IJCSS 6 (1) (2025) Pages:. 383-389

Journal homepage: http://pcijournal.org/index.php/ijcss

International Journal of Cultural and Social Science

Published: Pena Cendekia Insani

ZOONOTIC MALARIA POTENTIAL IN PAPUA FROM THE PERSPECTIVE OF ONE HEALTH AND NATIONAL RESILIENCE

Annisa Putri Cahyani[1], I Putu Juli Sukariada[2], Eni Susanti[3], Hendro Sukoco[4], Dwi Nurhayati[5], Aven B Oematan[6]

[1]Animal Production Technology Study Program, Politeknik Pembangunan Pertanian Yogyakarta Magelang, Indonesia

[2]Animal Husbandry Study Program, Faculty of Military Logistics Vocational Studies, Republic of Indonesia Defense University, Belu, East Nusa Tenggara, 85752, Indonesia

[3]International Relations Study Program, Faculty of Social and Political Sciences, Universitas Sulawesi Barat, Majene Regency, West Sulawesi, Indonesia

[4]Animal Husbandry Study Program, Faculty of Animal Husbandry and Fisheries, Universitas Sulawesi Barat, Majene, Indonesia.

[5]Diploma 3 Animal Health Study Program, Faculty of Animal Husbandry, Universitas Papua, Indonesia

[6]Animal Health Study Program, Department of Animal Husbandry, Politeknik Pertanian Negeri Kupang, Indonesia

Article Info

Keywords:

National resilience, One health, Papua, Zoonotic malaria

ABSTRACT

Malaria continues to be a significant public health issue in Indonesia, and Papua has the highest incidence of it in the country. Recent changes in the environment, greater interaction between humans and wildlife, and the expansion of habitats occupied by the malaria vector have raised concerns that zoonotic malaria may appear in the area. The purpose of this study is to examine the probable impacts of zoonotic malaria in Papua from the One Health perspective and its ramifications to the country's resilience. The study is primarily documentary, based on a qualitative review of pertinent literature consisting of scientific records from the previous five years, reports from the World Health Organization, and the country's databases on malaria surveillance. The study concludes that ecological changes, deforestation, and working in the forests all increase the possibility of spillover from other species of Plasmodium such as P. knowlesi and P. cynomolgi. The situation is then compounded by poor health access, high population movement, and ongoing transmission. The probable advent of zoonotic malaria presents an especially complex danger relative to Indonesia's national resilience. There is potentially a negative impact on food, the economy, the social structure, and the country's security. The Papua of Indonesia has a significant potential to contract the disease and to mitigate it surveillance should be made more integrated, improved, and more cross-sectoral collaboration should be instituted. This study emphasizes the One Health approach to malaria elimination and the intact national resilience to malaria that must be preserved.

Corresponding Author:

I Putu Juli Sukariada
Animal Husbandry Study Program, Faculty of Military Logistics Vocational Studies
Republic of Indonesia Defense University
jsukariada@gmail.com

1. INTRODUCTION

Malaria remains one of the most significant communicable diseases in the world. The 2024 World Malaria Report indicates that there were 249 million cases of malaria in 2023. This number is expected to continue to increase over the next few years. This increase is driven in part by the increased risk of malaria transmission due to climate change, social instability, and the WHO points out that climate change is one of the most important factors responsible for the expansion of the Anopheles mosquito in the tropical and sub-tropical areas. Recent studies have indicated that the Anopheles mosquitoes which are the most important malaria vector have expanded their climatic niche and now have more areas of the world where malaria (Muh et al., 2025; Carlson et al 2023) is likely to be transmitted. Similar findings have been reported where climate change has contributed to the geographic expansion of malaria vectors and increasing the length of the malaria transmission season.

On a national level, Indonesia continues to fall short in reaching the goal of malaria elimination by the year 2030. The latest reports from the Ministry of Health show that malaria cases at a national level will record a further increase in 2024, with Papua as the epicenter contributing more than 70% – 80% of the national cases (Ministry of Health 2024b). This situation will likely persist in 2025, with Papua and the Papua Highlands still the provinces with the highest Annual Parasite Incidence (API) in the country (Ministry of Health, 2025). Other recent national malaria epidemiological studies further demonstrate that Papua still accounts for 84% of the malaria cases in the country (Ashar et al 2025).

