# Innovative mosquito ovitrap for reducing mosquito outbreak

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## Abstract

The goal of this study is to create an innovative and efficient way to trap mosquitoes. In Hat Samran District and Mueang Trang District, Trang Province, 24 households out of 8 study points, each with 3 households, were visited in order to gather data. The emphasis was on locating mosquito breeding sites, and it was discovered that plant pot saucers were the most common site. The Aedes larvae index, which indicates the risk of dengue fever, was examined and showed that the HI was 83.33%, the CI was 62.58%, and the BI was 510.00%. These values were higher than the standard criteria of the World Health Organization (WHO, 2008), indicating that Trang Province was at high risk of dengue fever outbreaks. Using the results of the study, an innovation was created and developed in the form of mosquito trapping plant pots in three versions, each with its own limitations that needed to be overcome to improve efficiency. Version 3 was found to be the most effective, catching 1.77 times more larvae and 1.50 times more adult mosquitoes than another version. The effectiveness of the mosquito trapping pot was tested from December 2022 to January 2023, but seasonal variations in mosquito prevalence had no effect because the weather conditions were not different at the .05 significant level.

**Keyword** mosquito trap, mosquito index

## Introduction

Thailand is a tropical country, so most residents run the risk of developing serious diseases from Aedes spp., Culex spp., and other mosquito species, which serve as mosquito vectors for these diseases (Afolabi et al., 2013). In Thailand, outbreaks of deadly illnesses like dengue fever, elephantiasis, malaria, etc. are common throughout the year. Every year, there are an increasing number of cases and fatalities from severe diseases spread by mosquitoes. There is currently no medication or vaccination that can be used to treat it directly. The primary strategy for combating the spread of disease-carrying mosquitoes in the nation is prevention and control (WHO, 2018). According to data from the previous 5 years, from 2018 to 2022, there has been a persistent dengue fever outbreak, including in Trang Province, where there is an outbreak each year. The range of continuous cases, which ranged from 1,592 to 7,319 every year, demonstrates that dengue fever is still widely prevalent in Trang Province. As a result, the disease's spread has also accelerated.

The data show that a lot of mosquitoes lay eggs in water sources as a result of their high population. Household water storage containers are a favorite place for the Aedes aegypti to deposit eggs. But the Aedes aegypti likes to lay her eggs outside in a natural or artificial container. Since there are many different types of water storage containers, nuisance insects and female mosquitoes prefer to reside in filthy water sources (Rueda, 2008). Both artificial and natural spaces can be used as locations for bug traps. Mosquito breeding grounds may include trash left behind, among other things.

As a result, the researchers seek to investigate the prevalence of Aedes aegypti larvae in Trang Province and categorize the kinds of containers that serve as mosquito breeding grounds. In order to lower the danger of dengue fever in each community, it is necessary to use the facts and expertise gleaned from that research to further develop and create technologies that can trap or entice mosquitoes to lay eggs.

## Research questions

1. Can newly developed technologies be used to catch, lure, or intercept mosquitoes while they lay their eggs?
2. What effect do the species of mosquito breeding resources have on spawning?
3. In the area of Trang Province, is there a risk of dengue fever or not?

## Hypothesis

1. The innovation created and developed can trap or lure mosquitoes to lay eggs.
2. The breeding grounds are containers with trapped water to find mosquito larvae.
3. In Trang Province area, there is a risk of dengue fever

## Methods and materials

### 1. Materials

1.1. mosquito data collection

1.2. microscope

1.3. Alcohol 70%

1.4. dropper

1.5. microscope slide

1.6. bowl

1.7. screen

1.8. rubber band

1.9. plastic bag

1.10. water bucket

1.11. chemical pen

1.12. distilled water

1.13. forceps

1.14. GLOBE Observer Application

### 2. Methods

#### 2.1 Study area

This study was carried out in the Muang District, which is located at 7.5535 latitude and 99.6120 longitude, and the Hat Samran District, which is located at 7.2315 latitude and 99.5705 longitude. As shown in Figure 1.

