

# Mosquito Borne Diseases in Ambon Municipality

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## Abstract

Mosquitoes are very dominant vectors of common diseases in tropical region including Ambon Municipality, Indonesia. Three genera of mosquitoes namely *Anopheles*, *Aedes*, and *Culex* transmitted malaria, dengue fever, and lymphatic filariasis, respectively. Breeding sites of *Anopheles* and *Culex* are usually outdoors in dirty water such as drainage, gutters, and swamps, while that of *Aedes* is indoors in clean water such as flower vase, tubs, and opened water drum. Annual Parasite Incidence (API), which is number of cases per a thousand populations, is used to determine malaria cases in Ambon Municipality. The highest API of 6.54 was in Nusaniwe District in 2012, while that of 5.92 was in Teluk Ambon-Baguala District in 2013. Number of cases of dengue fever increased in the last three years. Since 2011, there are 8 cases of lymphatic filariasis in Ambon Municipality. Methods that are commonly used to control the vectors are source reduction as well as larval and adult controls. Surveillance was generally done by observing only the presence or absence of larvae in their breeding sites. Intensive surveillance in terms of collection and identification of the vectors as well as development of effective control methods are needed.

**Keywords:** dengue fever, lymphatic filariasis, malaria, mosquitoes

## Introduction

Mosquitoes have been one of the most important insect pests in the history of humankind. They are still significant as medical pests today, especially by vectoring organism that cause some diseases. In Ambon Municipality, three genera of mosquitoes namely *Anopheles*, *Culex*, and *Aedes* causes many health problems since they transmit malaria, elephantiasis (lymphatic filariasis), and dengue haemorrhagic fever, respectively. Malaria is a diseases caused by unicellular blood-dwelling parasite of genus *Plasmodium*. ARYANTI *et al.* (2006) stated that Eastern Indonesia including Ambon Municipality is the region with heavy malaria distribution. Dengue haemorrhagic fever is caused by virus carried by several species of mosquitoes, of which *Aedes aegypti* is the main vector. Elephantiasis (lymphatic filariasis) is caused by nematode worms of genus *Filaria* transmitted by several species of mosquitoes including *Culex* spp. and *Anopheles* spp.

Ambon Municipality is an administrative area of 377 km<sup>2</sup> in Ambon Island which is a capital of Maluku Province. Ambon Municipality consists of five districts, namely Nusaniwe, Sirimau, Baguala, Teluk Ambon, and Letimur Selatan with 50 villages and/or *kelurahan*. There are 22 community health centers that spread in these five districts. The total population of Ambon Municipality in 2013 was 379,615 and it has the highest population density in the province by 1,007 people per km<sup>2</sup> (BPS 2014).

### Vector

Number of mosquito's species as diseases vectors that had been reported in Indonesia was more than 457 species in 18 genera and dominated by genus *Aedes*, *Anopheles*, and *Culex* that consist of 287 species (SUWITO 2008).

HIZWANI (2004) reported that there were 20 species of *Anopheles* that transmit malaria in Indonesia. Some species of *Anopheles* are also vector of elephantiasis (lymphatic filariasis) (SYAHRIAL *et al.* 2005). Fifteen *Anopheles* species were found in Maluku (WEPSTER and SWELLENGREBEL 1953) where 5 of them were found in Seram, Ambon, and Ternate, i.e., *Anopheles subpictus* in Seram, Ambon, and Ternate, *A. parangensis*, *A. isulaeflorum*, and *A. vagus* only in Seram and Ambon, and *A. orientalis* in Seram, while another 10 species were generally found in Maluku. SUKIRNO (1994) reported about 10 *Anopheles* species found in Halmahera, North Maluku where 4 out of them were vectors of malaria.

*Aedes* spp. as vectors of dengue haemorrhagic fever as well as e elephantiasis lephantiasis (lymphatic filariasis) were also found in Ambon. PAGAYA *et al.* (2005) reported that *Aedes aegypti* was found indoors and *A. albopictus* were found outdoors in Waimahu Village, Nusaniwe District, Ambon Municipality.

*Culex* is cosmopolitan genus of mosquitoes especially in warm region. Some species transmit filariasis and encephalitis. In Ambon, larvae of *Culex quinguifasciatus* were often found. Larvae of *Culex* spp. sometimes become a predator of larvae of *Anopheles* spp.

