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The Role of the Community in the Implementation of Environmental Management for Malaria Vector Control in Sukajaya Lempasing, Teluk Pandan District, Pesawaran Regency

Endah Setyaningrum[1*], Dzul Fithria Mumtazah[1], Linda Septiani[2], Dody Swiyono[3], Budi Santoso[4], Enna Aslina[4], Jeany Audina Suryaningkunti[1], Adella Putri Apriliani[3,5]

[1] Department of Biology, Faculty of Mathematics and Natural Sciences, University of Lampung, Bandar Lampung 35145, Indonesia
[2] Faculty of Medicine, University of Lampung, Bandar Lampung 35145, Indonesia
[3] Department of Environmental Science, Postgraduate Program, University of Lampung, Bandar Lampung 35145, Indonesia
[4] Lampung Provincial Health Office, Bandar Lampung 35128, Indonesia
[5] Department of Forestry, Faculty of Agriculture, University of Lampung, Bandar Lampung 35145, Indonesia

Corresponding Author Email: endah.setianingrum@fmipa.unila.ac.id

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ABSTRACT

The purpose of this study was to determine the effect of environmental changes, environmental manipulation, and community involvement in IVM on malaria vector control. This article was written using a quantitative approach. The study was conducted from April to August 2024. The population surveyed consisted of all residents of Sukajaya Lempasing Village, Teluk Pandan District, Pesawaran Regency, Lampung. The research location was Sukajaya Lempasing Village, Teluk Pandan District. Purposive sampling is a side sampling method. The sample size was determined using the Slovin formula and as many as 70 residents who had had malaria. The data collection technique used a survey, while the data analysis technique used descriptive statistics, outer models, and inner models with SEM-PLS software. The results showed that environmental changes had a positive and significant impact on malaria virus control. Environmental changes significantly increased community participation but did not have a significant effect on home-based malaria control. However, host-based control was not significantly affected by community involvement alone. Environmental modification, either directly or through community engagement, also had no significant impact on host-based malaria control. These results, therefore, suggest that to achieve greater gains, a more holistic and integrated approach is needed that combines environmental manipulation and modification with host-based control strategies. This is a study that is limited to a specific geographic area and population, which may affect how generalizable the results are. Future research may look at applying these strategies more broadly across settings, incorporating longitudinal data to evaluate long-term impacts.

1. INTRODUCTION

Malaria remains a significant global health challenge, with cases increasing sharply in many parts of the world [1]. The disease contributes significantly to morbidity and mortality, especially in developing countries, where healthcare systems often face resource constraints and operational challenges [2]. Malaria worsens the health of affected individuals and imposes a high economic burden due to medical costs, lost productivity, and human suffering [3].

The global burden of malaria has prompted a variety of strategies for its control. These strategies include increasing public awareness through education, fostering collaboration and mutual assistance, and increasing public understanding of preventive measures [4]. Effective malaria prevention relies on activities such as the use of insecticide-treated bed nets, community education campaigns, and consistent monitoring and evaluation [5].

Vector control is the cornerstone of malaria prevention, with a primary focus on mosquito population management [6]. Comprehensive, integrated, and adaptable approaches to vector control have proven effective, especially when combining environmental sanitation, waste management, and improved living conditions [7, 8]. In addition, sustainable community-based programs targeting mosquito breeding sites have emerged as a key strategy [9]. Among these, environmental management has gained attention as an important component of integrated vector control efforts [10].

In developing countries such as Indonesia, malaria continues to be a significant challenge, causing significant human and economic losses. These include high medical costs, reduced labor productivity, and a large public health burden. Malaria transmission occurs naturally through interactions between Plasmodium spp parasites (agents): Anopheles spp mosquitoes (definitive hosts): and humans (intermediate hosts) [11].

The high prevalence of malaria in Indonesia underscores the urgent need for effective and context-appropriate control strategies, particularly those that emphasize environmental management and community involvement. One type of environmental disease that is impacted by the physical, biological, and sociocultural surroundings is vector-borne disease. Inadequate health care, migration of non-immune populations to endemic areas, and unsanitary living or hospital facilities are other risk factors [10]. Problems faced in vector control in Indonesia include geographic and demographic conditions that allow for vector diversity, the absence of vector species identification (vector distribution mapping) in all endemic areas, incomplete regulations on pesticide use in vector control, increasing populations of some vectors resistant to certain pesticides, limited resources, both manpower, logistics and operational costs, and lack of integration in vector control. Additionally, research is being conducted by worldwide partner organizations to identify novel approaches and new instruments that will support international efforts to prevent the spread of dengue. WHO recommends an integrated vector management strategy to accomplish successful and long-lasting local vector control measures [12].

Malaria control is implemented in accordance with the principle of decentralization, namely districts/cities as the focus of program management which includes planning, implementation, assessment and ensuring the availability of human resources. In efforts to control malaria, an understanding of factors called host, agent, and environment is also needed. Thus, efforts to control malaria are carried out based on these three factors [11]. Regarding health development, for decades, the government and various sectors have succeeded in reducing various health problems in Indonesia. Especially the problem of vector-borne diseases, the mortality rate of dengue fever has decreased significantly to below 1 percent. A total of 247 districts/cities with a population of more than 178 million have achieved Malaria Elimination. The success of vector control is determined by professionals who understand vector bioecology, pesticides and the use of materials and equipment for control, namely health entomologists.

