Journal of Sustainability Science and Management
Volume 19 Number 2, February 2024: 193-211
eISSN: 2672-7226

ADAPTATION MODEL OF AEDES SP. MOSQUITO DENSITY BREEDING TO THE EFFECT OF ENVIRONMENTAL RISK CONTROL

AIDIL ONASIS[1,2], ERI BARLIAN[2]*, ABDUL RAZAK[2], INDANG DEWATA[2], ISWANDI UMAR[2] AND RAHMI HIDAYANTI[2]

[1]Program of Environmental Health in Poltekes Kemenkes Padang, Indonesia. [2]Doctor Program of Environmental Science, Postgraduate School, Universitas Negeri Padang, Indonesia.

**Corresponding author: e.barlian@fik.unp.ac.id*
http://doi.org/10.46754/jssm.2024.02.010
Submitted final draft: 12 September 2023 *Accepted: 14 October 2023* *Published: 15 February 2024*

Abstract: This research aimed to determine the adaptation pattern of *Aedes sp.* mosquito density breeding to the effects of environmental risks. The research design is descriptive analytics with the population and sample in this research are all households that have the potential to become mosquito breeding as many as 200 houses with analysis in the form of container density. The results of adaptation on control interactions against *Aedes sp.* mosquitoes by families are that the potential for mosquito breeding in Nanggalo Sub-district is the TPA type as much as 50.69%, the most in the Gurun Laweh Village is 39.78 and in Pauh the Non-TPA type is 42.49% the most in the Limau Manih south 38.78%. The intervention of the breeding mosquito in the Nanggalo Sub-district averaged 69% draining and 97% covered the average by removing and closing. The spatial environment risk for transmission is higher than the high risk in Nanggalo Sub-district. Mosquito breeding it was found that there was a direct and significant effect of adaptation and potential characteristics on the risk of mosquito breeding with a coefficient of 0.594 and 0.279 with a T Value of 11.704 and 1.970.

Keywords: Adaptation, characteristics, environmental, *Aedes sp.*, mosquito breeding.

Introduction

Living beings, especially humans, play a crucial role in shaping the environment and its dynamics. This holds particularly true for developing countries like Indonesia where the risk of infectious diseases remains endemic. The prevalence of these diseases is on the rise due to the influence of environmental factors and people's lifestyles. Moreover, the deteriorating socio-economic conditions have further exacerbated the incidence of infectious diseases, requiring a more serious and professional approach towards their treatment (Adrianto, 2021).

Indonesia also faces a double burden in health development, or what is known as a double burden. Today, we are still faced with an increase in several communicable diseases (re-emerging diseases), while non-communicable or degenerative diseases are starting to increase. In addition, several new diseases (new-emerging diseases) have emerged (Alto *et al*., 2012; Sayavong *et al*., 2013). One the infectious diseases that are still a concern and a public health problem in Indonesia today is Dengue Hemorrhagic Fever (DHF) and *Chikungunya* Fever as mosquito-borne diseases (vectors) whose spread is increasingly widespread. The Zika virus is also transmitted through mosquito bites. *Aedes* mosquitoes can be in the type of *Aedes aegypti* for the tropics, *Aedes Africanus* in Africa, and also *Aedes Albopictus* in several other areas. The habitat *Aedes* mosquito is containers in the household potential type of mosquito that is active during the day and can live indoors or outdoors (Barrera *et al*., 2011; Alto *et al*., 2012; Arunachalam *et al*., 2012; Ardiansyah *et al*., 2015).

The current surge in DHF cases compared to the last three years poses a significant environmental risk, primarily attributed to the manual reporting system and the ongoing COVID-19 pandemic. The risk of transmission is still relatively high, surpassing the national CFR's threshold, which should remain below 1%. The environmental risk transmission is strongly influenced by the role of mosquitoes as transmitters and their adaptation in the domestic environment, especially in water storage as breeding places. The number of mosquito breeding places is closely related to the existence of community water reservoirs in households, which vary in size and condition (Adrianto, 2021; Sukesi & Ambarwati, 2022).

The intervention efforts that have been campaigned by the environmental health program manager by eradicating mosquito breeding through 3M must still be cultivated and even must be intensified. Continuation of routines and consistency in reducing the population by monitoring mosquito breeding in water shelters/containers is the easiest way to prevent the presence and density of mosquitoes so that the potential for *Aedes aegypti* as a transmitter can be maximised when there is an increase in DHF cases. The COVID-19 virus, in reality, this effort is starting to decrease along with the reduced number of recorded cases and incidents. The mosquito population as a vector during a pandemic is not significantly reduced.

The development of information technology creates new things for actors in the field of public health to improve the planning, study, monitoring, and management of health systems. Health mapping has evolved since Dr. John Snow introduced cholera mortality mapping in the mid-nineteenth century (Raju & Sokhi, 2008; Candra, 2010; Khormi & Kumar, 2011; Darwin *et al*., 2013).

Intervention analysis is expected to be able to carry out studies on the environmental potential to become mosquito breeding places and to design forms of control that are easily applied by the community. In order to prevent the transmission of DHF via environmental risks, it is imperative to monitor the density of larvae in water containers and the conditions of water reservoirs that are at risk of becoming breeding grounds. This can be done by establishing a baseline of the number and type of mosquitoes prevalent in the area, to help the community and health workers in monitoring and controlling larva density. Environmental health staff at the public health centre can play a crucial role in this process by overseeing monitoring and control efforts, thereby reducing the risk of DHF transmission in the community.

Assess vector control interventions that involve the community explicitly in implementation for transmission risk, focus on the most productive breeding sites for *Aedes aegypti*, and report an analysis of the costs of these interventions. By undertaking cost from the perspective of vector control programs, collect data on the number and unit costs of resources used to provide interventions. Comparable information is requested for routine activities. Cost items were classified, analysed descriptively, and combined to calculate the total cost each house accomplished and incremental costs.

The adaptation for the intervention component that focuses mainly on changes to established vector control programs appears to be affordable; cost savings were identified at Salto (-21%) and a net core component at Machala (-12%). Based on an estimated 10% surcharge, there are also completely new components that will require considerable financial effort (installing insecticide-treated nets costs a certain amount for each house). Interventions can improve the cost profile of existing vector control programs. The cost of new components can be substantial and must be assessed about the benefits of reducing the dengue burden (Raju & Sokhi, 2008; Candra, 2010; Khormi & Kumar, 2011; Darwin *et al*., 2013; Latifa *et al*., 2013; Kinansi *et al*., 2017; Kohler *et al*., 2017). Based on this, the researchers were interested in examining the adaptation model of *Aedes sp.* mosquito density to the effect of controlling environmental risks. The significant impact of the results of this research is environmental risk control on the density of *Aedes sp.* mosquitoes on the influence.

Methods

The design of this research is a descriptive-analytic type through observation and survey of larvae to obtain an interaction model for controlling *Aedes sp.* mosquitoes by families for predicting spatial risk in adapting to new habits. The time for conducting the research was 10 months, from March to November 2022. The population in this study were all houses that have the potential to become breeding for *Aedes sp*. In sub-districts within the working area of the health centres in Nanggalo and Pauh Sub-district of Padang City in 2022.

