The International Journal of Engineering and Science (IJES)
|| Volume || 9 || Issue || 05 || Series I || Pages || PP 01-15 || 2020 ||
ISSN (e): 2319-1813 ISSN (p): 20-24-1805

Dengue HemorrhagicFeverMappingSpreadInformation System

Muhammad Saleh[(1)], Fitri Imansyah[(2)], Janus Marpaung[(3)]
muhammad.saleh@ee.untan.ac.id[(1)], fitri.imansyah@ee.untan.ac.id[(2)], janus.marpaung@ee.untan.ac.id[(3)]
Department of Electrical Engineering, Tanjungpura University[(1),(2),(3)]
Corresponding Author: Muhammad Fahmi Faisal

----------ABSTRACT----------
One of the efforts to eradicate dengue fever (DHF) is by developing a periodic vector surveillance system so that it can see climate change and the pattern of case distribution. The Dengue Hemorrhagic Fever Dissemination information system in Pontianak City was built based on desktop using Borland Delphi7 and MySQL as its Database while the online catalog was based on Desktop for Administrative System using Borland Delphi7 and PostgreSQL as its Database, and web-based catalog online using the same php and database that is PostgreSQL. Online catalogs are built using a framework that is organized according to the standard web programming rules. The concept of Object Oriented Programming (OOP), the use of templates, and the implementation of web service technology are very supportive in the ease of developing online catalogs. Geographical Information System is a system that can support spatial decision making and is able to integrate location descriptions with the characteristics of phenomena found in a location. The geographic information system that was built was an effort to support a surveillance system for effective treatment in preventing and eradicating DHF. The expected output from this activity is the compilation of spatial data distribution of dengue cases which can be updated according to its development and the pattern of spread of dengue cases in Pontianak.
Key Words *— Geographical information systems, spatial data, dengue fever.*

Date of Submission: 28-04-2020 Date of Acceptance: 11-05-2020

I. INTRODUCTION

Pontianak City is one of the regions in Indonesia which is a vulnerable and endemic area for dengue fever. Dengue Hemorrhagic Fever (DHF) attacks Pontianak City every year before the change of seasons from the summer season to the rainy season.

Cases of dengue fever that occur every year have been handled and prevented by the Pontianak City Government and related parties with various efforts, including fogging (fogging) to kill adult mosquitoes and eradication of mosquito nests with 3M (draining the water tub; draining places that might be mosquito breeding dens; burying secondhand items that can hold water) and abating. The husbandry program (use of lukewarm fish) has also been socialized as an effort to kill mosquito larvae [3,6,16,18,20].

However, the number of dengue cases is still quite high, especially in the last year, so a different approach is deemed necessary to prevent dengue fever. One approach that can be done is to use mapping. Integration between the development of slums and community-based development around the area can be approached with Geographic Information System (GIS) technology. One of the main capabilities of GIS is being able to map real-world conditions (real world) so that a region's figures can be easily observed.

Geographic Information System is a geographic-based digital information processing and management, so that the main input of GIS is spatial data. Geographic Information Systems are needed in providing accurate information both position, area, and figure information, and graphs [2,4,5,15]. Geographic Information System provides spatial information, lines and points as outlined in the form of maps, tables and graphics that are interrelated so that GIS is able to change data quickly in accordance with developments that occur. Geographic Information Systems can conduct spatial analysis and statistical functions for numerical analysis, making it easier for decision making.

In order to support planning and development, there are several themes of geographic information systems that are very important for the City Government including thematic roads, channels, economic facilities, educational facilities, health facilities, social facilities, and so on. The thematic map when equipped with accurate attribute data can present very useful information, for example displaying the distribution of dengue cases. Presentation of information by displaying a map is certainly very informative because the situation of the object being analyzed can be observed properly. All of this information is very helpful for agencies / agencies especially the Pontianak City Health Office in determining steps to prevent the spread of dengue cases [17,19].

To build a geographic information system (GIS), it requires 2 (two) main data, namely spatial data (maps) and attribute data (statistics). Both types of data must be available together to provide accurate information. Problems that arise how to transform real world conditions into the GIS domain, how to manage data, and how to build a useful GIS application as a supporting element in decision making [2,7,11,13,14].