Papua has beautifully diverse ecosystems. The region has tropical rainforests, swamps, humid plains, and riverbank ecosystems which together make an appropriate habitat for several Anopheles species. (Setiyaningsih et al., 2019; Rozi et al., 2025). The ecosystem is put under stress by human activities, and in consequence, there is increased risk exposure. These include mining, logging, and land clearing, as well as the temporary human migration to the region. In addition, there is wildlife interaction, especially with primates, which facilitates pathogen spillover, including possible zoonotic Plasmodium. (Permana et al., 2023; Fransisca et al., 2025). Several studies report that Plasmodium knowlesi and P. cynomolgi (and other species as well) cross the human and primate barrier via Anopheles vectors (Amir et al., 2018; Jeyaprakasam et al., 2025). The clearing for agriculture encourages the close contact with primates, and this greatly increases the chances of pathogen spillover becoming a reality. (Fornace et al., 2019; Ahmed et al., 2025).

While the zoonotic malaria situation in Papua is still relatively new, the ecology and social conditions suggest the zoonotic malaria risk is appropriate for study, particularly in the realm of ecological change and increasing human-wildlife contact. A One Health approach is needed to grasp the connections between humans and the other components of the zoonotic malaria system in Papua (Destoumieux-Garzón et al., 2018).

The presence of malaria and health issues become a larger and more strategic problem than just a health problem in Papua. Malaria and other infectious illnesses are viewed as non-military threats that can severely undermine food security, poor economic, social, and general cohesion. Papua has the great burden of malarial and non-malarial diseases that will always result in poor productivity of the workforce, poor economic growth, poor social inequity, and will always pose a threat to the social order to the strategic area of Eastern Indonesia. Therefore, the study of malaria in Papua and the One Health framework and the national resilience framework is significant to the zealous pursuit of the One Health framework and the national resilience framework (Kelly et al., 2020; Ghai et al., 2022).

The need for this research is heightened by the fact that there is little to no work connecting Papuan malaria to zoonotic dangers and possible impacts on the nation's resilience. Malaria studies in Indonesia primarily deal with the epidemiology and public health response to the disease. However, the cross-sector analyses, relying on the One Health approach and the concept of national resilience, and the interdisciplinary studies remain highly unusual. As such, this research is anticipated to make a contribution, both conceptually and in practice, to strengthening the strategies for mitigation of the malaria and the bolstering of national resilience in Indonesia

2. RESEARCH METHODS

This research utilised a descriptive qualitative review of literature method to examine the potential for zoonotic malaria (as a One Health and national resilience perspective) for Papua. This perspective is congruent with the character of the topic, which is conceptual and multidisciplinary, involving several branches of science such as malaria epidemiology, zoonosis, ecology, health policy, and national resilience (Destoomieux-Garzón et al., 2018). The data in this research were taken from reputable journals published from 2020 to 2025, WHO reports, health reports of the Republic of Indonesia, and One Health literature. The research employed a search with the following keywords: zoonotic malaria, Papua malaria, One Health, spillover, and vector ecology. The analysis in this research was done by content and thematic analysis whereby the findings were classified under epidemiology, ecology, society, and national resilience.

3. RESULT AND ANALYSIS

Malaria as a Potential Zoonosis

Zoonotic malaria is a type of malaria that is spread to humans from non-human primates (NHPs) via bites from Anopheles mosquitoes. A large number of deforested areas across Indonesia have increased human-wildlife interactions, and the country is home to many species of deforested primates that may act as reservoirs for Plasmodium. As a result, the spillover risk has increased (Permana et al., 2023). More recent research indicates an increased risk for within-human transmission of malaria from several species of the Plasmodium genus in primates across several regions of Indonesia, including, for example, Sulawesi and Kalimantan. These primate Plasmodium species include Plasmodium knowlesi, Plasmodium inui, and Plasmodium cynomolgi (Permana et al., 2023; Lempang et al., 2025; Novita et al., 2025). An assessment across five Indonesian regions inhabited by primates has documented the risk of zoonotic malaria and the declining primate habitats as well as the increased human-primate interactions (Permana et al., 2023). Although the deforestation in the area and the subsequent impact of decreasing primates and increased human contact is a troubling situation, the findings indicate that the bio-ecological conditions of Indonesia predispose it to the emergence of zoonotic malaria. Although Papua has documented the least amount of zoonotic malaria, the risk is similar due to the thick tropical forests, a diverse amount of primates, and human activity within the forests (Permana et al., 2023). Thus, malaria in Papua has to be seen not just as an anthroponotic disease, but also as a disease that is likely to be zoonotic.

