RELATIONSHIP BETWEEN BREEDING PLACES (CONTAINERS) AND PHYSICAL ENVIRONMENT WITH THE PRESENCE OF *AEDES SP.* LARVAE AT SOEKARNO PORT MAKASSAR

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THESIS

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THANK-YOU NOTE

بِسْمِ اللَّهِ الرَّحْمَٰنِ الرَّحِيمِ

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ABSTRACT

SITI HAIRUNISA. *Relationship between breeding places (containers) and physical environment with the presence of Aedes.sp Larvae at Soekarno port Makassar (supervised by* **Hasanuddin Ishak** *and* **Erniwati Ibrahim***)*

Background: Mosquito-borne viruses from Aedes aegypti and Aedes albopictus can trigger localized outbreaks, influenced by global mobility. Factors such as water storage type, container conditions, and environmental parameters (temperature, humidity) impact mosquito reproduction and Aedes aegypti larvae presence. Regular sightings of larvae at Soekarno-Hatta Port, Makassar, prompted an investigation into how container and environmental conditions affect larvae**. Purpose:** This study aims to assess the relationship between breeding containers, environmental conditions, and Aedes larvae presence at Soekarno Port, Makassar. **Method:** An observational research design with quantitative, cross-sectional methods was employed. **Result:** From June to July 2024, 285 containers were examined from which 269 were negative and 16 were positive. No significant correlation was found between container type or room temperature and larval presence. However, a significant correlation between air humidity and Aedes larvae presence was identified. **Conclusion:** The study found no significant link between container type or room temperature and Aedes larvae at Soekarno-Hatta Port. However, increased air humidity was significantly associated with higher larvae presence, highlighting the need for effective mosquito control measures focused on managing humidity.

Keywords: *Mosquito larva, Containers, Temperature, Humidity*

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LIST OF ABBREVIATIONS

Abbreviation	Meaning
WHO	World Health Organization
KKP	Port Health Office
BMM	Berkah Mulia M
DHF	Dengue Hemorrhagic Fever
DF	Dengue Fever
DSS	Dengue Shock Syndrome
CI	Container Index
HI	House Index
PSN	Pemberantasan Sarang Nyamuk
FKM	Public Health Faculty
Unhas	Hasanuddin University

CHAPTER I
INTRODUCTION

1.1 Background

Dengue fever is the world's most widespread viral illness transmitted by mosquitos. Dengue fever is a tropical illness caused by the dengue virus. Symptomatic dengue infection results in a wide variety of clinical signs, from mild dengue fever (DF) to potentially fatal diseases including dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS). In recent decades, dengue fever has emerged as a serious global public health concern. The World Health Organization (WHO) estimates that around 2.5-3 billion people are now living in dengue-infected areas (Wang *et al.*, 2020).

The disease known as dengue hemorrhagic fever (DHF) is widespread across the tropics and the subtropics. The illness is a dangerous hazard because it spreads swiftly over a region and is carried by the *Aedes aegypti* mosquito. In endemic locations, the number of dengue cases can reach tens of thousands of persons infected with the virus in a single month (Lestari and Utomo, 2023). DHF is transmitted by two vector species: *Aedes aegypti* (general) and *Aedes albopictus* (secondary). *Aedes aegypti* can be found in the home and environs, but *Ae albopictus* is more prevalent outside. *Aedes aegypti* interrupts eating by sucking blood many times before reaching maximum capacity.

Dengue is an RNA virus that belongs to the Flavivirus genus and the Flaviviridae family. Dengue fever (DF) is caused by two agents: dengue haemorrhagic fever and dengue shock syndrome. The risk of transmission of any of the four dengue serotypes, DEN-1, DEN-2, DEN-3, or DEN-4. There are currently no particular antiviral treatments or vaccines available to tackle this virus. The only way to combat it is to restrict the vectors that transmit it (Of *et al.*, 2020)

Historically, the first description of dengue dates back to the early nineteenth century in the Caribbean islands, long before germ theory, when breakbone disease was known as Dandy fever. Dengue fever was thought to have arrived in the New World via slave trade from Africa. Dengue has progressed to increasingly severe forms and gained global attention, culminating in the COVID-19 epidemic (Kularatne and Dalugama, 2022).

