</td>
<td>11</td>
</tr>
<tr>
<td>Mar.</td>
<td>299</td>
<td>8</td>
<td>105</td>
<td>1</td>
</tr>
<tr>
<td>Apr.</td>
<td>186</td>
<td>5</td>
<td>23</td>
<td>3</td>
</tr>
<tr>
<td>May</td>
<td>135</td>
<td>6</td>
<td>135</td>
<td>3</td>
</tr>
<tr>
<td>Jun.</td>
<td>96</td>
<td>5</td>
<td>42</td>
<td>1</td>
</tr>
<tr>
<td>Jul.</td>
<td>220</td>
<td>10</td>
<td>32</td>
<td>2</td>
</tr>
<tr>
<td>Aug.</td>
<td>218</td>
<td>9</td>
<td>44</td>
<td>2</td>
</tr>
<tr>
<td>Sep.</td>
<td>1150</td>
<td>281</td>
<td>5118</td>
<td>53</td>
</tr>
<tr>
<td>Oct.</td>
<td>487</td>
<td>77</td>
<td>2713</td>
<td>113</td>
</tr>
<tr>
<td>Nov.</td>
<td>2337</td>
<td>427</td>
<td>6926</td>
<td>259</td>
</tr>
</tbody>
</table>

**THE ROLE OF MANrove看电视 TO PREVENT MALARIA OUTBREAK**

To support development, new prospective in management of the mangrove ecosystem is essential to minimize man-mosquito contact. In the malarious area of Cilacap, based on the flight range (0.5 - 4.5 km) of the vector mosquito, disease transmission among the

![Image](5x499 to 513x1218)
villagers may be avoided if a mangrove grove of 4 - 5 km distance is created between human settlement and the mangrove forest in addition to better management of the man-made fish ponds in the area.

The initiation of such a management scheme, in implemented, would not only retained the conservation of the mangrove ecosystem, but it will at the same time, provides a cleaner, better health environment of the human settlement in the area, and in turn promotes higher manpower productivity resources that would reflect on a better health and social-economic status of the environment.