The sample in this study was the sub-district with the highest prevalence rate of DHF in the last three years, where each sub-district had 200 households purposively based on the tendency of potential mosquito breeding containers and control interactions in new habits. Primary data is the result of observation and calculation of larval density with larval density index, ecological components, and potential breeding places. The study focuses on the use of the Containers Index (CI) as a key metric to examine disease prevention interventions and spatial risks associated with mosquito breeding. The goal is to obtain results that accurately reflect disease transmission and environmental spatial risks. Rigorous data processing from editing to processing, is conducted to ensure the accuracy and completeness of the collected data. Data analysis in visually determining spatial risk based on distribution and percentage arranged sequentially and given a score of 1 to 3 and other variables in the form of a Structural Equation Model (SEM) test between environmental components and breeding sites with the risk of DHF transmission. Field data processing is processed into attribute data, which is processed by applications using software by entering data from forms into Quantum computer program packages for mapping and SMARTPLS for modelling.

Results

Mosquito Adaptation Control Interactions *Aedes sp.* by Family in New Habits

Distribution of Potential Mosquito Breeding Water Containers in the Working Area of the Health Centre in Nanggalo Sub-district

The results of the overall power collection by dividing the number of houses and water reservoirs to get the condition and distribution of houses with potential water reservoirs as mosquito breeding sites as shown in Figure 1.

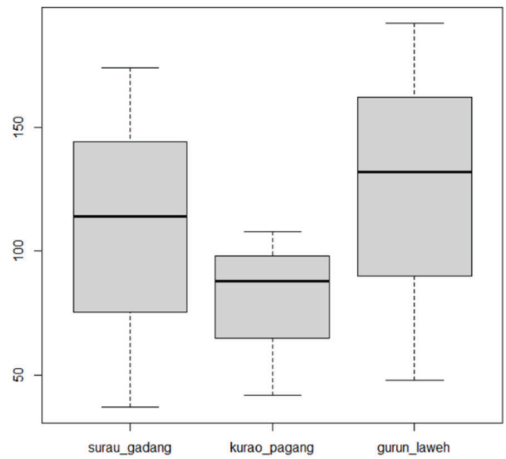

Figure 1: Distribution of water storage by type of family TPA in the health centre of Nanggalo Sub-district 2021 and 2022

From Figure 1, it can be described the distribution of water reservoirs based on the type of family TPA in the work area of the health centre in Nanggalo Sub-district, most of which are the Gurun Laweh Village, 372 containers, and the type of storage container water storage containers, 474 out of 935 containers which are used for washing, bathing and toilet purposes in everyday life, including cooking and drink.

From Figure 2, it can be described that the distribution of family water reservoirs found in larvae in the work area of the health centre in Nanggalo Sub-district was mostly of the TPA type in the Gurun Laweh Village area as many as 34 out of 192 TPA with the highest density of containers being 63 out of 372 total storage containers in Nanggalo Sub-district.

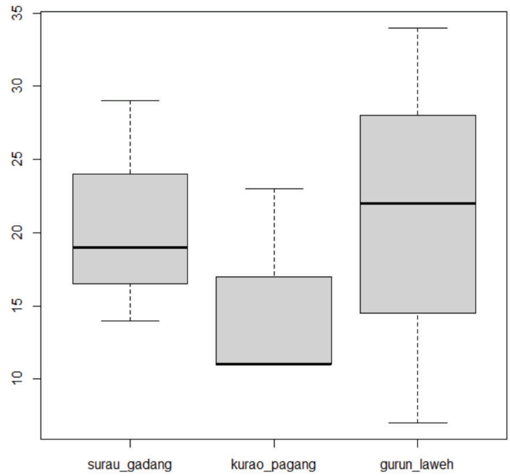

Figure 2: Distribution of water storage found by *Aedes sp.* in the health centre of Nanggalo Sub-district 2021 and 2022

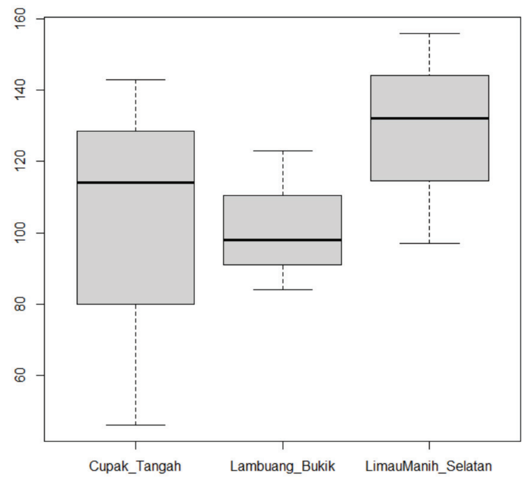

Figure 4: Distribution of water storage by type of family TPA in the health centre of Pauh Sub-district 2021 and 2022

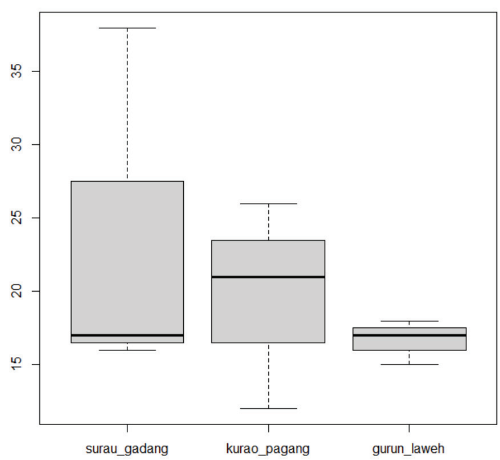

Figure 3: Percentage of water storage found *Aedes sp.* larvae in the health centre of Nanggalo Sub-district 2021 and 2022

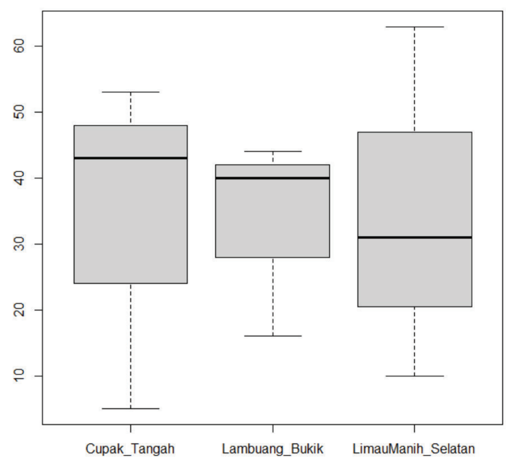

Figure 5: Distribution of water storage found by *Aedes sp.* in the health centre of Pauh Sub-district 2021 and 2022

Distribution of Potential Mosquito Breeding Water Storage Containers in the Health Centre of Pauh Sub-district

The results of the overall power collection by dividing the number of houses and water reservoirs to get the condition and distribution of houses with potential water reservoirs as mosquito breeding sites as shown in Figure 4.

From Figure 4, it can be described that the distribution of family water reservoirs in the health centre of Pauh Sub-district is mostly in the Limau Manih Selatan Village with 385 shelters as water containers.

From Figure 5 it can be described the distribution of family water reservoirs where larvae were found in the working area of the health centre in Pauh Sub-district, most of which were the TPA type in the Limau Manih Selatan Village, as many as 63 of the 132 TPA.