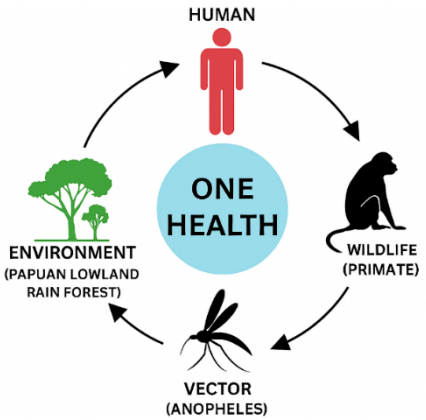

Figure 1. One Health diagram: human–animal–environment interactions in the dynamics of zoonotic malaria

Zoonosis Risk Analysis in Papua

Papua is at great risk for zoonotic malaria. First, Papua has extensive tropical rainforests which serve as ecosystems for Anopheles mosquitoes. The more suitable the climate, the more likely the area is to have malaria transmission (WHO, 2024). Second, Papua is the only home in the country for a population of wild primates that can be Plasmodium reservoirs. Studies show that in the entire nation, deforestation increases the number of humans picking contact with primates, which increases the chances for the pathogen of the Plasmodium and spillover to the human population (Permana et al., 2023). Activities such as mining, logging, and wildlife hunting also increase pathogen spillover and the risk of contact. Third, population movement is extremely rapid, especially for miners and people in remote communities. The remote communities also have limited access to medical facilities, which hinders the rapid response to an outbreak of malaria in an area. Fourth, research done in 2024 shows that the country still carries a great burden of malaria, which is also reflected in the number of malaria cases in Papua, which has the most people infected compared to the rest of the country (WHO, 2024). In the last five years the number of malaria cases within Papua has increased. Malaria cases in other areas of Indonesia are rare because of low disease burden; however, Papua and West Papua have 90% of the malaria cases in the country, despite being just 1.5% of the total national population (Ministry of Health, 2024b). This shows that the public health zoonotic risk in Papua is multidimensional. Some of the drivers of risk include the region's socio-economic situation and the health of the population.

Implications for National Resilience (Astagatra)

The impact of malaria is not only limited to health aspects, but can also affect national resilience such as :

a. Food Security
   Healthcare problems, including malaria, impact Papua residents, and malaria also has essential non-health consequences. Malaria also has non-health consequences, as Papua still engages in subsistence farming/fishing as its main economic activity, and this will undermine the social and economic conditions of the local populations. Malaria effects are even greater considering the rural farming and

fishing communities depend on agriculture and fishing for their food/livelihood. The impact of malaria on Papuan communities is very positive and very direct. Malaria-sick farmers and fishermen in rural areas are more susceptible to malaria, as they work outdoors and are in direct contact with the vectors. Affected symptoms such as fever and weakness impair work efficiency, resulting in poor harvest or fish and food supply disruptions in the community. Subsistence farming and fishing food production systems rely on the community's self's food production capacity. The eco food production systems are fragile and very open for such problems. The local citizens of Papua could also face higher food prices, as the contraction of the disease by both farmers and fishermen will impact the food supply.

This causes an even greater reliance on expensive, less sustainable food from other regions. Irma et al. (2023) state that the presence of malaria in Muna Regency causes a severe decline in work productivity and food insecurity in the subsistence sector. There is a direct correlation between the unhealthy population of a region and the inability to perform basic economic functions like farming and fishing. This also deepens the existing poverty and social disorder. Malaria is also known to infect other warm-blooded animals, including birds. Plasmodium gallinaceum, the malaria parasite that infests birds, primarily causes chicken deaths. Untreated, the parasite is known to cause mortality rates of 80% in infected chickens (Kittichai et al. 2024). According to Homer et al. (2017), indigenous chickens are the most traded livestock in Papua, and therefore the disease has the potential to greatly affect food security and the economy of livestock-dependent communities

