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DENGUE EPIDEMIC CONTROL IN MALAYSIA- CHALLENGES IN ENGINEERING CONTROL

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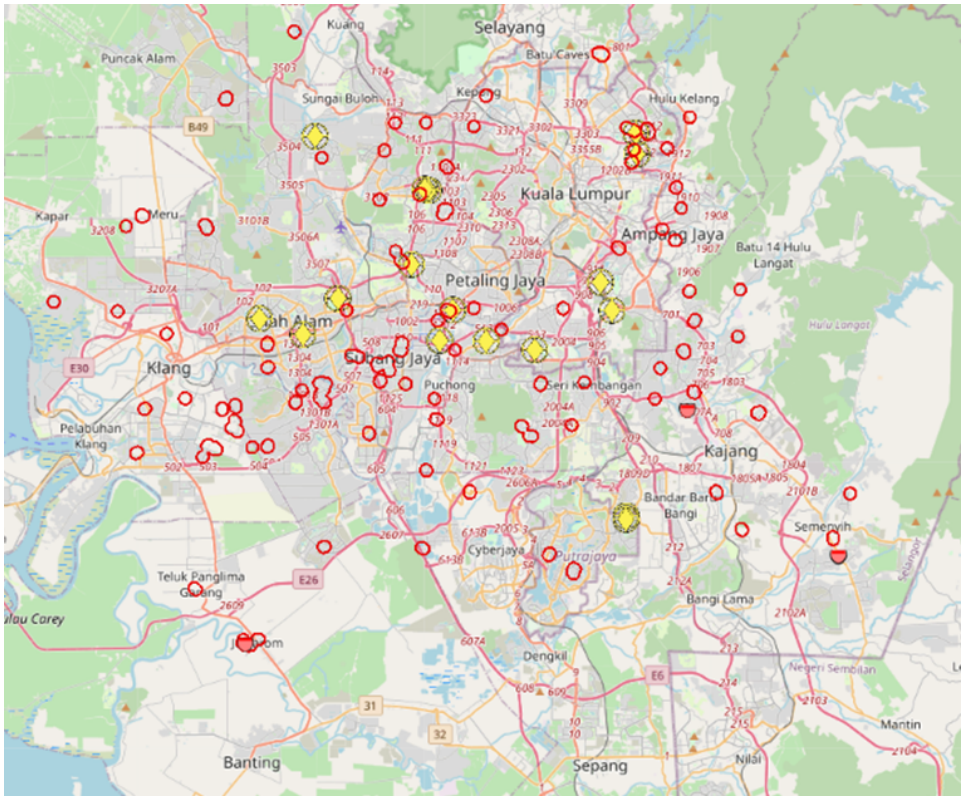
Abstract

In Malaysia, dengue fever has a high death rate, ranking as one of the most severe arthropod-borne infections that may be contracted. In Malaysia, the reproduction of dengue mosquitoes has developed into a significant problem for the country's public health. However, prevention efforts against the dengue fever pandemic must be started as soon as possible. In Malaysia, there are certain protocols to follow for the majority of difficulties, and both tropical and subtropical influences may be felt in Malaysia, particularly in the country's metropolitan and semi-urban areas. Dengue fever may be passed thru infection by bite of infected Aedes aegypti mosquitoes, specifically has recently fed on a person who is already infected with the disease. There is no transmission of dengue disease from one individual to another. It is only possible to get the disease by the bitten of infected mosquitoes only. The primary research problem begins with a current trend problem in the dengue epidemic, which is increasing day by day in Malaysia and necessitates a specific method of engineering control, particularly in improving the product to prevent the dengue epidemic. This presents a challenge for the researchers because need a proper engineering method of solution as a quickly as possible study. In addition, the primary focus of the research is on the rapid proliferation of Aedes mosquitoes due to the presence in engineering control. The purpose of this research is to find a way an Integrated Study of dengue prevention and engineering control method for aedes mosquitoes breeding to stop the spread of the dengue virus, which occurs when an infected Aedes mosquito bites a person and transmits the disease in certain dengue breeding locations, such as Selangor, Malaysia. Moreover, to battle aedes mosquitoes with the appropriate strategy and integration of engineering methods will help eliminate Aedes breeding spots phenomena. This study would then decrease the total number of dengue cases in the integrated study of dengue prevention in engineering control method for aedes mosquitoes breeding. The integration of engineering control will allow the machine to be improved following the most appropriate techniques and methods practiced in dengue vector control to decrease the number of cases that are becoming critical in Malaysia.