From Figure 6, it can be described that the percentage of family water reservoirs that found larvae in the working area of the health centre in

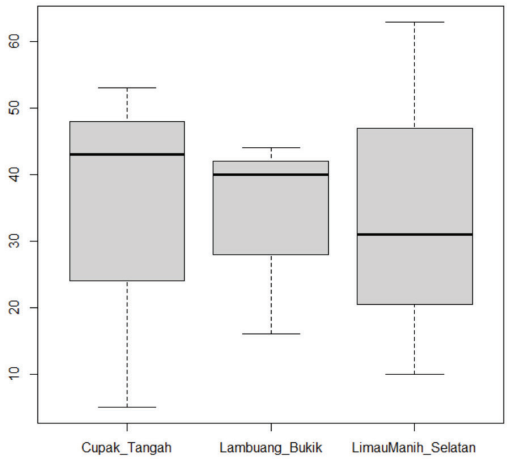

Figure 6: Percentage of water storage found *Aedes sp.* larvae in the health centre of Pauh Sub-district 2021 and 2022

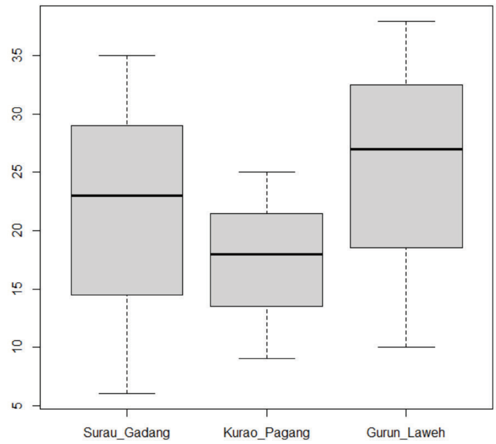

Figure 7: Intervention of water collection by families with new habits of the health centre in Nanggalo Sub-district 2021 and 2022

Pauh Sub-district was mostly of the natural type in the Lambuang Bukik Village of 71.34% with a container density of 30.70%.

Distribution Intervention of Potential Mosquito Breeding Water Storage Containers in the Working Area of the Health Centre in Nanggalo Sub-district

From Figure 7, it can be described that the percentage of family water collection interventions in the working area of the health centre in Nanggalo Sub-district is the highest in the desert laweh area in 3M compared to other urban villages and the effort to drain is 38%.

From Figure 8, it can be described that the percentage of family water collection interventions in the work area of the health centre in Pauh Sub-district was mostly in the Cupak Tangan village with an effort to drain it by 51%, in Limau Manih Selatan village it closed by 47% and got rid of 14%.

Spatial Risk of Dengue Transmission by *Aedes sp.* Mosquitoes in Adapting to New Habits

In order to illustrate the continued spatial risk analysis of DHF disease transmission by the *Aedes sp.* mosquito vector, processing was conducted with a combination of percentages and stratified scoring sequentially to visualise

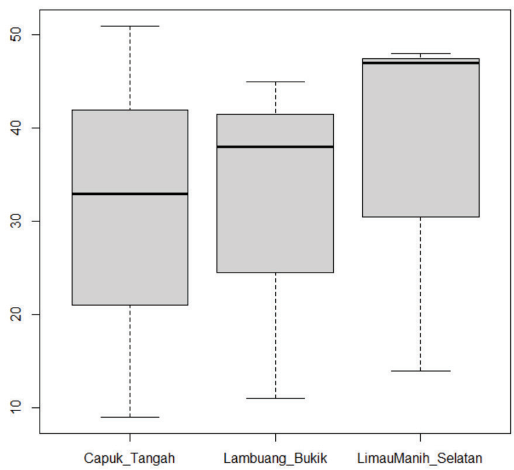

Figure 8: Family water storage intervention with new habits of the health centre in Pauh Sub-district 2021 and 2022

the health centre in Nanggalo Sub-district and Pauh Sub-district based on Table 1.

Based on Table 1, it can be explained that the percentage distribution of mosquito breeding density based on water storage containers and intervention efforts based on the percentage of observed variables and the order of scoring the tendency of the variables studied in determining the risk of transmission spatially of the health centre in Nanggalo Sub-district as shown in Figure 9 and Figure 10.

Table 1: Percentage of spatial risk of mosquito breeding with intervention efforts in adaptation to new habits of the health centre in Nanggalo Sub-district 2021 and 2022

Water Storage Inspection Area	Weighting			
	% Larval Density	Scoring	% Intervention Efforts	Scoring
	A	B	C	D
Surau Gadang	19.07	1	64	2
Kurao Pagang	18.9	2	52	1
Gurun Laweh	16.93	3	75	3
	18,18			

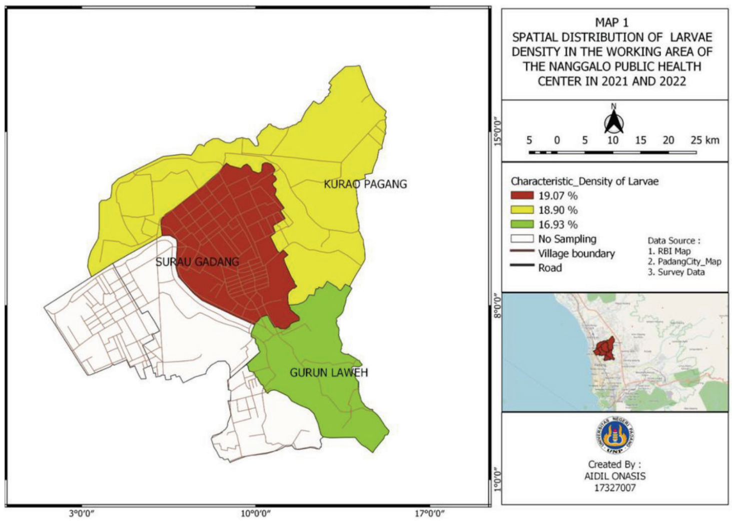

Figure 9: Map 1 of the spatial distribution of larval densities found in water storage containers of the health centre in Nanggalo Sub-district 2021 and 2022

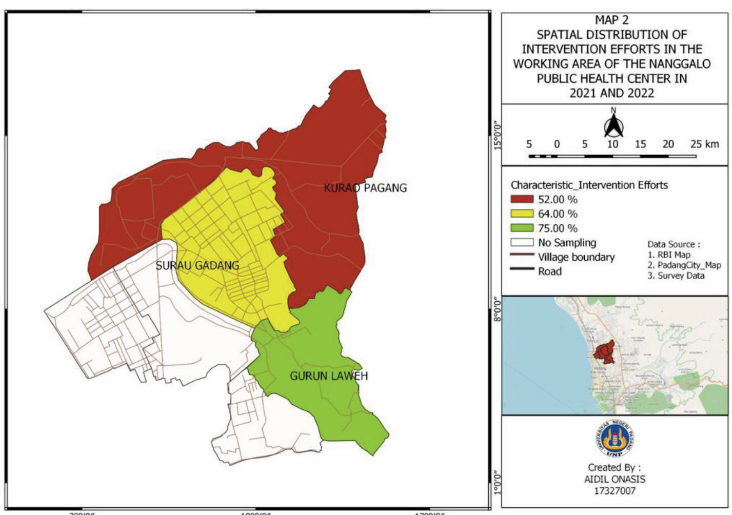

Figure 10: Map 2 distribution of water collection intervention efforts of the health centre in Nanggalo Sub-district 2021 and 2022

Based on Table 1, the spatial distribution of mosquito breeding density is visualised based on the container index, namely Surau Gadang Village with the highest density compared to other villages, namely 19.07%.

Based on Table 1, the spatial distribution of intervention efforts against mosquito breeding is visualised with the largest percentage, namely Gurun Laweh Village of 75.00%. Compared to other municipalities. Furthermore, to visualise the spatial distribution of transmission risk regionally based on Table 1, the analysis results can be described as shown in Figure 11.

Based on the data presented in Table 1, it can be inferred that the risk of mosquito breeding, larval density, and intervention efforts are relatively low in the Gurun Laweh Village subdistrict as compared to Kurao Pagang Village and Surau Gadang Village.

Table 2 explains the percentage distribution of mosquito breeding density based on water storage containers and intervention efforts based on the percentage of observed variables and the order of scoring the tendency of the variables studied in determining the risk of transmission spatially in the health centre of Pauh Sub-district as shown in Figure 12 and Figure 13.