One of the developments in efforts to control malaria mosquito vectors is through the implementation of environmental management in controlling malaria vectors. Environmental management is an effort to manage the environment so that it is not conducive as a habitat for vector breeding. Spraying, keeping predatory fish, spreading larvicide, etc.) and inhibiting vector growth (maintaining cleanliness of the home environment, reducing dark and damp places in the home environment) [10]. Environmental management is part of the overall vector control approach that is oriented towards interventions on environmental components. The author carried out a study on the application of environmental management activities in controlling malaria in Sukajaya Lempasing Village, Teluk Pandan District, Pesawaran Regency, Lampung, based on the knowledge of environmental management and risk factors that contribute to the spread of malaria that have been previously described.

2. METHODS

In this study, a survey method was used. The study was conducted on Sukajaya Lempasing Village, Teluk Pandan District, Pesawaran Regency, Lampung. The population that participated in the study were all residents of Sukajaya Lempasing Village, Teluk Pandan District. The number of samples was determined using the Slovin formula of seventy residents who had experienced malaria. A purposive sampling technique was used for the research, and the respondents were those who had been diagnosed with malaria in the last three years and had lived in the area for more than five years. To collect data, a survey was used. Meanwhile, to analyze the data, SEM-PLS software was used to create descriptive statistics, outer models, and inner models. The general form of analysis in this study is to connect four independent variables [X1] Environmental Manipulation, [X2] Environmental Modification, [X3] Community Involvement with the dependent variable [Y] Host Based Control of Malaria. The pattern of relationships between variables can be seen in Figure 1.

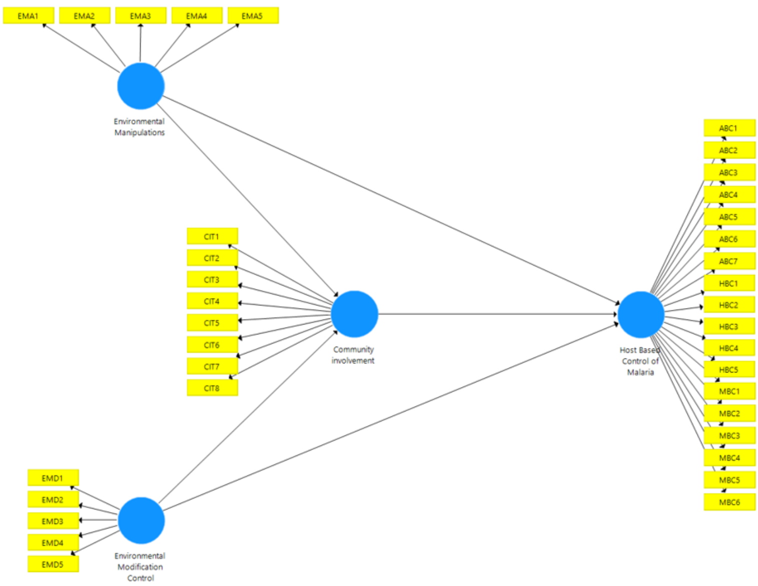

Figure 1. Structural model

3. RESULTS

3.1 Characteristics of research respondents

The demographic details of study participants are known as research respondent characteristics. Knowing this information is crucial to comprehending the study's history.

Background of the participants and to put the study's findings in perspective. These attributes cover a wide range of factors, including age, gender, degree of education, work status, and duration of local residency.

Research results data based on respondent characteristics are presented in Table 1.

Table 1. Characteristics of research respondents

Characteristic	Category	Frequency	%
Gender	Man	19	27.1
	Women	51	72.9
Age	20 - 24 Years	8	11.4
	25 - 29 Years	7	10.0
	30-34 Years	11	15.7
	> 34 Years	44	62.9
Education	Elementary School/Equivalent	47	67.1
	Junior High School/Equivalent	23	32.9
Employment status	Farmer	51	72.9
	Trader/Entrepreneur	14	20.0
	Private sector employee	5	7.1
Length of stay	15 years	6	8.6
	6 - 10 Years	5	7.1
	11 - 15 Years	6	8.6
	16 - 20 Years	8	11.4
	More than 20 Years	45	64.3

Table 1 shows that, with a percentage of 72.9%, female respondents predominate by gender. When it comes to age, 62.9% of respondents are older than 34. With a percentage of 67.1%, respondents' greatest degree of education is elementary school or its equivalent. Farmers make up the majority of respondents' occupational status (72.9%). It also describes how long respondents have resided in a given area; 64.3% of respondents have lived there for more than 20 years.

3.2 Measurement test - outer loading

To evaluate the validity and reliability of a model, external model evaluation uses a variety of tests, including discriminant validity tests, convergent validity tests, composite reliability values, and AVE.