Keywords: Dengue prevention, current engineering control, mosquito breeding spot, aedes aegypti, fogging machine.

1. INTRODUCTION



Dengue fever has been a significant health problem in Malaysia. The apparent number of individuals infected with the dengue epidemic is causing the difficulties to become more widespread. The day itself It is feasible to claim that the part of Selangor Malaysia has been impacted the most hotspot area facing an uphill battle against the dengue epidemic (Asat, Mahat, Hassan, & Ahmed, 2018). Consequently, dengue is a mosquito-borne viral infection that results in a high fever and flu symptoms. It has emerged as the most crucial factor in severe disease, and many deaths have been reported among Malaysian.

Furthermore, once a person is infected with the dengue virus, it becomes a sickness. Referred to the epidemic, the entire life stage of an Aedes mosquito might take from 4 to 10 days for the breeding process. According to the experts, dengue fever has been categorized into four stages of fertilization to reach adult aedes mosquitoes (Torres-Monzón, Casas-Martínez, & López-Ordóñez, 2020). A person who has a dengue outbreak is likely to spread to another through a dengue-infected individual bitten by an adult mosquito. Dengue also has a severe type: dengue hemorrhagic and dengue shock syndrome. Both are classified as react between 3 to 7 days in a catastrophic scenario as the process of embryogenesis Aedes mosquitoes with severe symptoms and dengue carries a concern since it may be a fatality (Usta & Usta, 2021).

However, after being bitten by an Aedes mosquito, in 14 days might develop severe disease symptoms such as gastrointestinal distress, frequent vomiting, and rapid weight gain symptoms. Aedes also known by its scientific name, Aedes aegypti (Mishra, 2018). The disease is spread to humans by the bites only infected mosquitoes. The virus would be transmitted to other people with blood and start to react slowly with the human body (Asmai, Zukhairin, Jaya, Rahman, & Abas,

2019). When the dengue virus is contaminated, the dissolute virus will begin to act erratically with symptoms such as high temperature, joint discomfort, blood vomiting, and difficulty eating and drinking.

Table 1. Statistic hotspot from Jun 2021 to Jun 2022

STATE	DAILY CASE 26 JUN 2022	TOTAL CASES UNTIL 2 JAN TO 26 JUN 2022	REPORTED DEATH CASE SINCE 2020 TO 2021 (1 YEAR)
Johor	17	966	39
Kedah	0	484	1
Kelantan	4	229	7
Melaka	1	220	9
Negeri Sembilan	12	626	11
Pahang	2	238	11
Perak	4	423	4
Perlis	1	16	21
Pulau Pinang	1	262	
Sabah	18	1460	22
Sarawak	5	267	
Selangor	94	14025	48
Terengganu	1	90	0
WP Kuala Lumpur	12	1848	9
Wp Labuan	0	12	12
Wp Putrajaya	2	100	9
MALAYSIA	174	21266	203

(Source from idengue/Kementerian Kesihatan Malaysia KKM)

Table 1 indicates that dengue cases are often recorded in high-risk locations. Approximately to 31,500 dengue cases were recorded and successfully treated. According to the above study, several of the patients eventually meet fatality due to dengue epidemic. In consideration of these findings, it's indeed that Selangor, Malaysia is the huge number of the dengue epidemic infected. There have been no successful to decrease the prevalence of dengue epidemic, due to Selangor is the largest state in Malaysia , research founds that dengue epidemic extensively spread (Kasbawati, Ningsih, Ribal, & Fatmawati, 2019).

The research found that reducing Aedes mosquito populations involves integrating engineering controls over both new and existing solution. Researchers have implemented new technologies and improved the technical control of the fogging machine to combat the rising cost of present solution. However, by implementing these approaches and understanding the fundamental engineering control in dengue vector that is practiced in Malaysia, able to reduce the overall number of cases (Shamsuzzaman, 2019).