Dengue haemorrhagic fever (DHF), a condition brought on by an infection with the dengue virus, is a health concern for society. Nearly every country in the globe has some form of this illness, although endemic and epidemic forms are more common in tropical and subtropical regions. Between 50 and 100 million cases of dengue fever are thought to occur annually in the world. One of the nations that is still susceptible to dengue fever is Indonesia.

In Australia, exotic mosquitoes, particularly those that live in containers like *Aedes aegypti* and *Aedes albopictus*, provide a worry due to the potential for serious pest and public health issues. Local health authorities' existing mosquito surveillance programs focus on endemic vectors and infections, whereas exotic mosquito surveillance is restricted to airports and seaports where foreign planes and boats arrive. According to molecular research, flights from Indonesia are the most likely routes of introduction for exotic mosquitoes that have been seized at Australian seaports and

airports. The significance of seaports should not be undervalued, even if reports of exotic mosquitoes from international seaports in Australia and New Zealand indicate that these locations are the biggest risk entry sites for these mosquitoes, together with accompanying freight-handling facilities (Webb, Porigneaux and Durrheim, 2021).

In Southeast Asia, dengue fever is the most significant virus spread by mosquitoes. In particular 2018 had 65,602 cases of dengue fever recorded in Indonesia, 467 of which were fatal (Gan *et al.*, 2021). Efforts to eradicate infectious illnesses continue to pose a threat to human life. Dengue fever incidences in various regions and cities in East Java have continued to rise. Dengue fever cases have spread across Pasuruan city. As a result, 85.3% of Pasuruan City's urban villages (29 out of 34) were DHF endemic in 2010 (Info, 2021)

Mosquito-borne viruses from *Aedes aegypti* and/or *Aedes albopictus* can generate occasional or limited epidemics due to global mobility. Weather and climatic changes, such as high temperatures, rainfall, and humidity, can lead to the spread of vector-borne illnesses to new places (Näslund *et al.*, 2021) The existence of *Aedes sp.* breeding grounds affects the determinant of mosquito presence. Water storage is one of the elements that affects mosquito reproduction. Type, colour, material, position, water storage closing circumstances, water sources, and container environmental parameters including water pH, air temperature, water temperature, and air humidity all have an impact on the shelter. *Aedes* larvae are also affected by factors that take the form of mosquito nest eradication behaviour. These behaviours include emptying containers, shutting them, burying used items, employing abate, keeping larvae that eat fish in water reservoirs, changing out vase water and animal drinking areas, and fixing gutters and drains (Daswito and Samosir, 2021)

Globalization has increased the risk for exposure of the world to emerging infectious diseases because more people are being exposed. While Port operations have a positive impact on the development of marine transportation, local economic expansion, and direct and indirect employment, they may also have a negative impact on the host community. Emissions from multimodal transportation, internal port operations, and maritime traffic can all have an influence on the environment. The top five environmental challenges, according to responses from a 2004 research, were noise, habitat conservation, garbage disposal, air quality, and water quality (Hossain, Adams and Walker, 2021). Mosquito breeding near seaports and/or international borders poses a significant danger to global health security. Trained scientists and vector control personnel should inspect international airports and seaports to prevent unwanted vector species from being exported and to identify any accidental or deliberate import of alien arthropod vectors. This is part of biosecurity and quarantine measures to prevent international health risks. All non-hermetically closed containers holding any amount of water were regarded potential breeding habitats. All water containers were checked. Breeding sites were identified based on container type (e.g., tire, cooler, fire extinguisher bucket) and building materials (e.g., cement tank, clay pots, plastic container).

Based on research in Tanjungpinang Riau about Physical environments of water containers and *Aedes sp* larvae. 863 containers were observed, 138 of them (15.99%) were found larvae of *Aedes sp*, containers inside the house (65.57%), and not closed (88.53%). The types of containers were controllable sites (95.13%), disposable sites (3.36%), and under controllable sites (1.51%). The measurement of water pH (76.13%) and water temperature (82.73%) of the containers were categorized as good. Container temperature 98.38% showed results with a range of unfavorable conditions ($300^{O}C$) and air humidity of 99.07% with a range (89.5%). Type, location, condition of container closure, water pH, water temperature, and air temperature of containers were related to

larvae in Tanjungpinang Timur District (p-value <0,05), while the variable humidity was not related to the existence or larvae (Daswito and Samosir, 2021).