Based on Table 2, the spatial distribution of mosquito breeding density is visualised based on the container index, namely Cupak Tangah Village with the highest density compared to other villages, namely 33.39%.

Based on Table 2, it is visualised the spatial distribution of intervention efforts on the density of mosquito breeding, which was mostly carried out in the Limau Manih Selatan Village compared to other villages, namely 97.00%. Furthermore, to visualise the spatial distribution

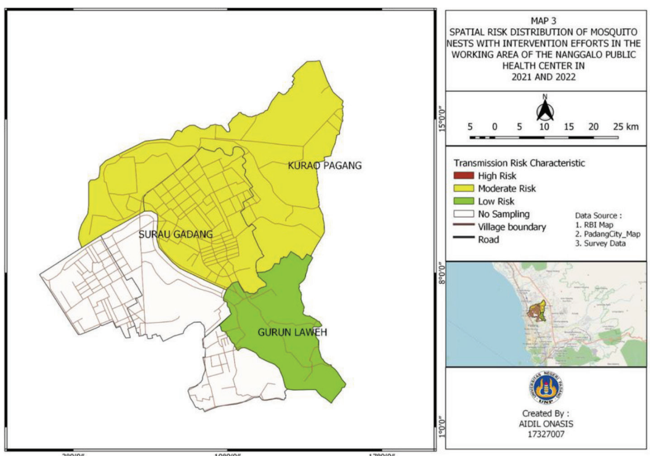

Figure 11: Map 3 of spatial risk distribution of mosquito breeding with intervention efforts of the health center in Nanggalo Sub-district 2021 and 2022

Table 2: Percentage of spatial risk of mosquito breeding with intervention efforts in habit adaptation of health centre in Pauh Sub-district 2021 and 2022

Water Storage Inspection Area	**Weighting**			
	% Larval Density	**Scoring**	**% Intervention Efforts**	**Scoring**
	A	**B**	**C**	**D**
Cengkeh	33,39	1	93	1
Lambuang Bukik	32.79	2	94	2
Manih Limau Selatan	27.01	3	97	3
	30,70			

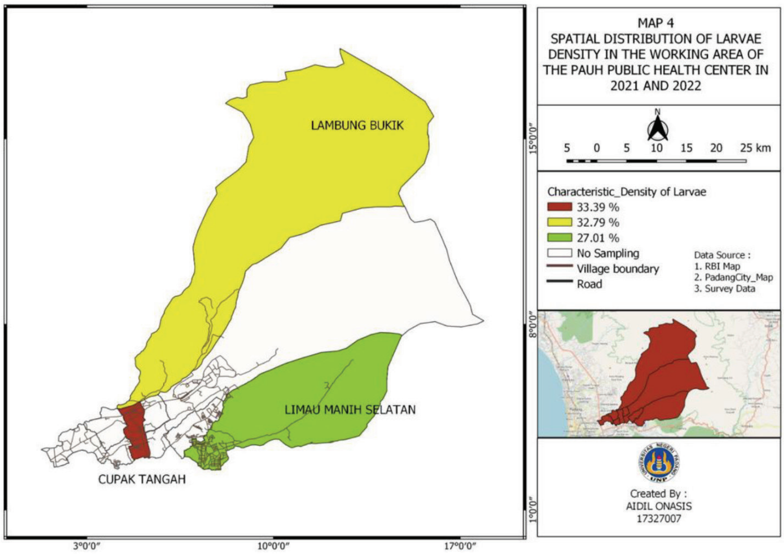

Figure 12: Map 4 of spatial risk distribution of larval density in the health centre in Pauh Sub-district 2021 and 2022

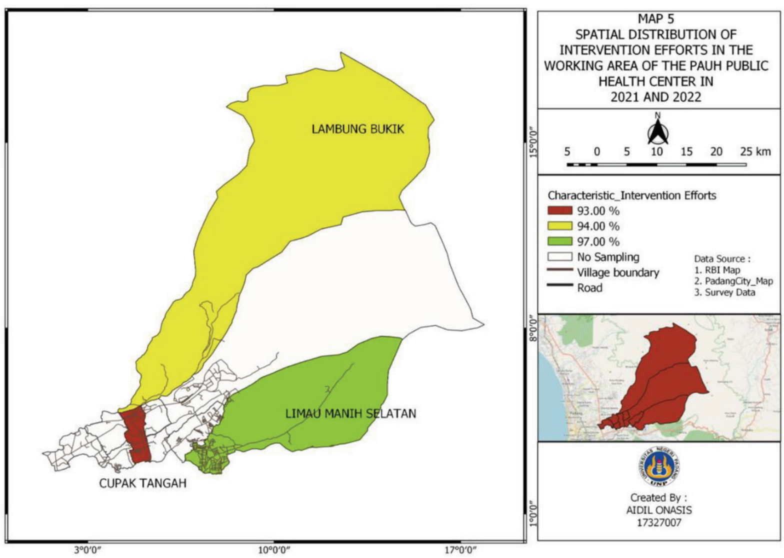

Figure 13: Map 5 distribution of intervention efforts of the health centre in Pauh Sub-district 2021 and 2022

of the risk of transmission in the working area of the health centre in Pauh Sub-district, based on Table 2, the results of the analysis can be described as shown in Figure 14.

Based on Table 2, the visualisation of the risk of mosquito breeding and intervention efforts can explain that the Limau Manih Selatan Village has a low risk compared to other Villages of the health centre in Pauh Sub-district.

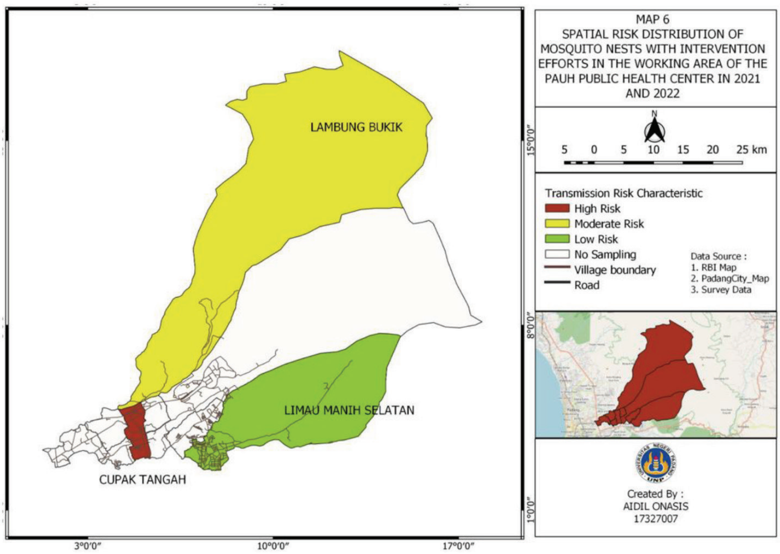

Figure 14: Map 6 of spatial risk distribution of mosquito breeding with intervention efforts of the health centre in Pauh Sub-district 2021 and 2022

The Influence Model Between The Variables of The Interaction Control of *Aedes sp.* Mosquito Breeding by the Family in The Adaptation of New Habits

Composite Variables with Confirmatory Factor Analysis (CFA)

For composite variables, this is intended to see whether data is valid or invalid on the observed variable in the latent/unobserved variable or how much the variance of the indicator can be explained by the latent variable.