If the outer loading (λ) value reaches 0.70 or more, the indicator is considered valid because this value indicates that the indicator has a strong enough contribution to explain the measured latent variables. However, in this study, several indicators with outer loading values between 0.5 and 0.7 were also retained (Table 2), considering the sufficient sample size and the theoretical contribution of the indicators to the model. This decision is based on the literature stating that in the context of exploratory research, outer loading values in this range are still acceptable for building a model, as long as the indicators are theoretically relevant and do not reduce the overall reliability or validity (Table 3). To create the model, indicators with outer loadings below 0.5 were used because the sample size was sufficient for this study.

Table 2. Outer loading of indicators

No.	Variables	Indicator	Outer Loading	Description
1	Environmental Manipulation [X1]	EMA1	0.573	Valid
		EMA2	0.327	Not Valid
		EMA3	0.657	Valid
		EMA4	0.252	Not Valid
		EMA5	0.803	Valid
2	Environmental Modification [X2]	EMD1	0.523	Valid
		EMD2	0.893	Valid
		EMD3	0.897	Valid
		EMD4	0.713	Valid
		EMD5	0.501	Valid
3	Community Involvement [X3]	CIT1	0.703	Valid
		CIT2	0.305	Not Valid
		CIT3	0.242	Not Valid
		CIT4	0.468	Not Valid
		CIT5	0.852	Valid
		CIT6	0.773	Valid
		CIT7	0.745	Valid
		CIT8	0.867	Valid
4	Host Based Control of Malaria [Y]	ABC1	0.629	Valid
		ABC2	0.471	Not Valid
		ABC3	0.479	Not Valid
		ABC4	0.166	Not Valid
		ABC5	0.031	Not Valid
		ABC6	0.180	Not Valid
		ABC7	0.204	Not Valid
		HBC1	0.677	Valid
		HBC2	0.747	Valid
		HBC3	0.806	Valid
		HBC4	0.810	Valid
		HBC5	0.770	Valid
		MBC1	0.870	Valid
		MBC2	0.826	Valid
		MBC3	-0.077	Not Valid
		MBC4	0.725	Valid
		MBC5	0.490	Not Valid
		MBC6	0.432	Not Valid

Table 3. Validity and reliability test

Latent Variables	Composite Reliability	Average Variance Extracted (AVE)
Community involvement	0.892	0.625
Environmental manipulations	0.721	0.568
Environmental modification control	0.840	0.527
Host-based control of malaria	0.927	0.586

All research variability has construct validity and reliability values, with CR more than 0.70 and AVE more than 0.50, so it meets the requirements [30].

3.3 Structural model

This structural model describes how latent variables relate to each other and affect measured variables (indicators). Table 4 of the structural model shows the suitability of the model that follows (Figure 2).

The Structural model fit table shows how the relationship between variables in the overall social model. The significance of the estimated parameters provides important information about the relationship between latent variables. To determine whether a relationship is significant or not, use a 5% significance limit with a t value of ±1.96. If the T value is outside the range of -1.96 to 1.96, The theory that there is an influence is considered significant and accepted. Conversely, the hypothesis should be rejected if the t value is outside the range. In structural model testing or hypothesis testing, decisions are made by checking the p-value against the significance level (alpha) of 0.05 or by comparing the CR (Critical Ratio) score with the t-table value (1.96). The results of the table above show that the variable on community involvement, which has a p-value of 0.000, has significant results.