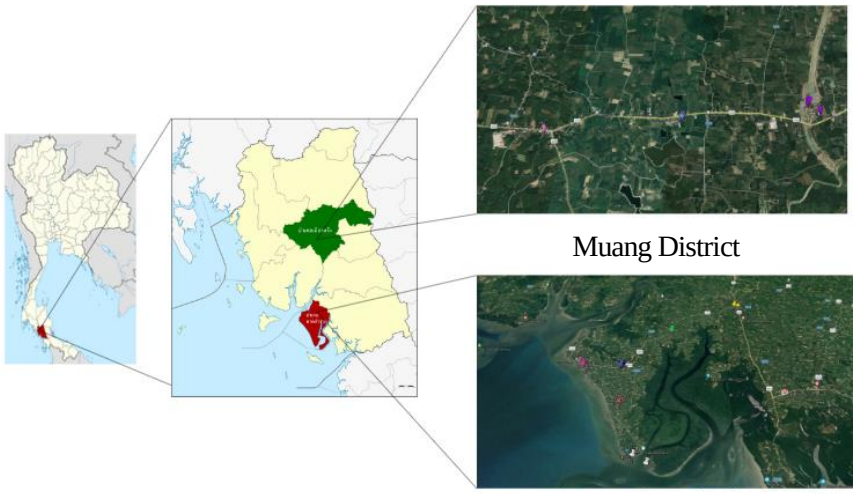


**Figure 1** Study area in Muang District and Hat Samran District, Trang Province.

**2.2 Defining the interval and defining the sampling point.**

Sample gathering During December 2022 to January 2023, the research team sampled mosquito larvae in each of 24 houses in Muang District and Hat Samran District, Trang Province.

**2.3 Collection and classification of mosquito larvae.**

1). In the districts of Mueang District and Hat Samran District, Trang Province, go to an unplanned location within the house to collect mosquito larvae samples. There were 24 residences altogether among the 8 research points. Each time, data were added to the GLOBE Observer after mosquito larvae samples were gathered using the Mosquito Habitat Mapper in accordance with the GLOBE protocol. in line with Figures 2 and 3.

**Figure 2** Show mosquitoes data storage using the Application GLOBE

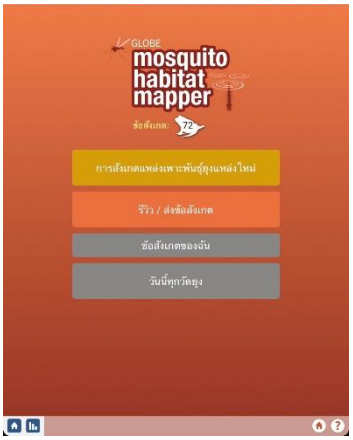


**Figure 3** Show mosquitoes habitat mapper in the Application GLOBE

2). Investigate the water-storage containers and photograph the containers or water sources where mosquito larvae are and are not found in each study area for future research.

3). Take samples of mosquito larvae from each container in each research area and put them in transparent plastic bags.

4). The number of mosquito larvae collected in each container in the study area was counted and recorded.

5). Sort the mosquito species and bring the mosquito larvae to be maintained in 70% alcohol. Then, putting mosquito larvae on the slide with a dropper to suckle them. After that, use a microscope, the species of mosquito larvae were determined. Using the features of the combs and breathing tubes of mosquito larvae, separate the larvae, and then record the information.

**2.4 Creation and development of innovative mosquito traps.**

1). Gather information, concepts, research, and innovations that can trap mosquitoes.

2). Design an innovative body that can trap mosquitoes.

3). Create innovative mosquito traps (version 1 mosquito trap pot).

4). Test the version 1 mosquito trap pot by placing it around the school building. student dormitory and the teacher's house, where mosquitoes are abundant for 1 week. 5. Analyze the test results. Take the disadvantages to improve the mosquito trap pot and develop it into a mosquito trap version 2.

5). Take the mosquito trap version 2 to test the same as item 4.

6). Analyze the results of the second test. Bring the disadvantages to light to improve and develop the mosquito trap pot. It is Version 3.

7). Take the mosquito trap version 3 to collect data.

8). Take the results of the mosquito study and analyze the data.

### 2.5 Study weather data

1). Gather weather information, including air temperature, relative humidity, precipitation, and wind speed, from the meteorological weather station at Princess Chulabhorn Science High School, Trang, during December 2022–January 2023.

Note : Weather data from meteorological weather stations at Princess Chulabhorn Science College Trang has been calibrated with weather data from the Meteorological Department of Trang Province.