### Habitat

Adult mosquitoes are differentiated by their long proboscis and scales along the wings vein. Adults female feed on blood and are responsible for transmitting disease organism. Adult males (and occasionally females) feed on nectar and other plant exudates. The immature (larvae or wrigglers) are found in water, where most consume algae and organic debris (PEDIGO 1998).

Members of genus *Anopheles* lay their eggs singly on the water surface. Most of *Anopheles* larvae were found in dirty slowly running water. Breeding sites of *Anophelidae* family is outdoors in water pool in grasses, swamps, mangrove areas (Fig. 1).

Members of genus *Culex* lay eggs in clusters as rafts on the water surface. In Ambon Municipality, *Culex* larvae were found in outdoor dirty water such as in stagnant water in gutters and fishing boat (Fig. 1) and many stagnant water pools around houses.

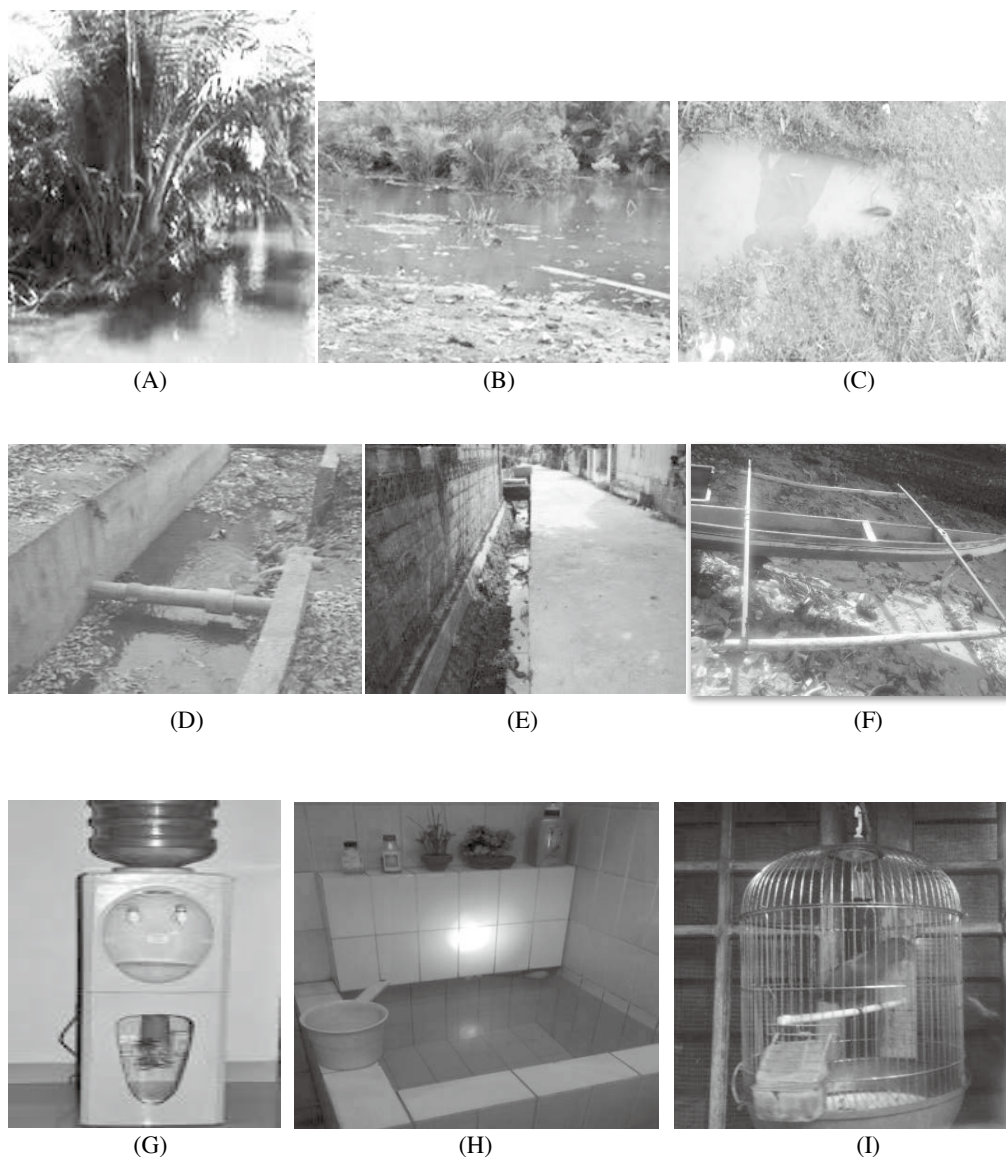


Fig. 1. Habitats of mosquitoes; A-C: habitats of *Anopheles* spp., D-F: habitats of *Culex* spp., and G-I: habitats of *Aedes* spp.