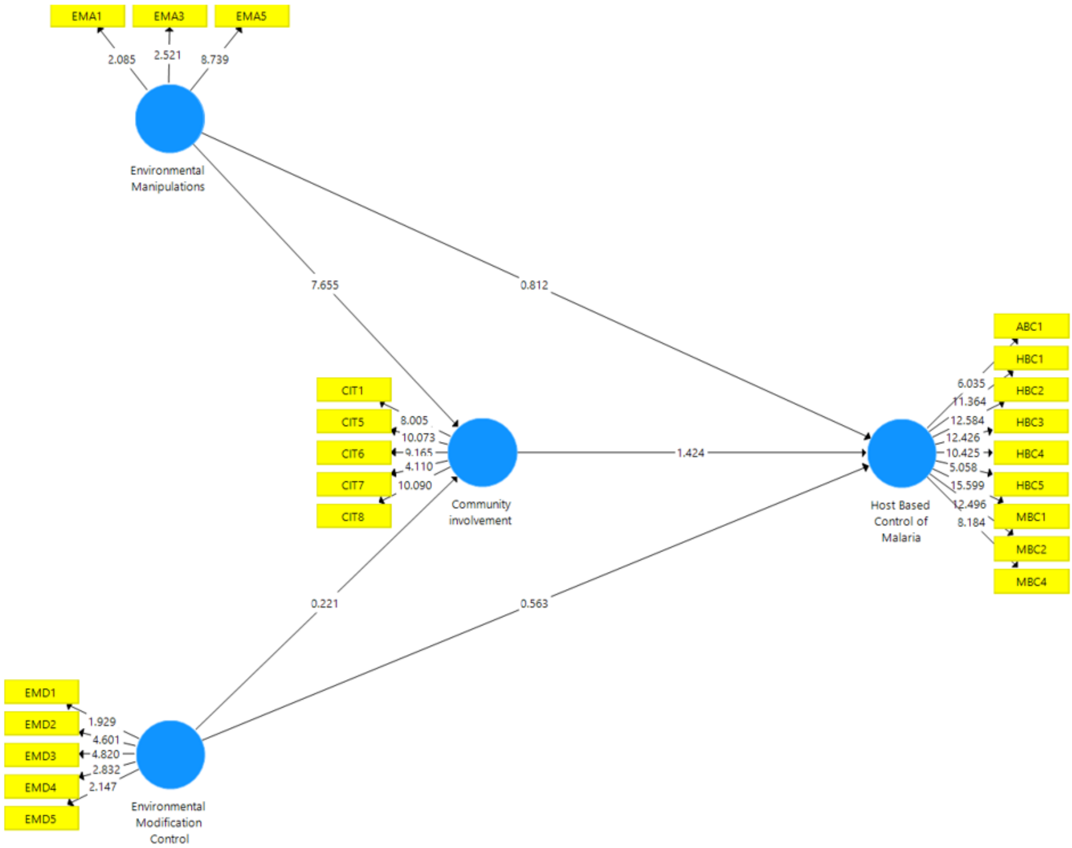

Figure 2. Outer loading coefficient numbers on the final model indicator arrows

Table 4. Hypothesis testing

	Original Sample	Sample Mean	Standard Deviation	T-Values	P-Values
Community Involvement → Host Based Control of Malaria	0.245	0.256	0.172	1,424	0.155
Environmental Manipulations → Community Involvement	0.701	0.726	0.092	7,655	0.000
Environmental Manipulations → Host-Based Control of Malaria	0.157	0.152	0.193	0.812	0.417
Environmental Modification Control → Community Involvement	0.031	0.032	0.141	0.221	0.825
Environmental Modification Control → Host-Based Control of Malaria	0.124	0.136	0.221	0.563	0.574
Environmental Manipulations → Community Involvement → Host Based Control of Malaria	0.172	0.186	0.133	1.296	0.195
Environmental Modification Control → Community Involvement → Host-Based Control of Malaria	0.008	0.005	0.050	0.153	0.878

4. DISCUSSION

4.1 Community involvement → Host-based control of malaria (not significant)

Community involvement in host-based malaria control initiatives did not significantly affect the disease, as indicated by the p-value of 0.155. A poor participation rate or a lack of community understanding and awareness of host-based control techniques could be the cause of this. Because of this, the results of this study did not indicate that involvement had a substantial impact on the control of malaria. This outcome can be explained by several reasons. The effectiveness of these measures may be diminished by low community involvement or a lack of awareness of the significance of host-based control techniques. The community's involvement may not be at its best and may not have the desired effect if they are unaware of how this strategy might prevent malaria. Furthermore, community service might be more concentrated on others. More extensive education and counseling initiatives on the advantages and use of host-based control techniques must be conducted in order to raise the significance of the impact of community engagement. This entails supplying the community with pertinent and understandable information and encouraging active and regular community participation in host-based malaria control measures.

4.2 Environmental manipulations → Community involvement (significant)

Community involvement is significantly impacted by environmental alteration, as indicated by the p-value of 0.000. This implies that environmental changes, such as removing mosquito habitats or altering living arrangements, might raise community awareness and encourage participation in the fight against malaria. The findings indicate that community participation in malaria prevention initiatives is significantly impacted by environmental alteration, with a very low p-value ($p < 0.05$).

According to reference [13], community participation is very important for the success of public health programs. With increased awareness through education and the availability of facilities, communities tend to be more involved in efforts to combat malaria. Environmental manipulation involving communities in environmental cleaning and maintenance activities shows that active participation can increase the sense of responsibility and concern for community health (Figure 3). The implications of these results indicate that malaria control programs should be designed to directly involve the community. A community-based approach that integrates environmental manipulation with education and active participation can strengthen the program. Existing programs need to be evaluated and adjusted periodically to make sure environmental manipulation is relevant and effective in increasing community involvement.

Malaria mosquito vector control methods are locally specific, taking into account physical environmental factors (weather/climate, settlements, breeding habitats), socio-cultural environment (knowledge, attitudes and behavior) and vector aspects. Basically, the most effective malaria mosquito vector control method is to involve Community Participation (PSM). So various other vector control methods are complementary efforts to quickly break the chain of transmission.