The purpose of this study is to produce a policy formulation that is expected to be the basis for preventing dengue fever to reduce dengue cases for the realization of the clean and healthy city of Pontianak without dengue fever. In general, the objectives of this activity are:

1. Understand the root causes of emergence through the linkages of environmental hygiene problems, and efforts to prevent dengue fever.
2. Find the cause of dengue cases by reviewing the linkages to environmental hygiene problems, and efforts to prevent dengue fever.
3. Finding strategies for handling and preventing areas with high dengue cases by reviewing the linkages to environmental hygiene problems, and efforts to prevent dengue fever.
4. It is one of the efforts to prevent dengue in areas that are vulnerable to dengue cases.

Technically the objectives of monitoring the spread of dengue are as follows:

1. Obtain a structured figure about the spread of dengue in Pontianak City.
2. Knowing the spatial distribution of dengue patients in Pontianak City.
3. To find out the pattern of the spread of dengue cases so quickly.
4. Identifying the spread of dengue cases.
5. Knowing the potential and problems of environmental utilities.
6. Knowing strategies for preventing and resolving dengue problems by paying attention to the problems and obstacles faced, as well as the solutions that must be taken.
7. Enhancing the ability of the city government to prevent the spread of dengue cases.

The impact that is expected to be felt from the implementation of this activity is the policies and strategies in an effort to prevent the spread of dengue cases in Pontianak in an effort to realize a healthy Pontianak City free from dengue fever.

The main design in presenting the Information Systems Mapping Information System Dissemination of DBD information system is basically formed visually on a computer monitor screen through forming and presenting software under the Windows 32 bit operating system. The objects contained in the application are function objects and information objects. Function objects are form (dialog), pull down menu, button (button), tool, query, text line (text box), list box text combo box, option button (radio button), check box, frame (control panel) and etc. as a tool to guide the operation of the application [8].

Conceptual design of Information Systems Application was originally a database design. This activity includes formal modeling (data model preparation) of the information system database and the initial stages of database planning activities. Database planning is the most important activity in the development of Information Systems. This activity starts from the introduction of the need for data in estimating needs, updating and maintaining data and finally storing data according to the schedule. This conceptual design includes:

- System and procedure design: Based on the results of surveys, systems and procedures analysis, design is carried out and conceptualization of systems and procedures is carried out.
- Concept design: At this stage an integrated system concept will be composed and consists of data classification, application models.

The product of this conceptual design activity is a data model that strictly defines a database of information systems and supports detailed database planning activities. In addition, the conceptual design of information systems also includes identification of basic architecture (type of hardware / software), estimation of use (derived from the needs assessment activity), determination of the scope of the system size. All of this is done by referring to the existing data processing environment which will have to interface with the system.

II. LITERATURE REVIEW

te febrile disease found in the tropics, with a geographical spread similar to malaria. This disease is caused by one of four virus serotypes of the genus Flavivirus, family Flaviviridae. Each serotype is different enough so that no cross-protection and epidemics caused by multiple serotypes (hyperendemicity) can occur. Dengue fever is spread to humans by the Aedes aegypti mosquito [3,10,12].

There are two types of dengue fever. Respectively, Dengue Fever (Dengue Fever) and Dengue Haemorrhagic Fever (Dengue Fever). According to Dr. Lindana Sastra, SpA, Pediatrician, Brawijaya Women and Children Hospital Jakarta (BWCH), both types of dengue fever exhibit the same symptoms. But DHF is more dangerous. Because, more deaths are caused by DHF [9].

This disease is shown by the sudden appearance of fever, accompanied by severe headaches, joint and muscle pain (myalgia and arthralgia) and rashes; Dengue rashes have bright red, petechial and usually appear

first on the lower part of the body. In some patients, it spreads to cover almost the entire body. In addition, inflammation of the stomach can also occur with a combination of abdominal pain, nausea, vomiting or diarrhea [12].