Members of *Aedes* lay eggs in depressions, along high water lines and in almost any container of rain water. These eggs lie dormant until flooded with water, after which they hatch and wrigglers develop in the flooded area (PEDIGO 1998). PAGAYA *et al.* (2005) reported that breeding sites of *Aedes* larvae were found both indoors and outdoors. Larvae of *A. aegypti* were found in indoor clean water in water container such as in water dispenser, bathroom, fresh water vase as well as in birdcage (Fig. 1). While *A.albopictus* larvae were found outdoors in tree holes, banana stem, open coconut shell, and any used container containing water.

### Diseases Conditions

#### Malaria

Health Research and Development Institute, Indonesian Ministry of Health stated that prevalence of malaria in Indonesia was 417,819 positive cases in 2012 and 70% was in Eastern Indonesia including Maluku. Malaria is a dominant disease among the community in Ambon Municipality and is measured using Annual Parasite Incidence (API) which is number of positive cases of a thousand risk populations (DEPARTMENT OF HEALTH OF AMBON MUNICIPALITY 2012, 2013). In general, average API in Ambon Municipality decreased from 4.49 in 2012 to 4.15 in 2013 (Table 1), but there were increasing of API in two out of five districts, i.e., Teluk Ambon Baguala and Letimur Selatan (Fig. 2). Besides that, all of API in five districts of Ambon Municipality in 2013 are still consider high since an indicator that a region is free of malaria if it has an API below 1.00 per a thousand population and there is no malaria cases in local population for three years in a row (Table 1).

Table 1. Number of malaria prevalence in Ambon Municipality in last two years.

No.	District	Number of community health center	2012				2013			
			Total population	Positive case		API	Total population	Positive case		API
			Male	Female			Male	Female		
1	Nusaniwe	6	100,307	168	167	3.34	103,423	171	159	3.19
2	Sirimau	8	156,337	542	480	6.54	162,263	404	392	4.91
3	Baguala	4	59,685	107	116	3.74	62,347	191	178	5.92
4	Teluk Ambon Baguala	2	42,918	40	31	1.65	44,618	49	19	1.52
5	Letimur Selatan	2	10,493	6	3	0.86	10,135	14	11	2.47
	Total	22	369,740	863	797		382,786	829	759	
	Average					4.49				4.15

Source : DEPARTMENT OF HEALTH OF AMBON MUNICIPALITY (2012, 2013).

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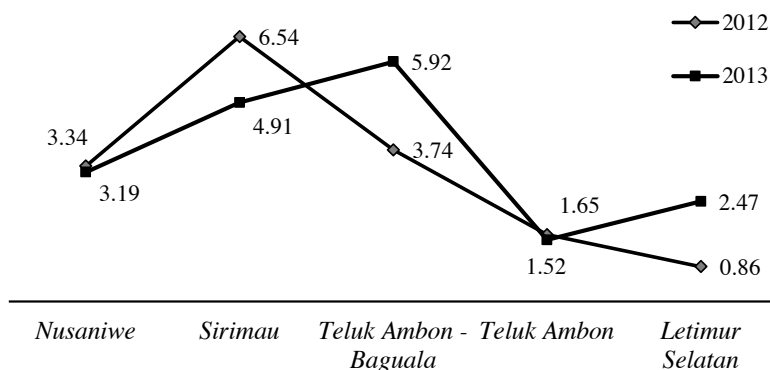


Fig. 2. Annual Parasite Incidences (API) in five districts of Ambon Municipality in the last two years.

Table 2. *Plasmodium* species causing malaria in Ambon Municipality in the last two years.

No.	Species	2012 (%)	2013 (%)
1	<i>Plasmodium vivax</i>	99.4	98.7
2	<i>Plasmodium falciparum</i>	0.4	0.9
3	<i>Plasmodium malariae</i>	0.0	0.2
4	<i>Plasmodium ovale</i>	0.0	0.0
5	Mix	0.2	0.2

Source : DEPARTMENT OF HEALTH OF AMBON MUNICIPALITY (2012, 2013).