In Figure 15, the obtained information from the factor loading values of each independent variable and the dependent variable, namely:

- At point a, the characteristics of TPA + larvae (0.874) and the number of mosquito breeding + insecticide (0.604) are significant indicators of the risk of areas being mosquito breeding grounds because they have a greater loading factor value of 0.5.
- At point b, the variable handwashing facilities (0.968) and new habits (0.964) are significant indicators of adaptation because they have a greater loading factor value of 0.5.
- At point c the number of buckets (0.802) and the number of buckets with larvae (0.771) is significant as an indicator of potential characteristics because it is 0.5 larger.
- In point e, the frequency of use of insecticides (0.880) and frequency of use (0.839) are significant indicators of chemical insecticides because they are greater than 0.5.
- At point d, the habit of closing buckets/drums (0.913) and the habit of monitoring potholes and stagnant containers (0.510) is significant as an indicator of PSN because it is greater than 0.5.

Results of Analysis 1 Using SEM

Next the results of analysis 2 used the SEM method for efforts to control the risk of mosquito breeding can be seen in Figure 17 and Figure 18.

The analysis results indicate that the observed variable data, which is invalid, has been removed to ensure the presentation of the valid data. This process has led to the attainment of a large influence value, which can be observed in Figure 17. Furthermore, the succeeding Figure 18 displays the T-value of the

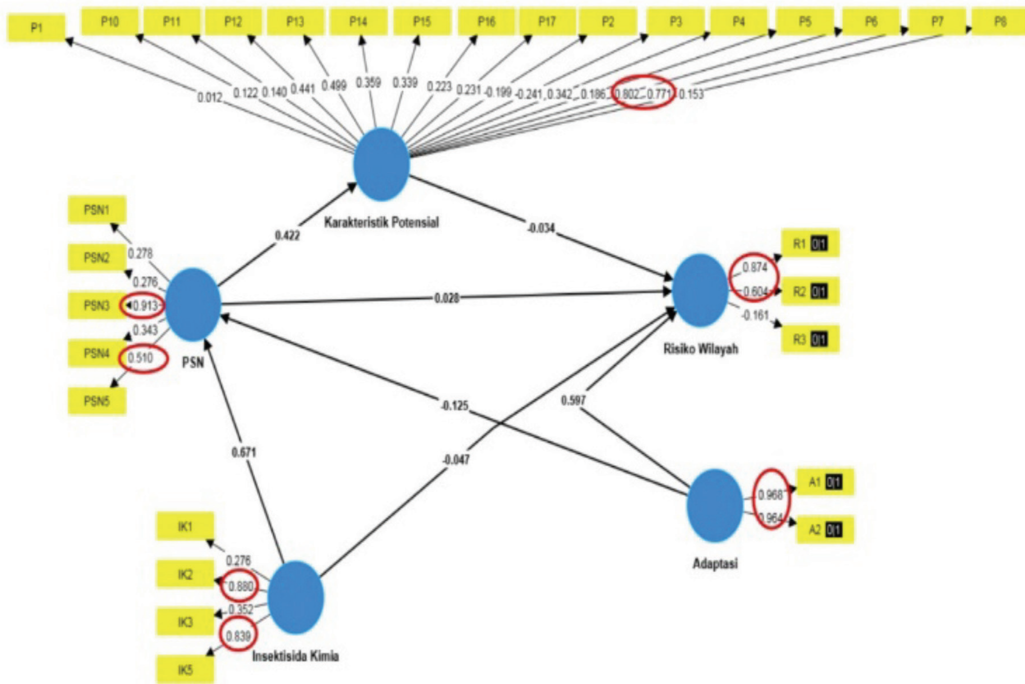

Figure 15: Mark factor loading on each variable

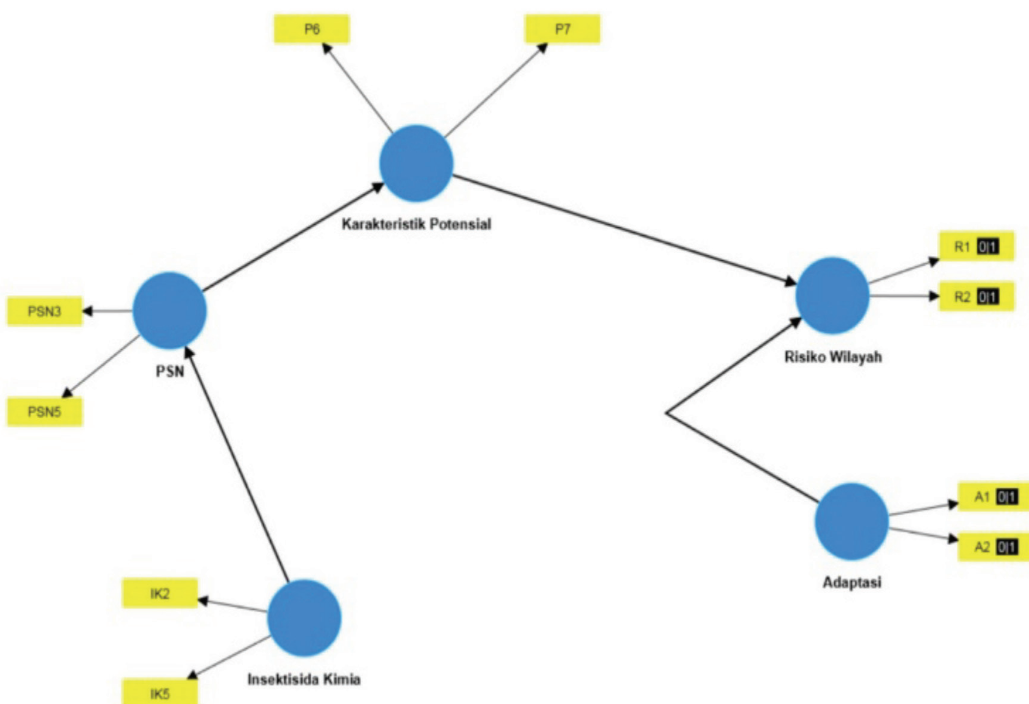

Figure 16: The design of the SEM Model on efforts to control the risk of mosquito breeding

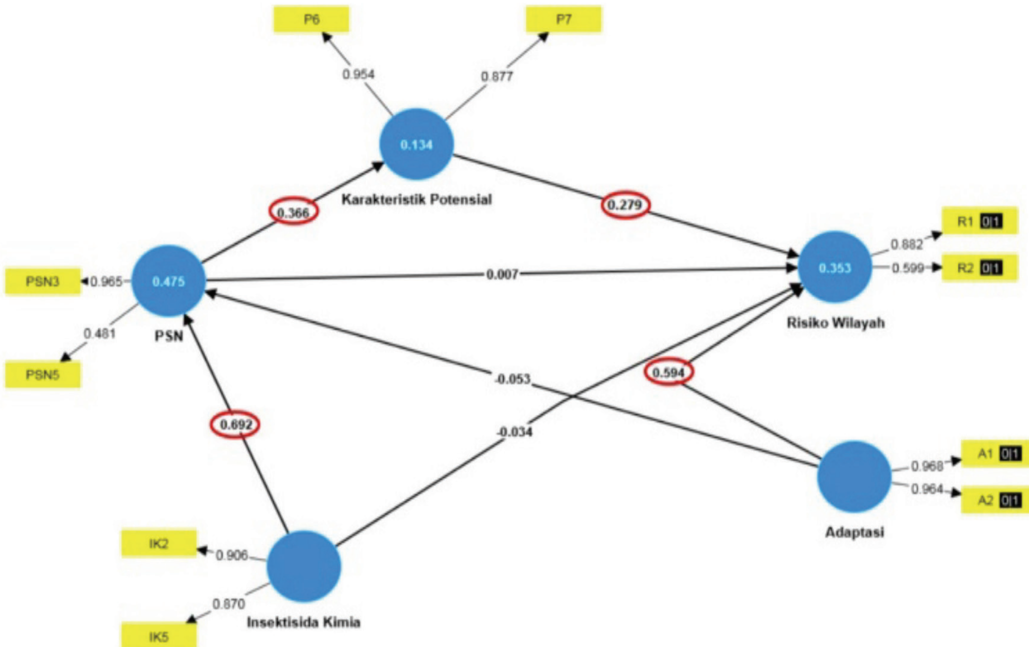

Figure 17: Path coefficient/magnitude of the influence of the risk of mosquito breeding using the SEM method