2). Sent the data to Atmosphere Protocol.

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## 3. Analysis

Use the Microsoft Excel program to analyze and display the obtained data in the form of tables and charts, and the analysis is as follows:

1) Descriptive statistics: frequency, percentage, mean, and standard deviation

2) Analysis of mosquito index:

$$\text{House Index (HI)} = \frac{Number\ of\ house\ where\ mosquito\ larvae\ are\ found}{Total\ number\ of\ house\ surveyed} \text{ x } 100$$

$$\text{Container Index (CI)} = \frac{The\ number\ of\ cantainers\ where\ mosquito\ larvae\ were\ found}{Total\ number\ of\ survey\ containers} \text{ X } 100$$

$$\text{Breteau Index (BI)} = \frac{The\ number\ of\ cantainers\ where\ mosquito\ larvae\ were\ found}{Total\ number\ of\ house\ surveyed} \text{ X } 100$$

3) Analysis of increased innovation efficiency

$$Increased\ innovation\ efficiency = \frac{Number\ of\ mosquito\ can\ trap\ in\ version\ 2 - Number\ of\ mosquito\ can\ trap\ in\ version\ 1}{Number\ of\ mosquito\ can\ trap\ in\ version\ 1}$$

4) Analyze weather conditions during December 2022 and January 2023 that are the same or different by using a statistical t-test at a significance level of .05

## Results

### 1. Risk study of dengue fever in Trang Province.

#### 1.1. The results of the study on the number of mosquito breeding sites found in the study area of Trang Province.

The researcher conducted a mosquito data collection study by surveying 24 houses in Mueang Hat Samran District and Mueang Trang District. There are 20 houses with mosquito breeding sites, as shown in table 1.

**Table 1** Survey data for study sites

| | **number** |
|---|---|
| Number of storage houses | 24 |
| Number of homes where breeding site were found | 20 |
| Total number of breeding sites found | 163 |
| Number of breeding sites where mosquito larvae were found | 122 |

#### 1.2. The results of the study on the species of mosquito larvae found in each container of each study area in the area of Trang Province.

The study had found the Aedes mosquito to be the most common. There had been 102 breeding sites. There are 30 breeding sites for Culex mosquitoes, and 2 breeding sites had Armigera mosquitoes, as shown in chart 1.

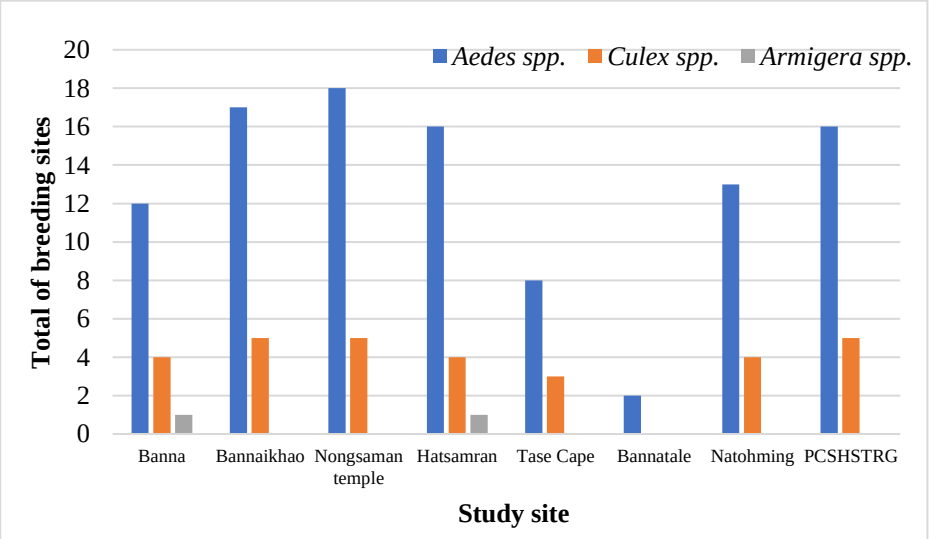


**Chart 1** show the number of breeding sites for each species of mosquito larvae found in the study area.

### 1.3. Mosquito index found in each study area in Trang Province.

From the study results, it was found that the HI value was greater than 50, the CI was greater than 10, and the BI was greater than 50, which were all higher than the standard criteria. It shows that the area of Trang Province is at risk of dengue fever, as shown in table 2.