2. MODERN IMPROVEMENTS IN DENGUE CONTROL

Defending the overall dengue control measures requires In Malaysia, vector control was the only way to minimize or prevent dengue virus transmission. Malaysian vector control controls mosquito, larvae and adults. For larva control, environment management have improved source of reduction for larvicides issues, such temephos (Abate), house inspection, and enforcement of the Destruction of Disease-Bearing Insect Act 1975 were used. For adult control, fogging would be done based on viral cases activity. Ministry of Health, and local government professionals performed in all fogging activity as to prevent dengue epidemic. There are some mordent improvement have measure to reduce the dengue cases (Krishnamurthy & Rahman, 2021)

3. MOSQUITO LARVA SIDING POWDER (BIOLOGICAL ACTIVITY)

The user uses a distinctive and odd product called larva siding powder. When used as prescribed, this drug may help some users lower their risk of developing dengue fever in its early stages.The powder's high efficiency and minimal chemical content make it ideal for killing mosquito larvae quickly and effectively. Powder is easily dissolved in water, and the product may be used in any kind of still water without any difficulties. Due to the low substance of chemicals in the product, it will largely be offered at selected store. The product has also received official government approval for widespread usage. Specifically, the siding powder is in a implementation of avoid and prevent the formation of a dengue breeding habitat (Zaki et al., 2017).

The World Health Organization (WHO) has noted that response lines against sensitive vector species and concentrations for observing susceptibility to the mosquito larvicide in the field are mentioned in their analysis on siding powder. The previous researcher (R. K. Singh & Singh, 2019) has highlighted that lethal concentrations (LC) of the larvicide for 50% and 90% death (LC50 and LC90) or for 50% and 90% inhibition of adult emergence (IE50 and IE90) will ensure that cross-resistance with regularly used insecticides is assessed and no negative effects result (Pereira, 2021). The dissemination of Bacillus thuringiensis H-14, which has been proved to be successful in controlling Aedes albopictus in outdoor containers, is what makes the larva siding method effective (Chapple & Cownie, 2020).

4. MOSQUITO COIL (TRADITIONAL ACTIVITY)

Previous author (Palupi, Octaviana, & Wijayanti, 2020) have explain Using the Aedes mosquito predator, Toxorhynchites , as an alternative to the more conventional pesticides and their administration mosquito coil. The natural breeding location of Ae. aegypti and Ae. albopictus in Malaysia was discovered to be infested with Toxorhynchites as biological way. Due to its innate capacity to locate dengue vector breeding grounds, the breeding kills proved to be an effective biological control measure.

However, This substance has the ability to pollute the air inside of places. The basic material of the repelling coil, on the other hand, is an organic and natural substance. The organic from nature consists of binders, dyes, and organic filter additives that are able to burn at a low temperature. The metofluthrin and mesquites combination will be used to control the burn rate of the slow burn. As a result, the smoke being produced by the coiling is still considered to be carbon monoxide pollution. According to the results of the study, the researchers advocate steering clear of the coil

because it has the potential to trigger undesirable health effects such as asthma (Kasbawati et al., 2019).

5. ULTRASONIC MOSQUITOES' REPELLENT (ULTRASONIC)

As indicated in Methods, ultrasonic devices tested were commercially available and emitted somewhat different sound frequencies, according to reseacher , Despite three significant results, all devices weakly repelled the device creates powerful 5–20 kHz multi-frequency sound waves to repel mosquitoes, whereas sound waves would be more spread, lowering repellency. (Panthawong, Doggett, & Chareonviriyaphap, 2021) conclude the result indicates that devices repelled ticks better than the other control, however the repellency was quite low (less than 40%). This repellency is able to chase mosquito. This activity will be reduced to fly aedes mosquito in certain distance from the ultra sonic repellent.