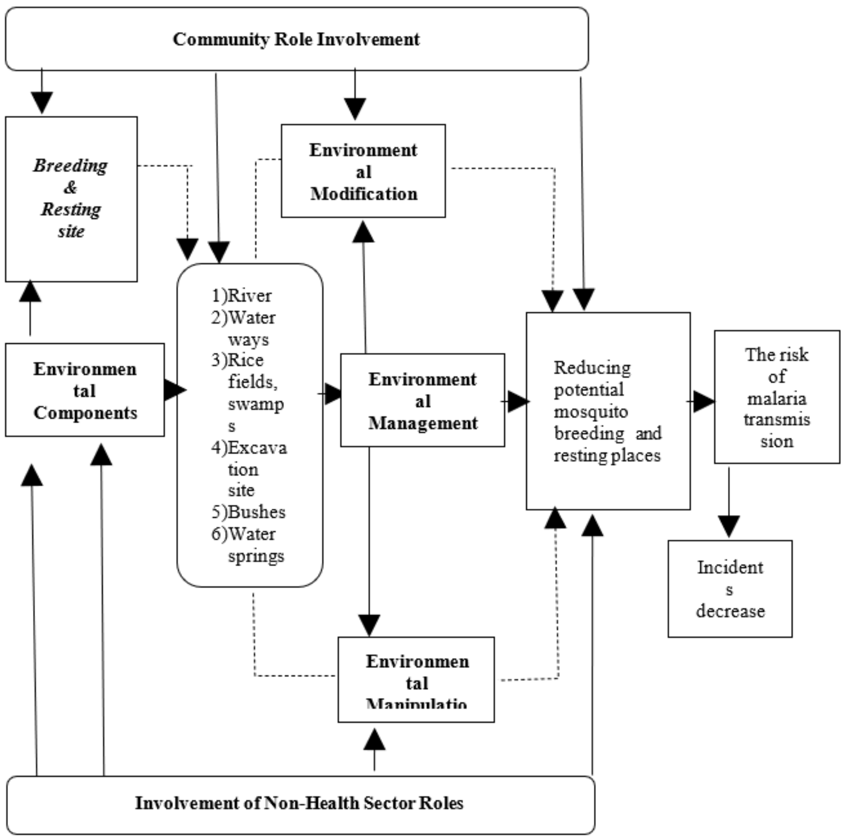

Figure 3. Framework of the role of environmental management in vector control

Environmental management (EM) is a form of environmental manipulation to reduce malaria transmission by attacking local vector mosquitoes and understanding the ecology of the species. The success of EM requires coordination and collaboration between various relevant government agencies, non-governmental organizations (NGOs), and the public sector [13]. Several factors that influence malaria elimination in various countries are grouped into vector control factors, malaria surveillance and malaria case management. In addition, vector control can also use livestock as a cattle barrier for Malaria [14]. The presence of resistance, which is the impact of insecticide use in some interventions, can threaten the success of malaria prevention programs [15].

Integrated approach, resource capacity, cross-sector collaboration, advocacy, mobilization, regulation, and evidence-based decision-making. Cross-sector collaboration is still limited to coordination and has not been maximized in implementation [16]. The program for controlling vectors that cause malaria biologically, physically, and chemically in the environment. Management of vector control that causes malaria has not been implemented properly [15, 17]. Acceleration of the discovery of new cases of malaria, and efforts to improve the ability of cadres to conduct malaria examinations. Community education, cadre training, provision of equipment to break the chain of malaria transmission, application of mosquito nets in ventilation, and development and provision of samples of anti-mosquito plants [18, 19].

Education related to vector control based on environmental control (non-insecticide) is needed at this time. Pre-intervention results show that environmental control is considered effective and efficient in controlling malaria mosquito vectors [20]. Dissemination of knowledge about malaria to the community through disease profiles, elimination efforts, epidemiological research, innovation programs, and larval protection activities [21]. To prevent mosquito bites, the most common method is to use non-insecticide-treated mosquito nets and mosquito repellents; however, insecticide-treated mosquito nets that are commonly used have typically been used for more than three years [22].

Malaria control policies should pay attention to local culture so that they can use local culture and be accepted and implemented [23]. The development of tourist areas must also pay attention to environmental factors such as the location of potential breeding sites for Anopheles spp [24]. As part of efforts to maintain malaria elimination certification, health services should request entomologists to be deployed, conduct training for program managers, increase active surveillance activities, improve integrated surveillance between sectors and programs, and emphasize program managers at health centers to produce monthly reports [25].

The breeding place or breeding site of Anopheles mosquitoes lays its eggs in clean and unpolluted water puddles, but the habitat of the breeding location is not the same. The breeding place of Anopheles mosquitoes is a large and medium water place, in the form of permanent puddles of water, namely fresh water or brackish water which includes swamps, river mouths, excavated holes, and abandoned ponds. Temporary puddles are natural including puddles of rainwater, riverbank water and puddles [11]. The distribution of spraying mosquito nets, screening of pregnant women with reduced frequency and control of biological vectors are not monitored. Training or socialization activities have never been held [26].

There is a significant relationship between knowledge and malaria prevention, and there is a significant relationship between attitude and malaria prevention [27]. Human resource development has been carried out, but retraining has not been carried out for microscopic personnel or management personnel [28]. In addition, the distribution of vectors is greatly influenced by the ecological conditions of the environment, and the water environment is a critical component for the life cycle of the vector (mosquito). Therefore, environmental management in vector control is directed at changing the condition of the water environment so that it does not become a breeding place for malaria vector mosquitoes [29, 30]. Conceptually, the form of environmental management efforts is grouped into two, namely, environmental modification and environmental manipulation. The difference between these two efforts is that environmental modification is intended to change environmental conditions that are permanent, such as changes in land use, making water channels, and filling water holes with soil. The latest malaria control method that is believed to be cheap and effective, as well as environmentally friendly, is what is called environmental management. Therefore, the author will provide an overview of the implementation of environmental management in the control of malaria vectors in this article.