Dengue fever generally lasts around six or seven days with a smaller peak of fever occurring at the end of the fever period. Clinically, the platelet count will fall until the patient is considered afebril. After the shoot / incubation period of 3-15 days the infected person can experience / suffer from this disease in one of the following four forms [6]:

1. Abortive form, the patient does not feel any symptoms.
2. Classic dengue, sufferers experience high fever for 4-7 days, aches in the bones, followed by the appearance of spots or spots of bleeding under the skin.
3. Dengue Haemorrhagic Fever (Dengue Hemorrhagic Fever), the symptoms are the same as classic dengue plus bleeding from the nose (epistaxis / nosebleeds), mouth, rectum and so on.
4. Dengue Shock Syndrome, the symptoms are the same as DHF added with shock / presyok. This form often leads to death.

Because of frequent bleeding and shock, the death rate is quite high in this disease. Therefore, every patient suspected of suffering from dengue fever in any level must be immediately taken to the doctor or hospital, considering that at any time they can experience shock / death.

Dengue Hemorrhagic Fever (DHF) is caused by dengue virus which belongs to group B Arthopod Borne Virus (Arboviroses) which is now known as the genus Flavivirus, Flaviviricae family, and has 4 types of serotypes namely: DEN-1, DEN-2, DEN-3, DEN- 3 4 Infection of one serotype will cause antibodies to the serotype in question, while antibodies that are formed against 9 other serotypes are very lacking, so it cannot provide adequate protection against other serotypes. The DEN-3 serotype is the dominant serotype and it is assumed that many show severe clinical manifestations [3].

The DHF disease vector is Aedes aegypti and Aedes albopictus mosquitoes, especially for Asian countries, the Philippines and Japan, whereas Aedes polynesiensis, Aedes scutellaris and Aedes pseudoscutellaris mosquitoes are vectors in the Pacific island countries and New Guinea. DHF vectors in Indonesia are Aedes (Stegomya) aegypti and albopictus mosquitoes.

The Aedes aegypti mosquito has long been known as the main vector in the spread of dengue disease, while its characteristics are as follows:

1. A small black body with white spots.
2. Mosquito flying distance approximately100 meters.
3. Age of female mosquitoes can reach about 1 month.
4. blood sucking in the morning around 09.00-10.00 and evening 16.00-17.00.
5. Female mosquitoes suck blood for egg maturation, while male mosquitoes eat plant juices.
6. Living in a pool of clean water not in sewers or sewers.
7. Inside the house you can live in a bathtub, crock, flower vase, and bird drinking water.
8. Outside the house can live in a pool of water that is in the drum, and used tires.

Transmission of DHF has three factors that play a role in the transmission of viral infections, namely humans, viruses and intermediate vectors. The Ministry of Health Republic of Indonesia explained more clearly the mechanism of transmission of dengue fever and its potential site of transmission [6].

The emergence of a disease can be explained through the concept of an epidemiologic triangle, namely the presence of agents (agents), hosts and the environment (environment).

Strategies for preventing and eradicating DHF can be done in several ways, namely: How to break the chain of transmission; Ways of eradicating Aedes aegypti larvae; How to prevent and deal with outbreaks

Such broad governmental authority requires the development of adequate capabilities and facilities, including planning, organizing and scheduling implementation, monitoring and control. The areas of authority include physical and non-physical development. Physical development clearly contains spatial implications, both in terms of space (location, distribution) and its impact.

However, non-physical development such as the development of health aspects, requires thematic information about the distribution and population density, location / spread of certain diseases, location and capabilities of health facilities and so on. Information that includes any theme is always needed in terms of location or distribution as policy or planning material.

It could be therefore said that to be able to carry out 80% of all authority as outlined in Law No. 22 of 1999, Regency and City Governments need information that refers to locations or maps. In this connection, surveys and mapping and monitoring of natural resources and the environment need to be carried out systematically and programmatically.

In the process of monitoring and preventing the role of this map is very clear, the use of maps include [9]:

a. Prevention Planning: Selection of prevention location targets; Preparation for prevention.
b. Prevention Pattern Design: Prevention design plan; Scheduling of preventive activities; Monitoring

scheduled activities.

c. Prevention Implementation: Perform actions that have been planned and designed according to the target; Monitor what has been done so that what has been planned and designed can be maintained so that the City government's program is not in vain.

From this example, it can be seen that the maps needed for DHF monitoring can also be used for the operation and management of many other aspects, both for the maintenance and management of infrastructure and utilities as well as in the context of health surveillance for an area.