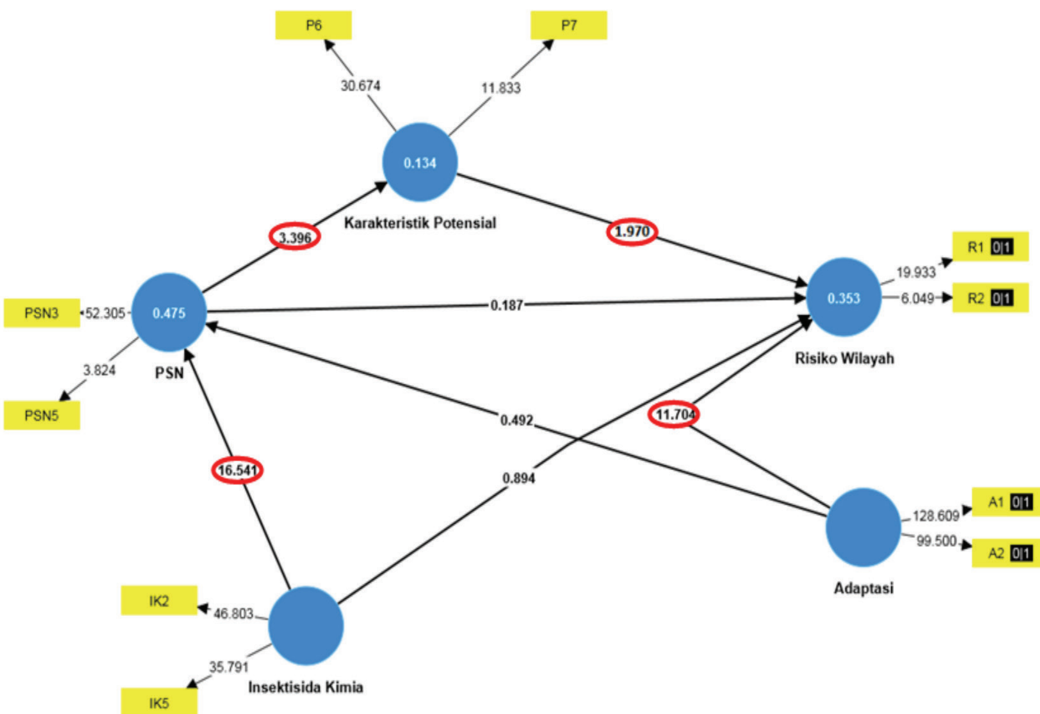

Figure 18: The T Value value of efforts to control the risk of mosquito breeding using the SEM method

efforts directed towards controlling the risk of mosquito breeding.

Y Structure Equation:

: $Pyx^1 X^1 + Pyx^2 X^2 + ; R_{square}\varepsilon$

: $0.594X^1 + 0.279X^2 + ; 0.353.0,647$

After obtaining the results of the SEM analysis are in Figure 17, and the results are shown in Table 3.

The research findings suggest that some factors influence the risk of mosquito breeding while others do not have a significant impact. The path coefficient and significant level of efforts to control mosquito breeding risk were analysed to arrive at this conclusion. More details can be seen in Table 3 this is obtained, namely:

- Adaptation to the risk of mosquito breeding: Based on Table 3, the results of the path analysis statistical test using the SEM method obtained a T-Value of 11.704 with a 95% confidence level. Value 11.704 > 1.96. This shows that adaptation has a significant effect on the risk of mosquito breeding. Adaptation has a path coefficient (β) of 0.594 to the risk of mosquito breeding. This shows that if respondents adapt well such as hand washing and new habits, it is expected to increase efforts to control the risk of mosquito breeding by 59.4% and vice versa.
- Potential characteristics of the risk of mosquito breeding: Based on Table 3, the results of the path analysis statistical test using the SEM method obtained a T-value of 1.970 with a 95% confidence level. Value 1.970 > 1.96. This shows that the potential characteristics significantly influence the risk of mosquito breeding. Potential characteristics have a path coefficient (β) of 0.279 on the risk of mosquito breeding. This shows that if respondents can reduce potential characteristics such as the number of buckets/containers with larvae, it is estimated that the risk of mosquito breeding can be reduced by 27.9% and vice versa.
- PSN against the risk of mosquito breeding: Based on Table 3, the results of the path analysis statistical test using the SEM method obtained a T-Value of 0.187 with a 95% confidence level. Value 0.187 < 1.96. This shows that PSN has no significant effect on the risk of mosquito breeding.
- Insecticides against the risk of mosquito breeding: Based on Table 3, the results of the path analysis statistical test using the SEM method obtained a T-Value of 0.894 with a 95% confidence level. Value 0.894 < 1.96. This shows that chemical insecticides do not significantly affect the risk of mosquito breeding. After obtaining the overall result diagram in Figure 19 and Figure 20, the results of path analysis are made which have a significant level only for the dependent variable, so that paths between variables are formed. The path formed is:

The results of path analysis with significance level values (T-Value).

Table 3: The results of the path coefficient and significant level of efforts to control the risk of mosquito breeding

Influence Between Variables	Path Coefficient (Beta)	T-Value	Test Result
Adaptation (X^1) to the risk of mosquito breeding (Y)	0.594	11,704	Significant
Potential characteristics (X^2) of the risk of mosquito breeding (Y)	0.279	1,970	Significant
PSN (X^3) on the risk of mosquito breeding (Y)	0.007	0.187	Not significant
Chemical Insecticides (X^4) against the risk of mosquito breeding (Y)	-0.034	0.894	Not significant