Based on this description, it can be concluded that the presence of *Aedes aegypti* larvae is caused by many factors. Apart from physical environment factors and container factors, they have a close relationship with the presence of vectors and prevention of dengue fever. Data collected from the port showed the presence of larva on regular bases. For this reason, researchers want to examine **The Relationship Between places (containers) and Physical Environment with The Presence of *Aedes sp.* Larvae at Soekarno-Hatta Port Makassar.**

1.2 Problem Formulation

From the description above, the formulation of the problem is obtained as follows:

"What is the relationship between breeding containers and physical environment with the presence of larva in Soekarno port Makassar?"

1.3 Research Purpose

1.3.1 General purpose

The general objective of this study is to find the relationship between breeding containers and physical environment with the presence of larva in Soekarno port Makassar.

1.3.2 Specific purpose

Based on the general objectives that have been described, the specific objectives of this paper are as follows:

a. To observe the presence of *Aedes larvae* in the Soekarno Makassar port area.
b. To find the number of breeding containers in the Soekarno Makassar port area.
c. To determine the relationship between the breeding container and the presence of *Aedes aegypti* larvae in the Soekarno Makassar port area.
d. To determine the relationship between water temperature and the presence of *Aedes aegypti* larvae in the Soekarno Makassar port area.
e. To determine the relationship between air humidity and the presence of *Aedes aegypti* larvae in the Soekarno Makassar port area.

1.4 Benefit of research

1.4.1 Benefit for scientific

The findings of this study are anticipated to serve as a source of knowledge, scientific theory, and references, particularly for students who will do additional research.

1.4.2 Benefit for researcher

The findings of this study are anticipated to give researchers knowledge and expertise regarding the necessary steps to manage mosquito and efforts to stop an increase in mosquito-related diseases at Makassar's seaport.

1.4.3 Benefit for public

It is hoped that the findings of this study would improve public awareness of the significance of constantly maintaining environmental health in ports and of the possibility that ports may serve as entry points for diseases.

1.4.4 Benefit for institutions

The findings of this study are anticipated to be used as a source of information by the Makassar Port Health Office Class 1 in Makassar, South Sulawesi Province, the Makassar City Health Office, and other relevant agencies in order to inform policymakers about the control of mosquito in port.

CHAPTER II
LITERATURE REVIEW

2.1 General overview of *aedes aegypti*

One of the primary species that spreads mosquito-borne infections around the world is *Aedes aegypti*. These pathogens, which cause devastation on human communities, include the viruses that cause dengue fever, chikungunya fever, and the Zika virus sickness. Insect development, reproduction, and behavior are all affected by changes in the climate, including temperature. Numerous poor nations suffer from diseases spread by *Ae. aegypti* while having climates that are perfect for the species' growth. Numerous factors contribute to this, such as population increase, insufficient access to basic healthcare, unstable public health systems, and rapid and unplanned urbanization (Cláudia *et al.*, 2022).

Whether or not *Aedes aegypti* is considered “the most dangerous animal in the world” there is no denying that throughout ages, this mosquito has caused a great deal of suffering to humans. It was discovered to be the yellow fever virus carrier around the beginning of the 20th century. Devastating the New World, yellow fever undoubtedly had an impact on significant historical occurrences that still shape the Americas today. In the recent past, dengue, chikungunya, and Zika fevers have all been spread by it as the main viral infections. Because humans and Ae. aegypti share a same evolutionary history in Africa, it has been postulated that, out of the nearly 3500 recognized mosquitoes, *Ae. aegypti* has been the most significant carrier of these viruses (Powell, Gloria-soria and Kotsakiozi, 2018).