**Table 2** Mosquitoes index found in the study area.

| Mosquito index | Percentage |
|---|---|
| HI | 83.33 |
| CI | 62.58 |
| BI | 510 |

### 1.4. 4. The results of the study of the types of containers in which mosquito larvae were found.

From the study, it was found that the most common containers for mosquito breeding were saucers of plant pots (40.16%), followed by plastic containers (26.23%), and the least common mosquito breeding containers were a pit or ditch where no breeding site is found as shown in chart 2.

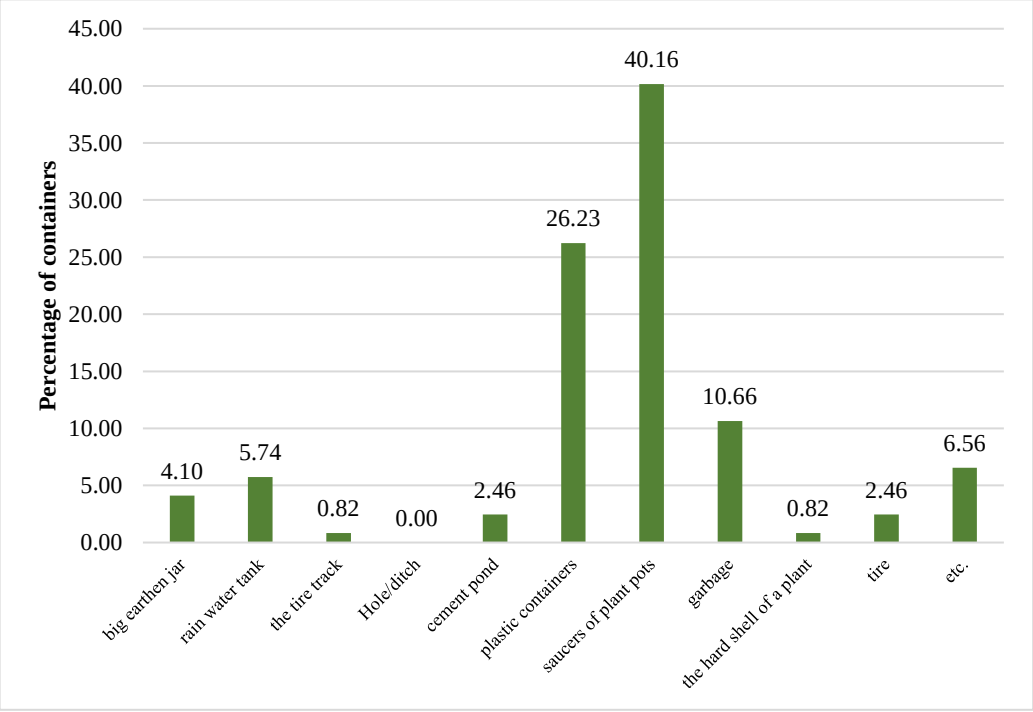


**Chart 2** Show type of container and percentage of mosquito larvae found.

## 2. Creation and development of innovation

### 2.1. The results of construction and performance testing of mosquito trapping plant pots version 1.

According to the survey's findings, the plant pot's saucer is the type of container that mosquitoes prefer to reproduce in. In order to eliminate mosquito breeding grounds, it has been suggested that an inventive mosquito trap be made in the shape of a potted plant. The mosquito trap version 1 was created by creating a cylinder form with two pieces, the upper part of which is used to plant trees. As seen in Figure 4, the lower piece is used to catch mosquitoes by drilling three holes for the insects to fly into. Next, construct a transparent plastic bottle into a planter for a mosquito-repelling plant and cover it with a black plastic bag. and to examine the effectiveness of mosquito trapping plant pots by putting them at three research locations for two weeks.