b. Economic Resilience

Papua has great future opportunities in the mining, plantation, and fisheries industries, all of which demand high volumes of labour. Unfortunately, the province has a major health issue, malaria, which affects the economy in numerous ways. Lost workdays due to malaria decrease productivity of workers in the plantations, mining, and fisheries industries, which in turn decreases available economic output for the workforce. This affects income at a company and nets a decrease in economic output in a country. Those workers who have malaria will not show up, and if they do, their productivity suffers. Symptoms of the disease reduce their physical ability and performance. According to a study by Andiarsa et al. (2015), malaria has the greatest prevalence among younger children and people in the most productive age. This age group is a key segment of the economy since they support the production in the key industries of Papua. The economic impact of malaria is large on the health as well as on the households due to income loss. People living in malaria-endemic areas of Indonesia suffer an income loss of around US$60,000, or approximately IDR 90 million. Such figures reflect the substantial individual and overall macroeconomic implications for Papua and Indonesia. In addition to the loss of income from the inability to work, malaria also imposes extra financial costs on the directly affected families. One of the major issues that low-income families have to deal with is the costs associated with malaria treatment. These costs, which include a diagnosis, medication, and treatment for more severe stages of the disease, often put a big financial burden on families and impoverished ones. Such costs may reduce the disposable income of economically challenged families to a point where it may drive them deeper into poverty. Amin et al. (2025) pointed out that treatment of malaria in endemic areas is an impediment to economic development due to poverty. These costs are associated with two rather unfortunate outcomes. Families may forgo appropriate medical care, leaving them with an unaddressed health problem, or the use of financial assets may be exacerbated by the need to borrow money. These conditions will reduce the overall wellbeing of the family unit, thus also relating to higher levels of poverty and greater wealth disparities in malaria-endemic areas. Kemismar et al. (2022) discuss the losses in tourism the disease threatens and the consequent economic loss caused by malaria.

c. Social Resilience

Malaria outbreaks can cause public disturbances (Nurdin et al., 2024). Outbreaks of the disease can cause fear and anxiety over the potential spread of the disease. This fear can be even greater among residents of areas where access to health facilities is limited. In Papua, with its vast and remote areas, the lack of access to accurate information by the communities can increase anxiety and impending unrest.

d. Defense and Security

Infectious diseases, including malaria, pose a non-military risk that can affect security stability. Papua as a region of geo-strategic importance with intricate socio-political dynamics, is particularly vulnerable to health public and humanitarian crises. The effects of Zoonoses infections are security situation aggravating if not adequately and comprehensively managed.

One Health-Based Mitigation Strategy

The One Health approach is extremely applicable in addressing the issue of zoonotic malaria in Papua. Suggested actions include :

a. Integrated Surveillance
   Combine the systems of human, animal, and environmental surveillance to promote prompt detection of zoonotic cases.
b. Improved Diagnostic Capacity
   Papua should strengthen the labs to be able to identify zoonotic Plasmodium species, such as P. knowlesi.
c. Environmental Management
   Deforestation should be managed, and control of the eco-system targeted as a form of vector control.
d. Interdisciplinary Collaboration
   Coordination among human and animal health, forestry, and local governments is essential.
e. Community Education and Empowerment
   People residing near forests should be informed of the zoonotic dangers as well as measures to guard against them.
f. Strengthening National Policy
   There should be the incorporation of the potential of zoonotic malaria in the national resilience policies and the malaria elimination in the year 2030 plan

4. CONCLUSION

This study demonstrates that Papua is at risk for the social and ecological triggers of deforestation, expanding the habitats of the vectors as well as human and wildlife interactions that nurture the risk of the more of the already high rates of malaria in the area. Emerging malaria carries a value for national and associated security as well as food security, economic, and social stability in a country. The high potential risk polarizes the vector borne malaria case entails in a One Health concept that balances the social interactions, improves the management of the environment, and ensures improvements in super healthy collaboration. If the One Health principles are incorporated with the malaria residual transmission elimination in Papua, Indonesia will secure the stability of the health system as well as national security.

5. REFERENCES

[1] Ahmed, A. N., Fornace, K. M., Iwamura, T., Murray, K. A. 2025. Human animal contact, land use change and zoonotic disease risk: a protocol for systematic review. Systematic Reviews, vol 14, no. 1, pp. 1-11

[2] Amin, M., Hansyah, P., Rafika, M., Nasution, A. P., Hasibuan, M. I., Harahap, S. Z., Putri, A. D. 2025. Sosialisasi Pencegahan Malaria Melalui Optimalisasi Penggunaan Kelambu Insektisida Untuk Mengurangi Kasus Malaria di Daerah Endemik Labuhan Bilik Kabupaten Labuhanbatu. IKA BINA EN PABOLO : PENGABDIAN KEPADA MASYARAKAT, vol *5*, no. 1, pp. *57–68*.