In Indonesia *Plasmodium* species that cause malaria are *P. falciparum*, *P. vivax*, *P. ovale*, *P. malariae*, and *P. knowlensi*. In Ambon Municipality 99% of malaria cases was caused by *P. vivax* both in 2012 and 2013 (Table 2) and *Anopheles subpictus* was the dominant species as major vector of *P. vivax* (DEPARTMENT OF HEALTH OF AMBON MUNICIPALITY 2013).

The endemic zone of malaria in Eastern Indonesia spread in 84 regencies/municipalities including Ambon Municipality (INDONESIAN MINISTRY OF HEALTH 2013). Efforts to control malaria have been done around the world. World Health Organization (WHO) set a global malaria day on April 25. Declaration “toward malaria-free Indonesia” had been done by Indonesia President on 2008 and publication of the decree of Indonesian Health Ministry no 293/MENKES/SK/IV/2009 dated 28 April 2009 regarding elimination of malaria in Indonesia. Elimination of malaria is expected to be done in Java, Bali, Riau, and Aceh in 2015; in Sumatera, Kalimantan, Sulawesi, and Nusa Tenggara Barat in 2020. Elimination of malaria in Papua Barat, Maluku, Maluku Utara, and Nusa Tenggara Timur are expected to be done in 2030 and at the same time Indonesia is targeted to be malaria-free (INDONESIAN MINISTRY OF HEALTH 2013). Many challenges faced in efforts to eliminate malaria especially in islands including Maluku Province, such as remote areas that are difficult to reach, there is no effective cure as well as resistant to some antimalarial drugs.

### Elephantiasis (Lymphatic Filariasis)

There were 8 cases of elephantiasis in Ambon Municipality in 2011 where 4 were chronic patients and 4 were new patients. Most of the patients (87.5%) are in Sirimau District and the rest are in Nusaniwe District. In 2012, there was no new case and in 2013 there was 1 new case in Sirimau District (Table 3).

### Dengue Haemorrhagic Fever (DHF)

Dengue haemorrhagic fever incidence in Ambon Municipality increased in the last three years by 19 % and 37%, respectively. Most cases were in Sirimau District, followed by Nusaniwe, Teluk Ambon Baguala, and Leitimur Selatan districts. No incidence was reported in Teluk Ambon District (Table 4).

Table 3. Elephantiasis incidence in Ambon Municipality in the last three years.

District	2011		2012		2013	
	Community health center	Cases	Community health center	Cases	Community health center	Cases
Nusaniwe	Latuhalat	1	-	0	-	0
	Rijali	2	-	0	-	0
Sirimau	Air Besar	4	-	0	Karang Panjang	1
	Ch.M.Tiahahu	1	-	0	-	0
Baguala	-	0	-	0	-	0
Teluk Ambon Baguala	-	0	-	0	-	0
Leitimur Selatan	-	0	-	0	-	0
Total		8	-	0	-	1

Source : DEPARTMENT OF HEALTH OF AMBON MUNICIPALITY (2011, 2012, 2013).

Table 4. Dengue haemorrhagic fever incidence in Ambon Municipality in the last three years.

No.	District	2011	2012	2013
		Cases	Cases	Cases
1	Nusaniwe	8	5	9
2	Sirimau	6	13	10
3	Baguala	2	0	4
4	Teluk Ambon Baguala	0	0	0
5	Letimur Selatan	0	1	3
	Total	16	19	26

Source : DEPARTMENT OF HEALTH OF AMBON MUNICIPALITY (2011, 2012, 2013).

### **Integrated Approaches to Mosquitoes Control**

Mosquitoes management that has been done so far are integrated approaches such as source reduction by elimination of mosquitoes habitats by sanitation of environment, chemical and biological control of larvae and adults, as well as prevention of mosquitoes bites using repellent and mosquitoes net. A program of environmental health, Ministry of Health Ambon Municipality is sources reduction by draining, washing, and burying any water containers and water pools which are habitats of mosquitoes. This program is done by educated community through environmental health extension.

### **Research toward Vectors Control**

Research towards vectors control that had been done so far is general monitoring and surveillance by determining the presence or absence of larvae in their habitats. Development of botanical insecticide as larvicide of *Culex* spp. and *Aedes* spp. by bioassay of crude seed extract of *Barringtonia asiatica* (Lecythidaceae) (PAGAYA *et al.* 2009, PELAMONIA *et al.* 2009).

Future research need to be done on intensive monitoring and surveillance by collection and identification of vectors, efficacy of botanical insecticide (plant extracts) on larval in their habitats as well as genetic control of the vectors.

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