Ultrasonic technology in modern society to prevent dengue outbreaks. For example, mosquito repellents that come with ultrasonic devices to avoid being bitten by Aedes mosquitoes are presented. The device sends forth sounds with a high frequency that are effective in killing mosquitos. As a result of the high frequency that is emitted by ultrasonic equipment, mosquitoes are discouraged from flying around the home. A wave of electromagnetism is produced by the gadget, which can be used to both pursue and evade insects (Mishra, 2018)

6. FOGGING ACTIVITY BY VECTOR MALAYSIA DEPARTMENT

Prevention of epidemic infections in Malaysia is prioritized first and foremost via vector control. Guidelines from the World Health Organization (WHO) state that stopping the life cycle of Aedes mosquitoes is the most effective strategy to stop the spread of dengue epidemic (Manaf, Mahmud, Ntr, & Saad, 2021). Nevertheless, main priority of Malaysia's vector control team is to prevent the breeding grounds for aedes mosquitoes breeding. It will eliminate mosquito breeding grounds, which is a major factor. Moreover, this action could help bring the dengue crisis under control. Additionally, Malaysian experts in vector control developed a basic educational initiative for students in primary and secondary institutions to help reduce the prevalence of Aedes mosquitoes. Public awareness of the problem and how to mitigate it was assumed by the program's regulatory framework (R. K. Singh & Singh, 2019).

Maximum comprehensive protection may be achieved by fogging activities, which can also help stop the spread of the dengue virus (Krishnamurthy & Rahman, 2021). The first step in preventing an Aedes outbreak is to eliminate any existing pupae or larvae. Performing the act of fogging requires certain regulations to be followed. As a result, it is important to record dengue epidemics and address any concerns residents may have about a specific area. The statement claims that the vector control department's fogging crew will show up at the identified case site and start fogging immediately (Ayers et al., 2019). Fogging may be done with either water or diesel as the heat medium. In Malaysia, thermal fogging is often used Fogging is useful because it eliminates Aedes mosquitoes from potentially infested areas, such as homes, workplaces, and public spaces. Aedes mosquitoes are immune to the effects of fogging, which is effective against other types of tiny insects too (Palupi et al., 2020).

7. INTEGRATION OF ENGINEERING IN FOGGING MACHINE CONTROL

The Malaysian government utilizes many distinct fogger types for vector control. Meanwhile, according to particular regulatory criteria and safe instructions, the vector type used in Malaysia, known as thermal fogging, is the most preferred method to prevent dengue epidemic. Nonetheless, "Agrofog" is the brand of choice in the vector control division. the engineering control played some role in universal fog thermal generator, which is, it will change to smoke cloud with huge density micron unit using a small engine with diesel (Zaki et al., 2017).

8. ENGINEERING CONTROL METHOD IN ENTOFOG TS35S THERMAL FOGGING MACHINE

The Entofog TS35S thermal fogging machine has been the ideal solution for vector, pest control, disinfection, public health, plant protection, stored product control. This device has been intended for use with insecticides, acaricides, fungicides, and disinfection! Light weight for practical usage in places where bad roads and track make it difficult to manage large equipment. The only mass manufactured machine with a covered air intake valve, Providing a quieter effect and protection from dust and solution particles (Source from fogging supplier 001/2011).

In brief, the heat generated by the machine's heating element is necessary for the smoke to be produced. The heat sink will provide the necessary heat to burn a large quantity of chemical liquid fog in a single pressing (Source from fogging supplier 001/2011).

9. ENGINEERING CONTROL METHOD RESULTS

Droplet size Fog) check points by aqua measuring r*esigen* at 12.00+0.65um and 1 1.6940.44um, respectively, is the overall mean for the application of the outdoor thermal formulation fogging. Droplet size decreased as distance increased between the checkpoint and the spraying path. Overall mortality at 24 hours post-treatment as a prevention testing machine to destroy *Aedes aegypti, Culex quinquefasciatus*, and *Anopheles sinensis* using an outdoor thermal fogging application with aqua resigen formulation was 100.0040.00, 98.00+2.00, and 100.000.00 percent, respectively (Source from fogging supplier 001/2011).

Excellent efficacy against Aedes aegypti, *Culex quinquefasciatus*, and Anopheles sinensis was observed following an outdoor thermal fogging application using with r*esigen* formulation, with 100% mortality at 24 hours post-treatment for all three species, respectively. For all of formulations tested against *Aedes aegypti, Aedes albopictus, and culex quinquefasciatus*, there was no evidence of a larvicidal effect across all of the engineering control points (Source from fogging supplier 001/2011).