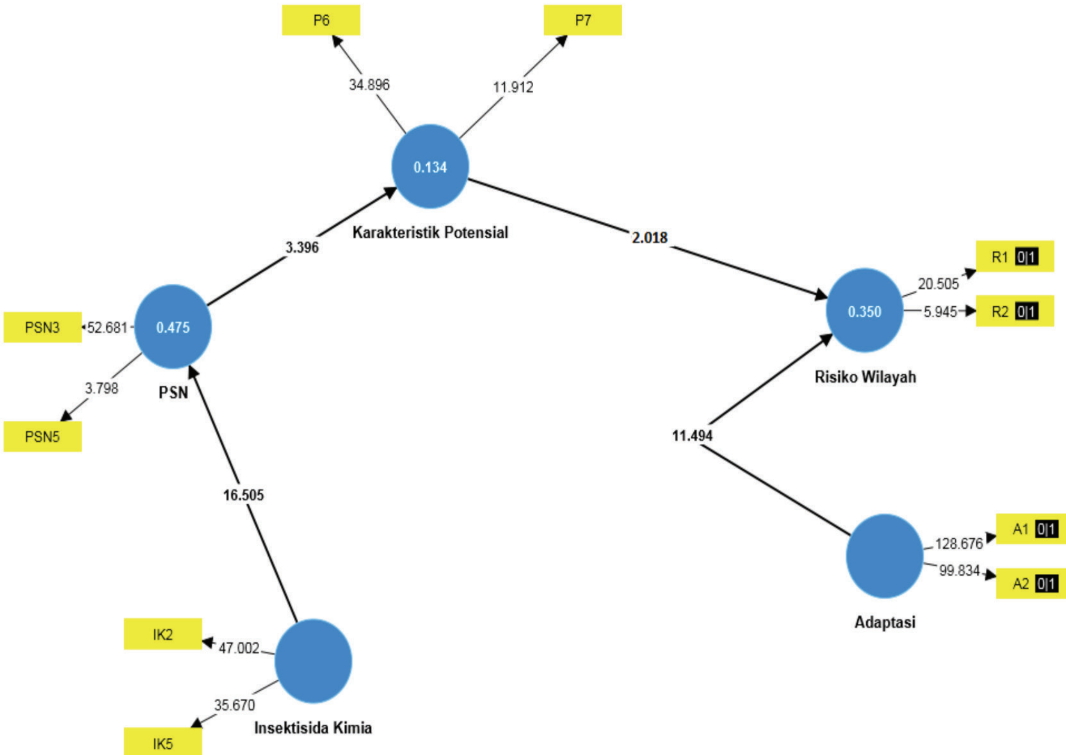

Figure 19: The significance level (T-Value) of efforts to control the risk of mosquito breeding using the SEM method

The results of path analysis with the value of the path coefficient/amount of influence (β)

Based on Table 4, a path analysis is formed which is obtained using the Structural Equation Modeling (SEM) method. Therefore, an interpretation is carried out to interpret the results of the path analysis so that it can provide information from the path analysis as follows:

Adaptation (X^1)

- The direct effect of adaptation (X^1) on efforts to control the risk of mosquito breeding (Y) = 0.585.
- Structural Equation X^1 against Y: $PyX^1 X^1 + y = 0.585X^1 + y\varepsilon\varepsilon$.
- Total adaptation (X^1) to efforts to control the risk of mosquito breeding (Y) = 0.585.

Based on the results of path analysis using the SEM method, it was found that adaptation directly affects efforts to control the risk of mosquito breeding with a large influence of 0.585.

Potential Characteristics (X^2)

- The direct effect of potential characteristics (X^2) on efforts to control the risk of mosquito breeding (Y) = 0.285.
- Structural Equation X^1 against Y: $PyX^2 X^2 + y = 0.285X^2 + y\varepsilon\varepsilon$.
- Total Potential Characteristics for Mosquito Breeding Risk Control Efforts (Y) = 0.285.

Based on the results of path analysis using the SEM method, it was found that the potential characteristics had a direct effect on efforts to control the risk of mosquito breeding with a large influence of 0.285.

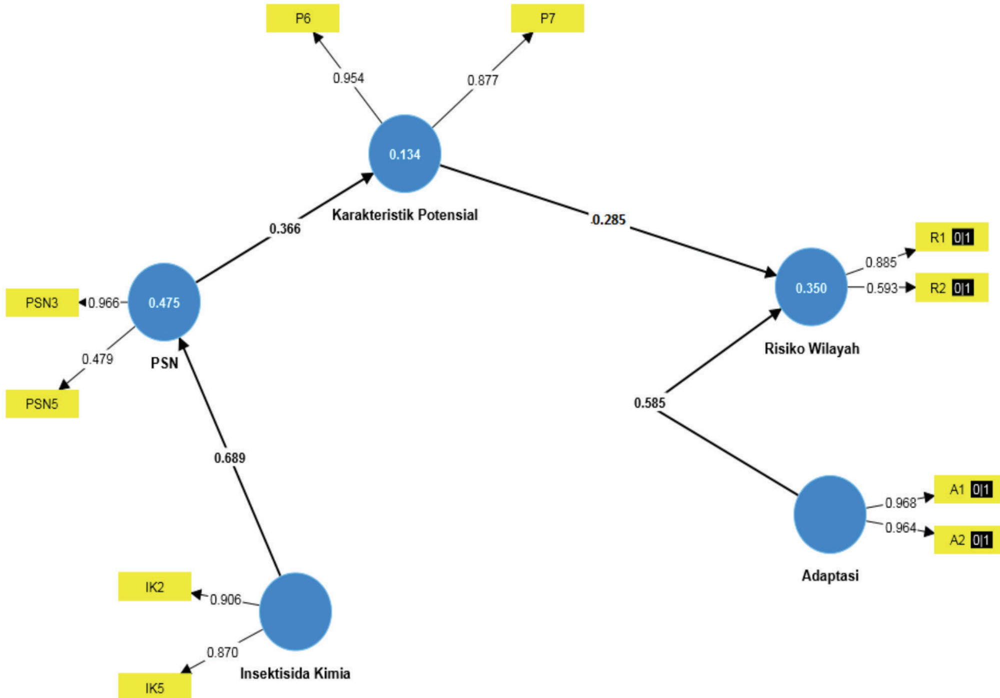

Figure 20: The magnitude of the influence/path coefficient of efforts to control the risk of mosquito breeding using the SEM method

Table 4: The results of the significance level and the influence/path coefficient using the structural equation modelling (SEM) method.

	Path Coefficient	**T-Value**
Adaptation (X^1) → Mosquito nest risk (Y)	0.585	11,494
Potential Characteristics (X^2) → Risk of mosquito nest (Y)	0.285	2.018
PSN (X^3) → Potential Characteristics (X^2)	0.366	3,396
Chemical Insecticide (X^4) → PSN (X^3)	0.689	16,505

PSN (X^3)

- The direct effect of PSN (X^3) on Potential Characteristics (X^2) = 0.36.
- Structural Equation of X^3 to X^2: $PX^2X^3X^3 + \varepsilon 2 = 0.366X^3 + \varepsilon 2$.
- The indirect effect of PSN (X^3) on efforts to control the risk of mosquito breeding (Y) through Potential Characteristics (X^2) = 0.104.
- The total PSN against efforts to control the risk of mosquito breeding is = 0.366 + 0.104 = 0.470.

Based on the results of path analysis using the SEM method, it was found that PSN has an indirect effect on efforts to control the risk of mosquito breeding through potential characteristic pathways, with a total large overall effect of 0.470.

Insecticide (X^4)

- The direct effect of chemical insecticides (X^4) on PSN (X^3) = 0.689.
- Structural Equation of X^3 to X^3: $PX^3X^4X^4 + \varepsilon 3 = 0.689X^4 + \varepsilon 3$.

- Indirect Effect of Chemical Insecticides (X^4) on Efforts to control the risk of mosquito breeding (Y) through PSN (X^3) and Potential Characteristics (X^2) = 0.071.
- The overall total of chemical insecticides for efforts to control the risk of mosquito breeding is = 0.689 + 0.071 = 0.760

Based on the results of path analysis using the SEM method, it was found that chemical insecticides have an indirect effect on efforts to control the risk of mosquito breeding through the PSN route and potential characteristics with a total magnitude of overall influence, namely 0.760. In accordance with the results and interpretations above, the total structural equation Y is formed: $PyX^1 X^1 + PyX^2 X^2 + Py$; R_{square}: $0.585X^1 + 0.285X^2 + 0.650; 0.350.\varepsilon\varepsilon$.

The overall results show that efforts to control the risk of mosquito breeding to explain the variance of each variable is 35% and other factors explain a value of 65%. After researching and based on the theory of other influencing factors are PSN Cadres, health infrastructure, ABJ (Friper Free Rate), temperature, and rainfall.