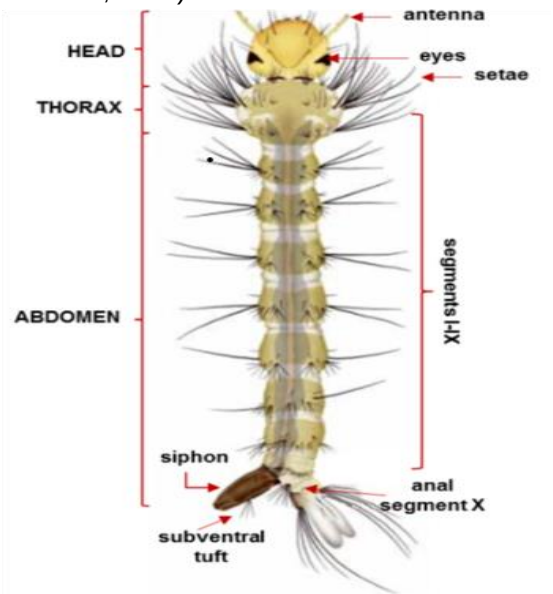


Figure 2.1 *Aedes aegypti*. (a) Head, (b) Thorax, and (c) Abdomen

The World Health Organization declared the ZIKV outbreak a public health event of international concern in February 2016, prompting calls for pregnancy cohort studies to better understand the role of clinical and subclinical infections in

congenital malformations, as well as to characterize the incidence and spectrum of these adverse outcomes. During the outbreak, prospective studies in Latin America revealed a wide range of seropositivity to ZIKV infection (8-53%), confirming the link between Zika infection in pregnant women and unfavorable fetal outcomes (Osoro *et al.*, 2022).

Yellow Fever

Yellow fever (YF) is a mosquito-borne viral infection caused by an arbovirus from the Flaviviridae family, genus Flavivirus, which includes positive-single-stranded RNA viruses. The virus was initially isolated from a male patient in 1927. Mosquitoes are mostly responsible for transmission. Following a 3-6-day incubation period, YF infection can result in a variety of clinical characteristics, ranging from a self-limited or moderate febrile illness with flu-like symptoms in the majority of cases to serious bleeding and liver failure. The Johansson group estimated the chance of each infection result by analyzing data on asymptomatic infections, moderate sickness, severe disease, and fatalities obtained in 11 research including Africa and South America between 1969 and 2011 (Gianchecchi *et al.*, 2022).

Yellow fever is generally controlled through vaccination, with no specific antiviral medication available. The 17D vaccination is live attenuated and was created in 1936. The vaccination is thought to be safe; adverse event rates are estimated to be no more than 0.6 per 100,000 doses, and reactions are often moderate. Yellow fever vaccination provides lifelong immunity, according to WHO recommendations that were recently modified (Ramos *et al.*, 2021).

2.2 Overview of Larva *Aedes Aegypti*

2.2.1 Lifecycle of *Aedes Aegypti*

First instar: the first of four larger-than-last instars that mark the beginning of larval development. The process of moulting—the shedding of chitinous skin—allows the larva to go from one stage to the next, facilitating the growth and development of the subsequent instar. When the fourth instar larva matures and transforms into the pupal form, the process of complete larval development comes to a finish, usually within five to seven days. The great abundance of bacteria in artificial breeding places (tires, tanks, etc.) such as Aeromonas hydrophila/caviae, Klebsiella oxytoca, Pseudomonas sp., and Enterobacter cloacae also promotes larval growth. (OECD, 2018)

2.2.2 Breding of larva *Aedes Aegypti*

Aedes aegypti's main breeding grounds are clean water sources near people's dwellings. In general, individuals require clean water for their everyday needs, which can be supplied by a drinking water business, rainwater, or well water. These three types of water have slightly varied properties and are intentionally or unintentionally accommodated, creating mosquito breeding grounds. Water contains low salinity, organic content, a neutral pH, clear or low turbidity, and is abundant, making it excellent for *Aedes aegypti* survival (Prameswarie *et al.*, 2023).

2.2.3 Feeding habit of larva *aedes aegypti*

The majority of mosquito larvae have two different ways to eat: they can scrape biofilms from underwater plants and rocks or they may filter-feed on microorganisms at the water's surface. The relative significance of each

technique varies between species and is dependent on the food that is available. Because this is far more active than filter-feeding, certain species regularly have a significantly greater proportion of bottom scraping than other species, which increases the likelihood that a predator would detect them (Roberts, 2014).

Being omnivores, larvae eat mostly through the use of oral silks organized in a fan to filter waterborne particles of suspended organic debris and microbes. The organic stuff on the edges and bottom of the flooded container is also fed to them. The larvae consume algae, bacteria, yeasts, and protozoa in the water, both at the bottom of the habitat and in the water column (OECD, 2018).