10. ENGINEERING CONTROL METHOD COLD FOGGING MACHINE

Control engineering in cold fogging machine has various use of application. There are no leaks or stains from spraying liquids during fogging operation because the fog lasts far longer than a regular

spray, more time is spent exposing the insects to the chemical. As a consequence, the fog is able to penetrate the leaves thoroughly, spread it out evenly, cover the spot completely (Manaf et al., 2021).

Since these devices are often totally automated, the only time the operator comes into direct contact with the chemicals, when the solution tank needs to be refilled. When compared to the time and effort needed for traditional spraying, fogging has a very light workload. To estimate the payout period of the unit, it is determined on how much effort and spot to cover of spraying. usually cold fogging device in terms of current engineering methods are able to utilized in the greenhouse and mostly in office and hospitals due to its very convenient to use in close place without expose to sun light the researcher found that, there is a significant decrease in noise (S. Singh, Bansal, Sandhu, & Sidhu, 2018).

When using a stabilizer, such as emulsifiable crop oil or polyethyleneglycole, even a tiny quantity may help ensure that the chemical elements are distributed evenly and efficiently throughout the spot. This stabilizer prevents drops from immediately evaporating, allowing them to remain in the air for a prolonged period of time (Wath, 2019).

In order to achieve the best possible penetration and coverage, cold fogging is also characterized as an ultra-low-volume application that generates very small droplets (1-50 m). Flying insects are most affected by droplets of the following sizes: 10-30 m, 20-40 m for leaf nematodes, and 30-50 m for fungal infections (Lasluisa, Barrios, & Vasilieva, 2019).

Electric motors powering compressors to create airstreams are at the heart of the pneumatic droplet preparation technology used by the vast majority of commercially available equipment. When the fogging solution reaches the nozzle system, it is atomized into tiny aerosol droplets and transferred by pressure (the Venturi effect). There are other machines that use a high-pressure system to generate droplets, as well as those that use spinning discs(S. Singh et al., 2018). Generally, a fan mounted on the device provides a directed airstream that carries the droplets created by the aforementioned processes. The droplets are spread uniformly inside the heat component via horizontal and vertical air movement. During application, the site must be sealed to eliminate any losses caused by leakages or open vents (Xu et al., 2019).

11. STANDARD OF COLD FOGGING MACHINE MEASUREMENTS

The machine operating components in cold fogging machine temperatures varied from 220 to 648 degrees Fahrenheit (-13S to 323°C). The engineering control for cold fogging machine (all versions) is come up with 16,100 kcal per hour (187 kw/25.4 horsepower) with combustion chamber of power. moreover, it comes with gas tank, stainless steel. Feeding force pressure for model fulfill with Fuel consumption with 1.4 to 0.12 bar approximately, leaded, or unleaded, standard-grade gasoline that is at least 74 octanes approximately 2 I/h Chemical tank. Hence the Capacity of Feed pressure is SN 50 PE SN 50- 10 SN 50 10 PE 65I 701 901 1001 dp. 0.3 - 035 bar approximately (depending on dosage nozzle used). The cold fogging machine operate with 4 dry batteries, an electronic ignition coil 1,5 V/ea. in series, ground-negative with optional accessory. The tolerance of nozzle capacity to fit micron unit for fog cloud is 0.7 10 lh, dose nozzle 08 14 I/h, dose nozzle 09 175 Vh, dose nozzle 1.0 20.5 V/h, dose nozzle 1.1 23.5 Vh, dose nozzle

1.2 27 Ih, dose nozzle 1.4 32 Ih, dose nozzle 1.7 42 Vh . The nozzel dimension for this machine is SN 50/SN 50 PE: 133 x 29 x 33 a; SN 50-10/SN 50-10 PE: 133 x 34 x 33 m. The cold fogging machine is also be provided with factory-mounted cut-off devices for the fogging mixture (Source from fogging supplier 001/2011).