[3] Amir, A., Cheong, F. W., de Silva, J. R., Liew, J. W. K., Lau, Y. L. 2018. Plasmodium knowlesi malaria: current research perspectives. Infection and Drug Resistance, vol. 11, pp. 1145–1155.

[4] Andiarsa, D., Suryatinah, Y., Indriyati, L., Hairani, B., Meliyanie, G. 2015. Pengaruh Kejadian Malaria Terhadap Hilangnya Hari Produktif Masyarakat Di Indonesia. Buletin Penelitian Sistem Kesehatan, vol. 18, no.2, pp. 169–177.

[5] Ashar, Y. K., Lauchan, A. M., Safira, P. 2025. Residential Environmental Risk Factors Associated With Malaria Incidence in Papua, Indonesia. Jurnal Kesehatan Lingkungan, vol. 17, no. 3, pp. 287–293.

[6] Carlson, C. J., Bannon, E., Mendenhall, E., Newfield, T., & Bansal, S. 2023. Rapid range shifts in African Anopheles mosquitoes over the last century. Biology Letters, vol. 19, no. 2. Pp. 20220365

[7] Destoumieux-Garzón, D., Mavingui, P., Boetsch, G., Boissier, J., Darriet, F., Duboz, P., Fritsch, C., Giraudoux, P., Le Roux, F., Morand, S., Paillard, C., Pontier, D., Sueur, C., Voituron, Y. 2018. The One Health Concept: 10 Years Old and a Long Road Ahead. Frontiers in Veterinary Science, vol. *5*, no. 14.

[8] Fitriany, J., & Sabiq, A. (2018). Malaria. Jurnal Averrous, vol. 4, no. 2, pp. 1–20

[9] Fornace, K. M., Brock, P. M., Abidin, T. R., Grignard, L., Herman, L. S., Chua, T. H., Daim, S., William, T., Patterson, C. L. E. B., Hall, T., Grigg, M. J., Anstey, N. M., Tetteh, K. K. A., Cox, J., Drakeley, C. J. 2019. Environmental risk factors and exposure to the zoonotic malaria parasite Plasmodium knowlesi across northern Sabah, Malaysia: a population-based cross-sectional survey. The Lancet. Planetary Health, vol. 3, no. 4, pp. e179–e186.

[10] Fransisca, L., Burdam, F. H., Kenangalem, E., Rahmalia, A., Ubra, R. R., van den Boogaard, C. H. A., Ley, B., Douglas, N. M., Poespoprodjo, J. R., Price, R. N. 2025. Enhanced data quality to improve malaria surveillance in Papua, Indonesia. Malaria Journal, 24(1). Pp. 1-14

[11] Ghai, R. R., Wallace, R. M., Kile, J. C., Shoemaker, T. R., Vieira, A. R., Negron, M. E., Shadomy, S. V., Sinclair, J. R., Goryoka, G. W., Salyer, S. J., Barton Behravesh, C. (2022). A generalizable one health framework for the control of zoonotic diseases. Scientific Reports, vol. 12, no. 1, pp. 1–11.

[12] Homer, B. E., Iyai, D. A., Sangkek, M. 2017. Sistem, Konstrain, Sustainabilitas, dan Skenario Peternakan Ayam Kampung di Manokwari, Papua Barat. Jurnal Sain Peternakan Indonesia, vo;. 12, no. 1, pp. 24–37.

[13] Irma, Sabilu, Y., Suhadi., Kamrin. (2023). Epidemiologi Kasus Malaria Terkonfirmasi Positif di Kabupaten Muna Sulawesi Tenggara. JUMANTIK, vol. 8, no. 1, pp. 27–34

[14] Jeyaprakasam, N. K., Phang, W. K., Shahari, S., Vythilingam, I. 2025. Plasmodium cynomolgi: potential emergence of new zoonotic malaria in Southeast Asia. Parasites & Vectors, vol. 18, no. 1, pp. 151.

[15] Kelly, T. R., Machalaba, C., Karesh, W. B., Crook, P. Z., Gilardi, K., Nziza, J., Uhart, M. M., Robles, E. A., Saylors, K., Joly, D. O., Monagin, C., Mangombo, P. M., Kingebeni, P. M., Kazwala, R., Wolking, D., Smith, W., Mazet, J. A. K. 2020. Implementing One Health approaches to confront emerging and re-emerging zoonotic disease threats: lessons from PREDICT. One Health Outlook, vol. 2, no. 1.