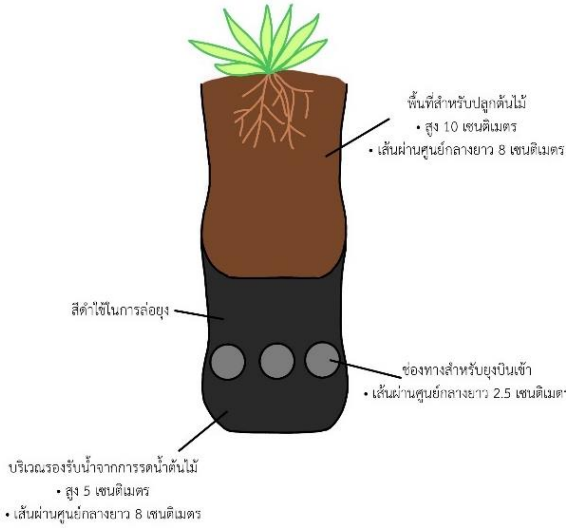


**Figure 4** Shows the design of the mosquito trapping plant pot version 1.

**Figure 5** Show mosquito trapping plant pots version 1.

### 2.2. The results of construction and performance testing of mosquito trapping plant pots version 2.

Version 1 has been produced and refined based on the outcomes of the study on the effectiveness of mosquito-trapping plant pots as follows: Create a pot body with two distinct pieces. As shown in Figure 6, you can increase the mosquito trap's hole count to let more insects fly into the pot. Then, make a pot with a 3D printer to make it more durable. It was an adaptation. two mosquito trapping plant pots, as indicated in Figure 7, and a 2-week test of the pot's effectiveness at three research locations.


**Figure 6** Shows the design of the mosquito trapping plant pot version 2.

**Figure 7** Show mosquito trapping plant pots version 2.

**2.3. The results of construction and performance testing of mosquito trapping plant pots version 3.**

Version 2 has been produced and enhanced based on the findings of the study on the effectiveness of mosquito-trapping plant pots. In order to prevent mosquitoes from flying out of the mosquito inlet, the draft design changed it to be a pointed cone. then putting a 1-2 micron-wide wire mesh to the bottom of the pot to filter soil sediment and stop mosquito larvae from flying up. In addition, as illustrated in Figure 8, titanium dioxide (TiO2) was utilized to entice more insects into the pot. I then used a 3D printer to produce the following mosquito trapping plant version 3.0: Diagram 9. We examined the effectiveness of mosquito trap plant pots by putting them at three research locations for two weeks.

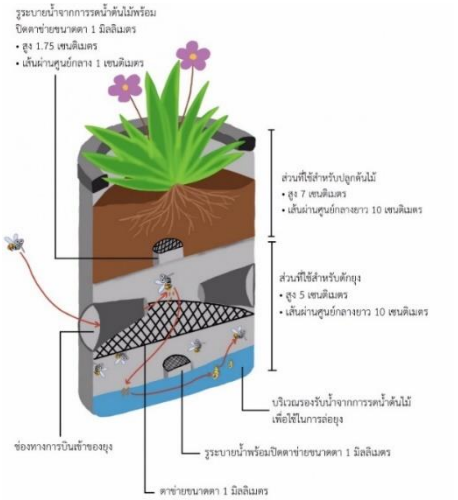


**Figure 8** Shows the design of the mosquito trapping plant pot version 2.

**Figure 9** Show mosquito trapping plant pots version 2.

### 2.4. Comparison of the efficiency of mosquito traps in each version

By using each version of the mosquito trapping plant pots to trap mosquitoes at 3 study points for a period of 2 weeks during December 2022 to January 2023, the results are shown in Table 3.

**Table 3** Shows the number of mosquitoes trapped in Mosquito trap plant pot version 1, 2, 3

| Study site | The number of mosquitoes larvae found | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Plant pot version 1 | | | Plant pot version 2 | | | Plant pot version 3 | | |
| | larvae | pupa | adult | larvae | pupa | adult | larvae | pupa | adult |
| Student dormitory | 5 | 0 | 0 | 10 | 2 | 0 | 16 | 5 | 2 |
| Teachers' resident | 7 | 1 | 0 | 13 | 4 | 1 | 27 | 8 | 3 |
| School building | 4 | 0 | 0 | 7 | 0 | 0 | 12 | 2 | 1 |

From the results of the study, the mosquito trapping effect of each version of the mosquito trapping pot was compared with the addition of trap version 1, and it was found that version 3 of the pot was able to trap the most mosquitoes. as shown in chart 3.