A concrete example of the effectiveness of environmental manipulation can be seen in the program of cleaning stagnant water in several malaria-endemic areas, which has succeeded in reducing mosquito populations and increasing community engagement. Educational campaigns accompanied by environmental manipulation have also shown significant increases in community participation and reductions in malaria cases [21, 24]. Therefore, the study findings demonstrate the importance of using an environment-based approach to encourage community participation and improve overall public health outcomes.

4.3 Environmental manipulations → Host-based control of malaria (not significant)

With a p-value of 0.417, environmental manipulation had no discernible impact on host-based malaria control. This shows that efforts to improve host-based malaria control, such as clearing stagnant water or applying insecticides to minimize mosquito habitats, have not been enough. This can be explained by several variables. Modifications to the environment might only have localized or transient effects that are insufficient to lower the general mosquito population over time. External factors that cannot be addressed by environmental manipulation alone, such as community compliance with bed net use and antimalarial medicine distribution programs, also affect the efficacy of host-based malaria control. The effectiveness of environmental initiatives might be diminished by a lack of community education and understanding of the significance of individual preventive steps. Fourth, despite interventions, mosquitoes can continue to spawn because of their great degree of environmental adaptation. It's possible that the size and reach of initiatives are insufficiently extensive or long-lasting to make a major difference. As a result, a more comprehensive strategy is required, integrating environmental modification with awareness and education initiatives that focus on personal behavior. To improve long-term efficacy, environmental manipulation initiatives also need to be sustainable, backed by robust legislation, and actively involve the community.

4.4 Environmental modification control → Community involvement (not significant)

Environmental modification did not show a significant effect on community involvement, with a p-value of 0.825. This may be because the environmental modifications carried out did not attract enough attention or involve the community directly in the change process. Without active participation or deep understanding from the community about the importance of this modification, it is difficult to achieve a significant effect. The community may not feel involved or understand how environmental changes can affect malaria control, so they are not motivated to participate [20]. In addition, environmental modification programs that are not implemented with transparency and effective communication can also be a barrier to community involvement. Therefore, it is important to design environmental modification programs that are not only technically effective, but also include strong education and socialization efforts to increase community awareness and participation.

4.5 Environmental modification control → Host-based control of malaria (not significant)

Environmental modification did not show a significant effect on host-based malaria control with a p-value of 0.574. Although environmental modification efforts, such as reducing mosquito habitats through drainage or rezoning of water areas, can help suppress mosquito populations, their impact on host-based control methods may not be large enough to be seen as significant in this study. This could be due to several factors. One is that environmental change is not the only way to address all aspects of malaria transmission, especially if not accompanied by additional preventive measures such as the use of insecticide-treated bed nets and antimalarial treatment [16]. In addition, the effectiveness of environmental modification may take longer to be seen and may need to be implemented on a larger scale and more integrated with other control strategies. Lack of community participation and awareness can also reduce the effectiveness of environmental modification, as the success of this step depends heavily on the active involvement of the entire community [25]. Therefore, an effective malaria control strategy must include a holistic and sustainable approach, combining environmental modification with direct interventions that target mosquito vectors and increase community awareness and participation.

4.6 Environmental manipulations → Community involvement → Host-based control of malaria (not significant)

With a p-value of 0.195, the impact of community involvement and environmental alteration on host-based malaria prevention was not statistically significant. This suggests that while altering the environment can boost community engagement, the chain reaction is insufficiently powerful to have a substantial impact on host-based malaria control. Furthermore, it could take longer for environmental modification to have a noticeable effect, whereas continuous incentives and instruction are needed to alter an individual's behavior. To effectively manage malaria, it is crucial to combine environmental manipulation with robust and continuous education initiatives that not only boost community involvement but also promote more successful individual behavioral changes [11, 26]. For malaria to be controlled more successfully, a more comprehensive and cooperative strategy that involves several stakeholders and makes use of a variety of intervention techniques is required.

4.7 Environmental modification control → Community involvement → Host-based control of malaria (not significant)

The effect of environmental modification through community involvement on host-based malaria control also did not show a significant p-value of 0.878. This indicates that environmental modifications carried out are not enough to increase community involvement which in turn can significantly affect host-based malaria control. However, there are several studies that show that there are significant results, such as in research [20]. The results of pre-intervention show that environmental control is considered effective and efficient in controlling malaria mosquito vectors. One of the developments in mosquito vector control efforts is through environmental management [10]. Vector control can be more effective through sustainable community-based programs targeting mosquito breeding sites [9]. Integrated approach, evidence-based decision-making, advocacy, mobilization and regulation, and cross-sector collaboration. The spread of Integrated Vector Management (IVM) Malaria must be maximized [16].