[16] Kemenkes. (2024a). Percepatan penurunan beban kasus malaria di kabupaten dengan endemisitas tinggi di Papua. chrome-extension:// efaidnbmnnnibpcajpcglclefindmkaj/ https://malaria.kemkes.go.id/sites/default/files/2024-10/ Percepatan Penurunan Beban Kasus Malaria di Kabupaten dengan Endemisitas Tinggi di Papua.pdf

[17] Kemenkes. (2024b). Laporan Perkembangan Malaria Indonesia. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://malaria.kemkes.go.id/sites/default/files/2024-10/ Percepat

[18] Kemismar, Y. Y., Manurung, I. F. E., Weraman, P. 2022. Risiko Karakteristik Orang dan Tempat Perindukan Vektor terhadap Kejadian Malaria di Kabupaten Manggarai Provinsi Nusa Tenggara Timur. Jurnal Penelitian Kesehatan Suara Forikes, vol. 13, no. 1, pp. 73–76.

[19] Kittichai, V., Kaewthamasorn, M., Thanee, S., Jomtarak, R., Klanboot, K., Naing, K. M., Tongloy, T., Chuwongin, S., Boonsang, S. 2024. Classification for avian malaria parasite Plasmodium gallinaceum blood stages by using deep convolutional neural networks. Scientific Reports, vol. 11, no. 16919, pp. 2444–2453.

[20] Lempang, M. E. P., Permana, D. H., Asih, P. B. S., Wangsamuda, S., Dewayanti, F. K., Rozi, I. E., Setiadi, W., Syahrani, L., Muslimin, L., Malaka, R., Syafruddin, D. 2025. Malaria infection of endemic primates

in the Buton Utara Wildlife Sanctuary, Indonesia: Potential for transmission to humans. International Journal of One Health, vol. 11, no. 1, pp. 27–33.

[21] Muh, F., Qanita, N. G., Yuwanita, M. R., Wusono, A. D., Rahayu, A. A., Amirudin, F. A., Firdaus, M. E. R., Cahyani, N. K. D., Han, J.-H. 2025. Plasmodium knowlesi and global changes : socio-ecological drivers and challenges.

[22] Novita, R., Suprayogi, A., Agusta, A., Nugraha, A. B., Darusman, H. S. 2025. Unveiling the Diversity and Zoonotic Potential of Plasmodium inui: a Comprehensive Review of Insights from Indonesia and Southeast Asia. Acta Parasitologica, vol. 70, no.1, pp. 59.

[23] Nurdin, M. A., Violita, F., Asriati, Adimuntja, N. P., Lisda Pamangin, O. 2024. Pendekatan Positive Deviance: Upaya Pencegahan Kejadian Malaria Pada Remaja di Kota Jayapura. Jurnal Promotif Preventif, vol. 7, no. 4, pp. 651–659.

[24] Organization, W. H. (2024). Malaria 2024 Indonesia country profile. Global Malaria Programme.

[25] Permana, D. H., Hasmiwati, Suryandari, D. A., Rozi, I. E., Syahrani, L., Setiadi, W., Irawati, N., Rizaldi, Wangsamuda, S., Yusuf, Y., Irdayanti, Aswad, H., Asih, P. B. S., Syafruddin, D. 2023. The potential for zoonotic malaria transmission in five areas of Indonesia inhabited by non-human primates. Parasites & Vectors, vol. 16, no. 1, pp. 267.

[26] Rozi, I. E., Syahrani, L., Permana, D. H., Asih, P. B. S., Sumiwi, M. E., Lobo, N. F., Hawley, W. A., Syafruddin, D. 2025. Gaps in protection to Anopheles exposure in high malaria endemic regencies of Papua Province, Indonesia. PLOS ONE, vol. 20, no. 4, pp. e0311076.

[27] Setiyaningsih, R., Yanti S, A. O., Lasmiati, L., Mujiyono, M., Prihatin, M. T., Widiarti, W., Garjito, T. A. 2019. Keanekaragaman Anopheles dalam Ekosistem Hutan dan Resiko Terjadinya Penularan Malaria di Beberapa Provinsi di Indonesia. Media Penelitian Dan Pengembangan Kesehatan, vol. 29, no. 3, pp. 243–254.