2.2.4 Resting habit of larva *aedes aegypti*

Ae. Aegyptus's resting habits have been the subject of several investigations. Nonetheless, the majority of them concentrated on the resting behaviour in indoor or outdoor rest areas related to residual pesticides and insecticide treatment. Because they are endophilic, *Ae. aegypti* mostly hibernate within human homes. Additional understanding of these vectors' diel resting behaviour might enhance vector surveillance and control methods for concentrating on populations of resting vectors (Wei *et al.*, 2023).

2.3 Overview of Physical Environmental

cycle of larvae is influenced by a variety of environmental factors; however, some, like temperature, have a greater impact on the frequency of molting or larval development, while others, like food availability, seem to have a greater impact on the size increments of larvae during ecdysis or larval growth (Zeng *et al.*, 2020).

The availability of mosquito breeding, resting, and feeding areas influences the density of mosquitoes. The CO2 that humans create, amino acids, higher outside temperatures, and humidity are all factors that draw mosquitoes to people. Mosquitoes of the species *Aedes aegypti* prefer to hide under hanging garments and rest indoors (Baskoro, Satoto and Diptyanusa, 2017).

2.3.1 Temperature

Insects are vulnerable to several threats resulting from daily, seasonal, and localized temperature fluctuations. These include desiccation, altered metabolism, and even paralysis. Insects have, however, evolved a number of coping mechanisms during evolutionary ages to deal with these temperature fluctuations and prevent thermal stress. In order to maximize their fitness and survival, insects are able to preserve cellular integrity through a variety of mechanisms, including thermoregulatory responses, synthesis of heat shock proteins, and behavioural adjustments (Reinhold and Lazzari, 2018).

Due to climate change, unpredictable weather patterns are becoming increasingly frequent. Since temperature is frequently cited as the primary factor influencing the growth and survival of the *Aedes species*, it is important to provide a sufficient explanation for how variations in temperature impact these vectors. temperature range that is thought to be ideal for mosquito growth, as well as any deviations that may have a favorable or unfavorable impact (Muhammad *et al.*, 2022).

One of the most significant abiotic environmental variables influencing physiological functions and biological processes, such as ectotherms' ability to move, grow, and reproduce, is temperature. For instance, people raised in warmer climates may develop more quickly than those raised in colder climates, but adults often grow smaller and have worse fitness since size is frequently positively correlated with fecundity (Ezeakacha and Yee, 2019).

2.3.2 Humidity

The incidence of DHF is also influenced by climate variables as humidity, air temperature, and rainfall. Rainfall has a special bearing on the *Aedes* mosquito life cycle. A lot of rain can saturate the ground, producing plenty of puddles that mosquitoes can use as hatching grounds, increasing the number of mosquito vectors. However, there is a tight relationship between mosquito respiratory systems and physiological functions and atmospheric humidity. Mosquito life spans are prolonged with humidity levels exceeding 85% (Wulandari *et al.*, 2023).

The environmental elements of the space, such as the humidity and temperature, had an impact on the larvae's existence there. 60–80% humidity was ideal for mosquitoes. The proliferation of *Aedes aegypti* would be supported by high humidity. Low humidity, on the other hand, would accelerate their demise by causing their bodies to evaporate more quickly (Heriyani, 2019).

The incidence of DHF is influenced by physical environmental elements as humidity, rainfall, and temperature. Studies have indicated that environmental variables such humidity, rainfall, and temperature have an impact on the occurrence of DHF (Pinontoan *et al.*, 2022).

buckets or drums were the "most productive containers" for larva generation outside of residential structures, whereas the water storage containers inside of houses have been determined to be the most productive places. Furthermore, the ecology of the container sites—that is, whether they are situated in sunny or shaded areas—affects the pupal production (Islam *et al.*, 2019).