Biological, physical, and chemical vector control programs and mosquito vector control management need to be carried out optimally [17]. Acceleration of the discovery of new cases of malaria, efforts to improve the ability of cadres to conduct malaria examinations. Community education, cadre training, supply of equipment to break the malaria transmission chain, installation of mosquito wire on ventilation, and introduction and supply of mosquito repellent plants [18]. Socialization of the vector control program is carried out periodically, there is a person in charge of vector control in each room, and facilities and infrastructure in carrying out vector and pest control [19].

5. CONCLUSION

Based on the results of this study, the application of environmental management in controlling the spread of malaria viruses gave different results. Environmental manipulation significantly increased community involvement, but had no significant impact on host-based malaria control. Conversely, community involvement alone had no significant impact on host-based control. Environmental modification, either directly or through community involvement, also did not show a significant effect on host-based malaria control. These results emphasize the need for a more in-depth and integrated approach, combining environmental manipulation and modification with host-based control strategies and deeper community involvement to achieve better effectiveness in malaria control. This study was limited to a specific geographic area and a limited population size, so the results may not be widely generalizable. For future research, it is recommended to apply this strategy in a wider and more diverse area, and include longitudinal data to evaluate the long-term impact of this approach.

REFERENCES

[1] World-Health-Organization. (2011). Comprehensive guidelines for prevention and control of dengue and dengue haemorrhagic fever. https://iris.who.int/handle/10665/204894.

[2] Mulderij-Jansen, V., Gerstenbluth, I., Duits, A., Tami, A., Bailey, A. (2021). Evaluating and strengthening the health system of Curaçao to improve its performance for future outbreaks of vector-borne diseases. Parasites & Vectors, 14: 500. https://doi.org/10.1186/s13071-021-05011-x

[3] Sood, S.K., Sood, V., Mahajan, I., Sahil. (2023). An intelligent healthcare system for predicting and preventing dengue virus infection. Computing, 105(3): 617-655. https://doi.org/10.1007/s00607-020-00877-8

[4] Pervaiz, R., Aslam, H., Sarwar, T., Hafeez, T., et al. (2022). Assessment of programs to control the endemic dengue fever: A literature review. Pakistan Journal of