12. ULV (ULTRA-LOW VOLUME) HEAVY DUTY MACHINE ENGINEERING CONTROL

ULV (Ultra-Low Volume) Heavy Duty is commonly stated more than 18 HP twin-cylinder, 4-cycle, air-cooled internal combustion engine powers the unit. Chemicals can be dispersed up to 150 meters horizontally and 50 meters vertically using the unit's highly machined heavy duty turbine blower, which can produce air moving at up to 200 km/h. The cast iron fog head that is attached to the machine can move 360 degrees both horizontally and vertically, and the machine's internal components are entirely composed of stainless steel (Hazra, Samanta, Karmakar, Sen, & Bakshi, 2017). Thus, the machine can be operated remotely from the cab of a car using a gadget. The machine also has a 12-volt dry automobile battery installed for standalone operation. Either a 20 liter (5 gallon) or a 60 liter (15 gallon) stainless steel formulation tank is included with the unit. Moreover, front panel of the machine are a tachometer, an hour-meter, and an ammeter or sometimes will connected inside the vehicle as per to monitor. A robust pressure gauge, a thermometer, and a premium flowmeter are all installed on a portable frame and make up the remote-control panel. The unit measurement is 49" (122.5 cm) long, 43" (1 07.5 cm) wide, and 38" (95.0 cm) tall, and it weights 450 lbs (200kg). The sole commercially available machine with a heavy-duty silencer that has been patented to reduce noise (less than 68 decibels). The machine will also provide additional protection against pests such as locusts, grasshoppers, Qualia birds, and other migrant pests. The Public Health Insects and Disease Control Program uses this type of cold fogging machine to kill aedes mosquitoes as a means of preventing an outbreak of dengue fever (Source from fogging supplier 001/2011).

13. CONCLUSION

Throughout the life cycle of Aedes mosquitoes, habitat and environmental control were implemented using public awareness of health by government law in fogging activity. Additionally, the law will play a significant role in a social organization. Static water in the street or elsewhere outside is the first step in the habitat of Aedes mosquitoes (Shepard, 2019). As a result, environmental monitoring is challenging to manage due to its wide scope. In addition, rainwater that pools outside makes it simple for Aedes mosquitoes to reproduce. Aedes mosquito habitat and environmental control can be achieved by cleaning the targeted area to stop stagnant water from growing Aedes mosquitoes outside. The broader public, however, was not following the precise strategy for stopping the breeding side. Aedes is the outcome of this specific behaviour.

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REFERENCE

[1] Asat, a. N., mahat, a. F., hassan, r., & ahmed, a. S. (2018). Development of dengue detection and prevention system (deng-e) based upon open data in malaysia. *Proceedings of the 2017 6th international conference on electrical engineering and informatics: sustainable society through digital innovation, iceei 2017*, *2017-novem*, 1–6. Https://doi.org/10.1109/iceei.2017.8312426

[2] Asmai, s. A., zukhairin, m. N. D. M., jaya, a. S. M., rahman, a. F. N. A., & abas, z. B. A. (2019). Mosquito larvae detection using deep learning. *International journal of innovative technology and exploring engineering*, *8*(12), 804–809. Https://doi.org/10.35940/ijitee.l3213.1081219

[3] Ayers, v. B., huang, y. J. S., lyons, a. C., park, s. L., dunlop, j. I., unlu, i., … vanlandingham, d. L. (2019). Infection and transmission of cache valley virus by aedes albopictus and aedes aegypti mosquitoes. *Parasites and vectors*, *12*(1), 1–6. Https://doi.org/10.1186/s13071-019-3643-0

[4] Bangertid, m., latheef, a. T., dev pant, s., ahmed, i. N., saleem, s., rafeeq, f. N., … shepardid, d. S. (2018). *Republic of maldives, 4 policy planning and international health, ministry of health, malé, republic of maldives, 5 department of control of neglected tropical diseases, world health organization regional office for south east asia*. 1–14. Retrieved from https://doi.org/10.1371/journal.pntd.0006796

[5] Hazra, d. K., samanta, a., karmakar, r., sen, k., & bakshi, p. (2017). Mosquito vector management knowledge, attitude, practices and future of user & environment friendly new generation botanical mosquitocide formulations: a review. *International journal of chemical studies*, *5*(3), 32–37. Https://doi.org/10.13140/rg.2.2.11050.72640

[6] Kasbawati, ningsih, s., ribal, a., & fatmawati. (2019). An optimal integrated vector control for prevention the transmission of dengue. *Journal of physics: conference series*, *1245*(1). Https://doi.org/10.1088/1742-6596/1245/1/012043

[7] Krishnamurthy, p., & rahman, r. (2021). A study on dengue prevention and control method for aedes mosquitoes. *Annal of r.s.c.b.*, *25*(6), 11671–11677.