Spatial risk of dengue transmission by *Aedes sp.* mosquitoes in adapting to new habits. Spatial mapping results based on maps 9 to 12 can visualise the risk of mosquito breeding and intervention efforts can be explained that the Gurun Laweh Village has a low risk compared to the Kurao Pagang Village and Surau Gadang Village. As well as the risk of mosquito breeding and intervention efforts it can be explained that the Limau Manih Selatan Village has a low risk compared to other Villages in the health centre of Pauh Sub-district. The results of this risk can spatially display the vulnerability of transmission based on the density of mosquito breeding with patterns of intervention during new habits. Each of the results of the sum of the weight values for each village is carried out by a spatial analysis which is processed in a spatial application using the QuantumGis software. After that, it is overlaid and produces a new map called the mosquito larvae density map.

The spatial distribution of vulnerability to the density of mosquito larvae is carried out to find out how much risk there will be in an area related to variables that may become areas prone to the density of *Aedes aegypti* mosquito larvae such as the free larvae rate (ABJ), mosquito breeding sites and 3M implementation. According to Dewata and Putra (2021) and Putra *et al.* (2023), spatial data is data that shows the position, size, and possible topographical relationships (shape and layout) of all objects on Earth. Environmental data refers to location points or represents the results of routine measurements at measurement, analysis, and observation points taken systematically or randomly. Data from an emission source is spatial data. According to Arlym *et al.* (2019), spatial data has two important parts that make it different from other data, namely location information or spatial information, namely information showing latitude and longitude information, and descriptive information, namely a locality can have several attributes or properties related to spatial information. Spatial data in this study are risk factors for DHF, namely population density and ABJ, as well as case coordinates and the risk of transmission.

The results of the study explaining the risk of spatial transmission based on potential water reservoirs, mosquito breeding, and intervention efforts with 3M in new habits is more high risk in the working area of the Nanggalo Sub-district, namely location information or spatial information, namely information showing latitude and longitude information, and descriptive information, namely a locality may have several attributes or properties related to spatial information. Spatial data in this study are risk factors for DHF, namely population density and ABJ, as well as case coordinates and the risk of transmission. From the results of the study explaining the risk of spatial transmission based on potential water reservoirs, mosquito breeding, and intervention efforts with 3M in new habits is more high risk in the working area of the health centre in Nanggalo Sub-district namely location information or spatial information, namely information showing latitude and longitude information, and descriptive information, namely a locality may have several attributes or properties related to spatial information. Spatial data in this study are risk factors for DHF, namely population density and ABJ, as well as case coordinates and the risk of transmission.

The results of the study explaining the risk of spatial transmission based on potential water reservoirs, mosquito breeding, and intervention efforts with 3M in new habits is more high risk in the working area of the health centre in Nanggalo Sub-district. Spatial data in this study are risk factors for DHF, namely population density and ABJ, as well as case coordinates and the risk of transmission. The results of the study explaining the risk of spatial transmission based on potential water reservoirs, mosquito breeding, and intervention efforts with 3M in new habits is more high risk in the working area of the health centre in Nanggalo Sub-district. Spatial data in this study are risk factors for DHF, namely population density and ABJ, as well as case coordinates and the risk of transmission. The results of the study explaining the risk of spatial transmission based on potential water reservoirs, mosquito breeding, and intervention efforts with 3M in new habits is more high risk in the working area of the health centre in Nanggalo Sub-district.

This report presents the findings on the influence model of the interaction control of *Aedes sp.* mosquito breeding by the family concerning the adaptation of new habits. The study aims to control the risk of mosquito breeding by analysing the data using SEM. The variables were derived by computing the observed variable with all the other variables, and the data were grouped based on the SEM. The loading factor value was used to obtain the values of the variables under study. The correlation value is the result of analysis with the conceptual model being the benchmark for comparing it. In research that is still in the development stage or testing theory, the standard value so that the composite value or loading factor is fulfilled is to use a tolerance value greater than 0.5 Susianti *et al.* (2017) add the analysis of environmental factors and DHF PSN movement on the density of *Aedes aegypti* mosquito larvae and the incidence of DHF in Makassar City. It was found that the type of container, temperature, humidity, and pH affect the presence of *Aedes aegypti* mosquito larvae. In addition, there was an increase in ABJ after the PSN DHF intervention (3M Movement and Abatisation) was carried out.

The human factor in the form of behaviour and community participation which is still lacking in PSN activities, as well as the factor of population growth and the factor of increasing population mobility which is in line with the improvement of transportation facilities, is also one of the causes of the easier and wider spread of the DHF virus (Singh *et al*., 2013). Besides DHF, the Aedes mosquito is also a vector for *Chikungunya*, Zika, and Yellow Fever. Therefore, interventions that aim to reduce the mosquito population are efforts to protect people from several diseases. The most successful approach to Mosquito control is when integrated mosquito control management is implemented, where all appropriate technologies and management techniques are used, to produce an effective reduction of target species populations cost-effectively.

This is in line with research conducted by Pratamawati *et al.* (2019), which showed that the results of examining larvae carried out by Sismantik who had been given training four times each week, obtained the highest larvae-free number (ABJ) results in the fourth larva monitoring. This research is also in line with research conducted by Hayani *et al.* (2006) which showed that there were significant differences in the presence of larvae in the respondent's house before and after counseling. The targets of the 3M PSN activities are all potential breeding places for Aedes mosquitoes, including water reservoirs (TPA) for daily use, water reservoirs not for daily use (non-TPA), and natural water reservoirs.

The results and factor loading values for each independent variable and the dependent variable, which is obtained for points obtained information that the characteristics of TPA + larvae (0.874) and the number of mosquito breeding + insecticide (0.604) are significant as indicators of the risk of areas as mosquito breeding sites because they have a value loading factor greater than 0.5. Furthermore, the variable information on handwashing facilities (0.968) and new habits (0.964) is significant as an adaptation indicator because it has a greater loading factor value of 0.5. Non-landfill containers, namely the number of buckets (0.802) and the number of buckets with larvae (0.771), are significant indicators of potential characteristics because they are greater than 0.5. In intervention efforts with the habit of closing the bucket/drum (0.913) and the habit of watching for holes and puddles of containers (0).

Intervention efforts in controlling the frequency of use of insecticides (0.880) and frequency of use (0.839) are significant indicators of chemical insecticides because they are greater than 0.5. This control integration model is expected to become an integrated and self-reliant control concept for the community to reduce the mosquito population as a vector for transmitting DHF, especially in Padang City with ecological local specificity, and can be implemented at regional and even national levels by developing research on the stages of applying various model approaches and mosquito breeding control engineering in breaking the chain of disease transmission by *Aedes sp.* mosquitoes at all stages of their life.

Conclusions

Spatial Risk of DHF Transmission by *Aedes sp.* mosquitoes in the adaptation of new habits based on potential water reservoirs, mosquito breeding, and intervention efforts with 3M in the new normal is more high risk in the working area of the health centre of Nanggalo Sub-district. In the influence model between the variables of the interaction control of *Aedes sp.* mosquito breeding by the family in the adaptation of new habits, it was found that mosquito breeding control has an indirect effect on other control efforts through potential characteristic pathways with a total large overall effect of 0.470. The influence model between the variables of the interaction control of *Aedes sp.* mosquito breeding. by the family in the adaptation of new habits found that mosquito breeding control has an indirect effect on other control efforts through potential characteristic pathways with a total large overall effect of 0.470. The influence model between the variables of the interaction control of *Aedes sp.* mosquito breeding by the family, in the adaptation of new habits, it was found that mosquito breeding control has an indirect effect on other control efforts through potential characteristic pathways with a total large overall effect of 0.470.

Acknowledgements

This article was compiled from the results of the dissertation research, which is a requirement for completing the education at Universitas Negeri Padang. We would like to thank the parties who participated in this interview and literature collection activity, especially the local government of Padang City.

Conflict of Interest Statement

The authors declared that they have no conflict of interest.

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