Intensive Care Medicine, 2022(1): 13. https://doi.org/10.54112/pjicm.v2021i1.13
[5] Lusno, M.F.D., Yudhastuti, R., Haksama, S., Sari, J.D.E., et al. (2023). Evaluation of the implementation of the dengue hemorrhagic fever eradication program (P2DBD) during the COVID-19 pandemic (study at the Sememi Health Center, Benowo district, Surabaya City). Journal of Public Health in Africa, 14(S2): 2564. https://doi.org/10.4081/jphia.2023.2564
[6] Overgaard, H.J., Linn, N.Y.Y., Kyaw, A.M.M., et al. (2023). School and community driven dengue vector control and monitoring in Myanmar: Study protocol for a cluster randomized controlled trial. Wellcome Open Research, 7, 206. https://doi.org/10.12688/wellcomeopenres.18027.1
[7] Joshi, A., Miller, C. (2021). Review of machine learning techniques for mosquito control in urban environments. Ecological Informatics, 61, 101241. https://doi.org/10.1016/j.ecoinf.2021.101241
[8] Overgaard, H.J., Dada, N., Lenhart, A., Stenström, T.A.B., Alexander, N. (2021). Integrated disease management: arboviral infections and waterborne diarrhoea. Bulletin of the World Health Organization, 99(8): 583-592. https://doi.org/10.2471/BLT.20.269985
[9] Parker, C., Garcia, F., Menocal, O., Jeer, D., Alto, B. (2019). A mosquito workshop and community intervention: A pilot education campaign to identify risk factors associated with container mosquitoes in San Pedro Sula, Honduras. International Journal of Environmental Research and Public Health, 16(13): 2399. https://doi.org/10.3390/ijerph16132399
[10] Irawan, D.W.P. (2022). Control of vectors and nuisance animals in hospitals. Surabaya Ministry of Health Polytechnic. https://repo.poltekkesdepkes-sby.ac.id/6885/.
[11] Setyaningrum, E. (2020). Get to know Malaria and its vectors. Lampung: Ali Imron Library. http://repository.lppm.unila.ac.id/19438/.
[12] World Health Organization. (2021). Dengue and severe dengue key facts. World Health Organization. pp. 1-13. https://www.who.int/health-topics/dengue-and-severe-dengue.
[13] Sunarsih, E. (2011). Application of environmental management concepts for Malaria vector control (A thought concept). Journal of Public Health Sciences, 2(1): 7-14. https://ejournal.fkm.unsri.ac.id/index.php/jikm/article/view/54.
[14] Mayasari, H., Windusari, Y., Hasyim, H. (2023). Eliminasi malaria di berbagai negara: Literature review. Journal of Nursing and Public Health, 11(1): 73-83. https://doi.org/10.37676/jnph.v11i1.4086
[15] Fitriana, Y., Windusari, Y., Hasyim, H. (2023). Berbagai metode intervensi untuk pengendalian vektor malaria: Naratif review. Journal of Nursing and Public Health, 11(1): 196-212. https://doi.org/10.37676/jnph.v11i1.4120
[16] Fitriani, D., Raharjo, M., Martini, M., Setiani, O., Wahyuningsih, N. E. (2023). Penerapan integrated vector management (ivm) dalam upaya eliminasi malaria di daerah endemis kabupaten purworejo. Jurnal Kesehatan Lingkungan Indonesia, 22(1): 112-121. https://doi.org/10.14710/jkli.22.1.112-121
[17] Nanda, M., Berutu, A.N.I., Berutu, W.O., Ash-shiddiq, M.D. (2023). Analysis of the implementation of dengue hemorrhagic fever (DBD) vector control management in the 19th ward of Belawan Bahagia Subdistrict. VISA: Journal of Visions and Ideas, 3(2): 425-433. https://journal.laaroiba.com/index.php/visa/article/download/3331/2464/.
[18] Huda, M., Marhamah, M., Yuniza, F. (2022). Community education and cadre training in malaria prevention and examination in the working area of the Maja Health Center, Pesawaran Regency. Journal of Community Service Creativity (PKM): 5(9): 2829-2842. https://doi.org/10.33024/jkpm.v5i9.6782
[19] Rachmawati, K.D., Khambali, R. (2022). Implementation of the CIPP method in evaluation of vector control programs in hospitals to reduce the risk of disease transmission (Study at the Royal Surabaya Hospital in 2020). Echo Journal of Environmental Health, 20(1): 42-48. https://gelinkes.poltekkesdepkes-sby.ac.id/index.php/gelinkes/article/view/4.
[20] Tjitradinata, C., Laksono, M.A., Fymbay, D.M., Pratiwi, Y.B.D., Juliandari, C.A.G. (2022). Mosquito vector control pre-intervention (non-insecticide) in the Santo Thomas orphanage environment. Biomedical Pranata Journal, 1(1): 11-20. https://doi.org/10.24167/jpb.v1i1.3714
[21] Huda, M., Marhamah, M. (2022). Education on Malaria prevention and anemia monitoring as well as efforts to prevent transmission of Covid-19 to the community in the Sukamaju Bay betung health center working area. Journal of Community Service Creativity (PKM), 5(10): 3262-327. https://doi.org/10.33024/jkpm.v5i10.6937
[22] Supranelfy, Y., Oktarina, R. (2021). Gambaran Perilaku Pencegahan Penyakit Malaria di Sumatera Selatan (Analisis Lanjut Riskesdas 2018). Journal Kolegium, 17(1): 19-28. https://doi.org/10.22435/blb.v17i1.3556
[23] Isnani, T., Ikawati, B., Sholichah, Z., Prastawa, A. (2021). Javanese cultural values in malaria control to achieve Malaria Elimination in the Menoreh hill area. Health Systems Research Bulletin, 24(4): 252-264. http://doi.org/10.22435/hsr.v24i4.3974
[24] Ruliansyah, A., Pradani, F.Y. (2020). Perilaku-perilaku sosial penyebab peningkatan risiko penularan malaria di pangandaran. Buletin Penelitian Sistem Kesehatan, 23(2): 115-125. https://doi.org/10.22435/hsr.v23i2.2797
[25] Saputra, R., Alamsyah, A., Devita, Y. (2020). Pemantauan surveilans program malaria dalam mempertahankan sertifikasi eliminasi di Kabupaten Rokan Hulu. Al-Tamimi Kesmas: Jurnal Ilmu Kesehatan Masyarakat (Journal of Public Health Sciences): 9(2): 131-150. https://doi.org/10.35328/kesmas.v9i2.1514
[26] Afriadi, Suroyo, R.B., Haharap, J. (2020). Evaluation of the implementation of the Malaria elimination program in Aceh Singkil Regency in 2018. Priority Nursing Journal, 3(1): 1-12. https://doi.org/10.34012/jukep.v3i1.757
[27] Tin, S. (2019). The relationship between community knowledge and attitudes and malaria prevention at the teling community health center, Manado City. Nursing Inside Community, 1(2): 42-48. https://jurnal.stikesnh.ac.id/index.php/nic/article/view/56.
[28] Lalandos, N., Kepel, B.J., Umboh, J.M.L. (2019). Evaluation of the Implementation of the Malaria

Elimination Program in Talaud Islands Regency. Pps Journal of Sam Ratulangi University Manado, 2(1): 54-62. https://journal.iktgm.ac.id/index.php/nursing/article/view/67.

[29] World Bank Group. (2004). Environmental management for malaria control in the East Asia and Pacific (EAP) Region. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/327941468770746528/environmental-management-for-malaria-control-in-the-east-asia-and-pacific-eap-region.

[30] Bakri, S., Apriliani, A.P., Kurniawaty, E., Mayaquezz, H. (2024). Environmental and demographic effects on vector borne disease incidence: Welfare role on DHF reduction. Journal of Human, Earth, and Future, 5(1): 34-50. https://doi.org/10.28991/HEF-2024-05-01-03