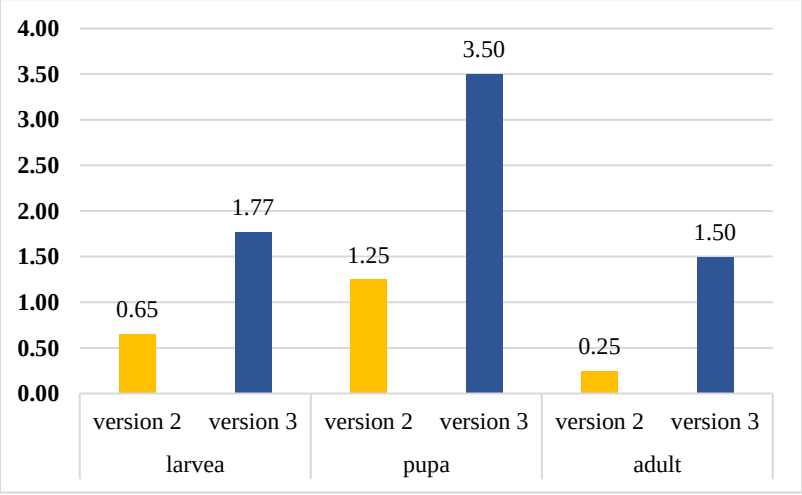


**Chart 3** Show the mosquito trapping efficiency of versions 2 and 3 compared to version 1.

**2. 5. Study the results of weather conditions during December 2022–January 2023 that may affect mosquito breeding factors.**

From the analysis of weather data, including air temperature Relative humidity, precipitation, and wind speed during December 2022 to January 2023: What are the similarities and differences? By using a t-test, it was found that the weather conditions in both months were not significantly different at.05. It was concluded that during the testing period, the pots did not affect the number of mosquitoes before trapping.

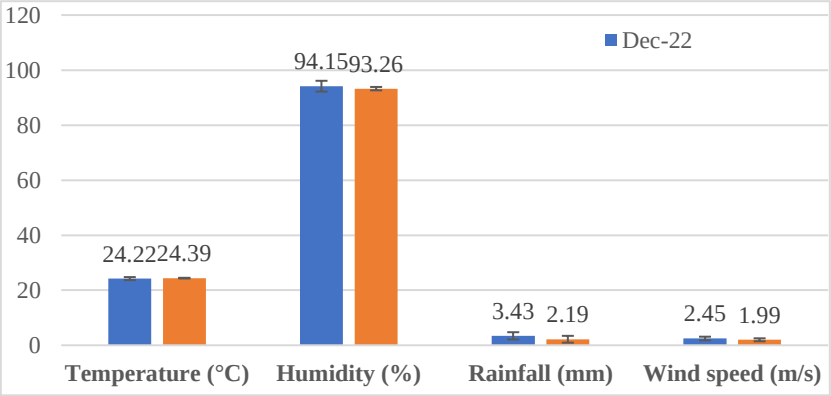


**Chart 4** Show weather data in December 2022 to January 2023

## Conclusion

A study was conducted in Hat Samran District and Mueang Trang District, Trang Province, to investigate the spread of mosquitoes. There was a total of 24 houses in the study area, which had 8 study points with 3 houses each. The study discovered three types of mosquito larvae: Aedes mosquito larvae, annoying mosquito larvae, and mosquito larvae. The types of containers that were classified as mosquito breeding grounds included saucers and plant pots, with the highest percentage (40.16%), followed by plastic containers (26.23%), and leftover trash (10.66%). The Aedes larvae index was then analyzed, and the results indicated that Trang Province is at risk of spreading dengue fever. The plant pot saucer was discovered to be the type of container most conducive to mosquito breeding. To address this issue, the researcher created an innovative mosquito trap in the form of a potted plant that can trap mosquitoes. The first version of the trap was designed as a cylindrical shape with two parts: the upper part for planting trees and the lower part for mosquito trapping. To test the effectiveness of the innovation, the researcher made a mosquito trap plant pot out of a clear plastic bottle and covered it with a black plastic bag. Version 2 of the trap was created after further development. The pot body was divided into two parts, and the number of holes in the mosquito trap was increased to allow more mosquitos to fly into the pot. A 3D printer was used to create a stronger pot. However, Version 2 needed to be improved and developed further, according to the results of the study on the effectiveness of mosquito-trapping plant pots.