[8] Lasluisa, d., barrios, e., & vasilieva, o. (2019). Optimal strategies for dengue prevention and control during daily commuting between two residential areas. *Processes*, *7*(4). Https://doi.org/10.3390/pr7040197

[9] Manaf, r. A., mahmud, a., ntr, a., & saad, s. R. (2021). A qualitative study of governance predicament on dengue prevention and control in malaysia: the elite experience. *Bmc public health*, *21*(1), 1–11. Https://doi.org/10.1186/s12889-021-10917-3

[10] Mishra, d. T. K. (2018). The study of cardiac manifestations in patients with dengue infection and correlation of cardiac manifestations to warning signs of dengue. *Journal of medical science and clinical research*, *6*(7), 1001–1005. Https://doi.org/10.18535/jmscr/v6i7.166

[11] Palupi, s. W., octaviana, d., & wijayanti, s. P. M. (2020). Dengue prevention practices and its determinants factors in purwokerto, central java. *Insights in public health journal*, *1*(1), 8. Https://doi.org/10.20884/1.iphj.2020.1.1.2634

[12] Panthawong, a., doggett, s. L., & chareonviriyaphap, t. (2021). The efficacy of ultrasonic pest repellent devices against the australian paralysis tick, ixodes holocyclus (acari: ixodidae). *Insects*, *12*(5), 1–8. Https://doi.org/10.3390/insects12050400

[13] Selvakumaran, s., & paneerselvam, s. (2020). Dengue prediction recommendation engine using machine learning and genetic hybrid algorithms. *Journal of xidian university*, *14*(6), 1293–1301. Https://doi.org/10.37896/jxu14.6/151

[14] Shamsuzzaman, a. (2019). Dengue virus and aedes mosquitoes: ecological relationship. *Journal of current and advance medical research*, *6*(2), 67–68. Https://doi.org/10.3329/jcamr.v6i2.42695

[15] Shepard, d. S. (2019). Considerations for the 2030 sustainable development goals for dengue. *Gates open research*, *3*, 1656. Https://doi.org/10.12688/gatesopenres.13084.1

[16] Singh, r. K., & singh, s. (2019). Prevalence of aedes mosquitoes during the first outbreak of zika in jaipur city, india. *Journal of communicable diseases*, *51*(3), 33–39. Https://doi.org/10.24321/0019.5138.201924

[17] Singh, s., bansal, a., sandhu, r., & sidhu, j. (2018). Fog computing and iot based healthcare support service for dengue fever. *International journal of pervasive computing and communications*, *14*(2), 197–207. Https://doi.org/10.1108/ijpcc-d-18-00012

[18] Torres-monzón, j. A., casas-martínez, m., & lópez-ordóñez, t. (2020). Infection of aedes mosquitoesbynative wolbachia in urbancemeteriesof southern mexico. *Salud publica de mexico*, *62*(4), 447–449. Https://doi.org/10.21149/10163

[19] Usta, m., & usta, g. (2021). Biological disasters and some prevention method samples in turkey. *E-journal of new world sciences academy*, *16*(1), 25–39. Https://doi.org/10.12739/nwsa.2021.16.1.5a0146

[20] Wath, s. B. (2019). Waste management and resource efficiency. In *waste management and resource efficiency*. Https://doi.org/10.1007/978-981-10-7290-1

[21] Xu, j., xu, k., li, z., tu, t., xu, l., & liu, q. (2019). *Developing a dengue forecast model using long short term memory neural networks method*. (lx). Https://doi.org/10.1101/760702

[22] Zaki, r., roffeei, s. N., hii, y. L., yahya, a., appannan, m., said, m. A., … rocklov, j. (2017). Public perception and attitude towards dengue prevention activity and response to dengue early warning in malaysia. *Plos one*, *14*(2), 1–22. Https://doi.org/10.1371/journal.pone.0212497