2.4 Synthesis Table

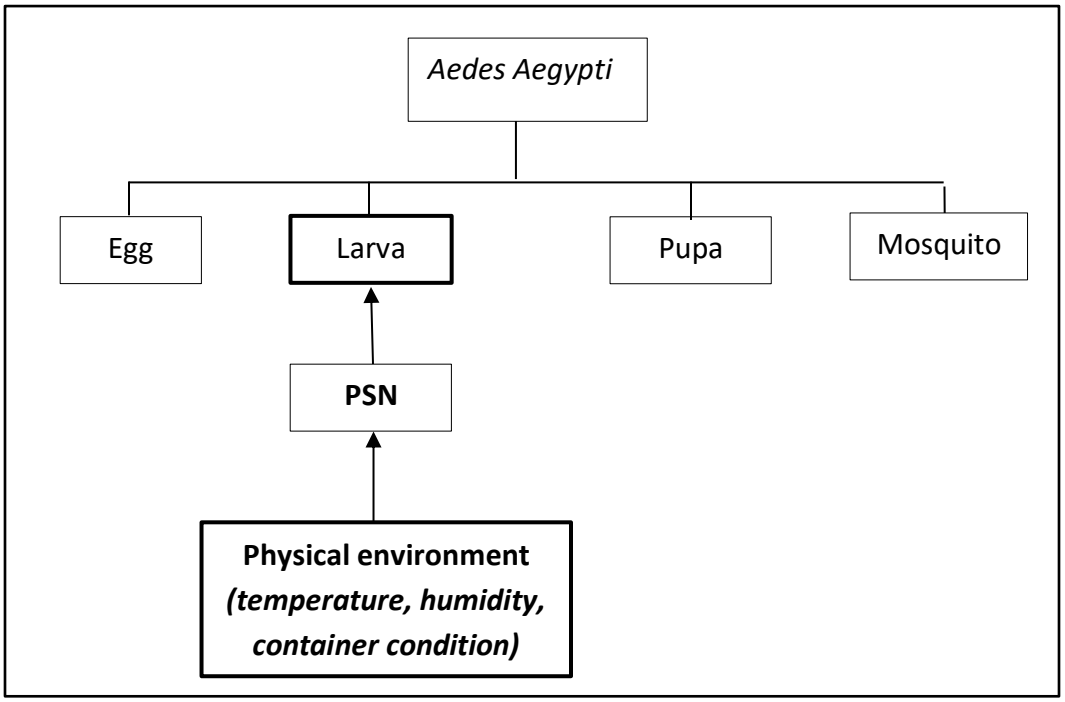
Table 2.1 Synthesis Table

No	Title (Research/Year)	Study Method	Study variable	Research result
1.	Relationship between sanitation condition and vector's existence on vessels at the working area of port heath office (KKP) class II Semarang in 2019.	Analytical method and cross-sectional design	Sanitation condition and vector's existence	The results with chi-square test showed that there was a relationship between galley sanitation, pantry sanitation, warehouse sanitation, crew's bedroom, and officer's bedroom with vector's presence on the ship.
2.	Physical environments of water containers and *Aedes sp* larvae in dengue-endemic areas of Tanjungpinang Riau	An observational study with a cross-sectional approach	Physical environments and *Aedes sp* larvae	The type, location, condition of container closure, water pH, water temperature, and container air temperature are related to larvae's presence, while the humidity variable is not related to the presence of larvae in East Tanjungpinang District. Given the physical environmental factors that strongly support the reproduction of DHF vectors in the East Tanjungpinang District. So, it is necessary to increase public knowledge and routine activities to eradicate mosquito nests (PSN) at home, especially controllable site containers widely used in the form of water reservoirs.
3.	Relationship of presence larvae's *aedes aegypti* in the water containers with dengue hemorrhagic fever in the Sei Kera Hilir 1 village sub-district Medan Perjuangan Medan city	This research was an analytic observational study with cross sectional design	Larvae's *aedes aegypti* and water containers	The most common larvae found in the village of Sei Kera Hilir 1 were from dispensers. There was a significant relationship between the presence of *Aedes aegypti* mosquito larvae in water containers with dengue hemorrhagic fever.
4.	Determinant factors to the existence of *aedes aegypti* mosquito in the working area of	This research was an analytic observational study	Mosquito *Aedes aegypti*	This study showed that respondents' actions of MNE-DHF, water pH, and container colour have a significant relationship with Aedes aegypti

	Ubud I health center gianyar regency, Bali	with a cross-sectional study design		larvae' presence in the Ubud I Health Centre's working area, Gianyar district, Bali. On the other hand, respondents' knowledge about MNE-DHF and room humidity has no relationship with *Aedes aegypti* larvae' existence in the Ubud I Health Centre's working area, Gianyar district, Bali. The container color was the variable with the highest impact on *Aedes aegypti* larvae' existence.

2.5 Theoretical Framework

The following is the theoretical framework in this research, namely as follows:



Source: Theory Modification Martik, 2017; Kemenkes RI, 2016; Soegito,1989; Green.

Figure 2.2 Theoretical Framework