In version 3, the mosquito inlet was changed to a pointed cone to prevent mosquitoes from flying out. A 1-2 mm fine wire mesh was added to filter soil sediment and prevent mosquito larvae from developing into mosquitos and flying from the bottom of the pot. Moreover, titanium dioxide (TiO2) was used as a mosquito lure to attract more mosquitoes into the pot. The innovation was tested, and the results

showed that the trapping of version 3 was more effective than version 1. Version 3 was able to catch 1.77 times more larvae and was 1.5 times more effective in trapping adult mosquitoes. This shows that the last version has improved efficiency and can completely eliminate mosquito larvae. The seasonal mosquito prevalence factor had no effect on trap efficiency because the weather conditions between December 2022 and January 2023 were not significantly different at the 0.05 level.

**Acknowledgement**

We would like to thank Assoc. Prof. Dr. Mullica Jaroensutasinee from Walailak University, who gave advice Consultation on the project process. We would like to director and teachers of Princess Chulabhorn Science High School Trang especially Mrs.Patchara Pongmanawut and Miss Apasri Chumchuen, the project advisors. who help and give advice, suggestions that are useful in doing this project as well as community public health information and the villagers, who cooperated very well in collecting data for this research study.

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## Badge

### I am engineering

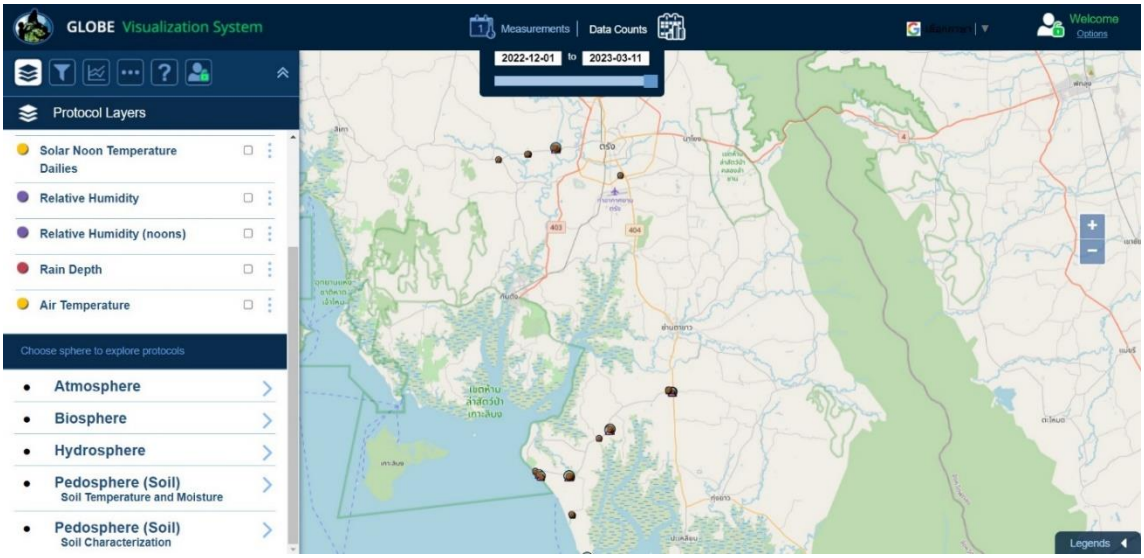
I am Engineering because this research uses the engineering process to work from the beginning of the work to solve the problems that arise. There is innovative design and use of tools and equipment to invent and develop innovations leading to actual use.

### I am a stem professional

I am A STEM professional because innovation development is the application of knowledge through a scientific inquiry process, and focusing on bringing knowledge (scientifically applied mathematics and related technologies) to create innovation to reduce problems in society.

### I am a collaborator

We have to work with group processes efficiently. Starting with thinking about the topic and planning the work. There is a clear sharing of work responsibilities. During the field data collection, Piyapat and Parima collected mosquito data and breeding sites. Kanyakorn and Narupat were the ones who recorded the data and entered the data into the Mosquito Habitat Mapper, leading to the design and development of all three versions of the innovation. Next, design/innovation development and modification and improvements. After that, Naruphat and Prima led the innovation to be tested in each area and recorded the data for analyzing the efficiency of the innovation. The final step is to present the information. Piyapat and Kanyakorn are responsible for all reports and presentation materials. And finally, record a presentation clip together. In addition, there are teachers and scientist consultants to give advice throughout the research.




Visualize Data

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