A standard base map is needed as a reference system for all data / information needed to carry out these functions. In addition to the basic map, thematic maps are the completeness needed for handling development.

III. RESEARCH METHODS

The research material in the form of sample data of cases of Dengue Hemorrhagic Fever (DHF) was obtained from the Pontianak City Health Office. Dengue cases data needed consist of name, sex, age, address, type of dengue fever (Dengue Fever or Dengue Fever) and patient status (dead or not).

a. Research Tools

Research tools are tools used for research. The research tools used in this study are [1]:

- Entity Relationship Diagram (ERD), to explain the relationships between data in a database based on data base objects that have relationships between relationships.
- Data Flow Diagrams (DFD), to configure data flow on systems consisting of data management systems and data analysis systems.

b. Software

To build this geographic information system some software is needed. The software used in this study are: Windows XP Professional Service Pack 3 operating system; ArcView GIS 3.3; MySQL 5.0 database; MySQL Connector ODBC 3.51.20; Delphi 7.0; MapObject 2.4

c. Hardware

To build this geographical information system requires some hardware. The hardware used in this study are: PC / Laptop, used for system development; GPS, used to determine the location of dengue cases.

This research uses several methods. The methods used in this study are:

a. Method of Collecting Data

Data collection is done by taking data from the Pontianak City Health Office, puskesmas or hospitals, and by conducting interviews and observations.

Method of System Design

The system design begins with database design, data flow diagram design and system interface, designing the case mapping method, designing a history data analysis algorithm to find out areas with a high number of DHF cases, the spread of DHF cases and their distribution patterns (if found). In carrying out system design there are stages carried out, namely:

1. Database Design
   Database design stages consist of designing Entity Relationship Diagrams (ERD), tabular database table specifications, spatial database table specifications, tabular relationship diagrams between tabular data tables and spatial data relationship models and tabular data.
2. Designing a Data Flow Diagram
   The stages of data flow diagram design consist of designing a system context diagram, a system overview diagram and a detailed system diagram
3. System Interface Design
   The stages of system interface design are system interface structure design and layout design and system interface components.

b. Method of System Development

The system development is carried out with the Software Development Life Cycle (SDLC) method which starts from the planning stage (initiation / planning), then is followed by the gathering and analysis of requirements (requirements gathering and analysis), design (design), programming (build / coding), testing (testing) and system usage and maintenance (operations and maintenance). The steps in developing the system can be explained as follows:

1. Conceptual system design
   In the form of entity relationship diagram (ERD) and data flow diagram (DFD) systems, determine the case mapping method, determine the data history analysis algorithm to find out areas with high number of DHF cases, the spread of DHF cases and their distribution patterns (if found) and test method planning system.

2. Designing a system prototype
   Represents the implementation of the third step in application form.
3. System testing and validation
   Testing uses the Black Box method where the input is in the form of a data set to test the validity of integration and system consistency..
4. Analysis of test results
   Analysis of the test results is carried out to determine the characteristics of the system that has been developed.

c. Method of Testing System

Testing for input and tabular data search is performed using the Black Box method, while for spatial data input and search is performed using the spatial feature functionality testing method. Tests carried out on the system will check whether the system can run properly as expected. The test data is chosen based on the problem specifications without regard to internal details of the system. The selection of testing methods is done by using data that is easily checked (easy value), data that is simple and easily calculated (typical realistic value), extreme data (extreme values), data that is not allowed (illegal values), data that is empty (null) and correct data.

Data of dengue cases collected include names, gender, age, parents 'names, parents' occupation, date of illness, date of admission to hospital, week of discharge from hospital, address (including RT / RW), origin of the village, the hospital where the patient was treated, the patient's lab results (hematocrit, platelets and hemoglobin), the type of dengue fever suffered (Dengue Fever or Dengue Fever) and the patient's status (dead or not). Analysis of the results was carried out by the point density / concentration analysis method and the overlay layer method. DHF cases data are mapped as dots. These points and their attributes are stored as history data. Later on, this historical data will be analyzed for its density / concentration, where areas with high density / concentration indicate that the area has many cases of DHF. From the historical data can also be seen the spread of dengue cases and patterns of spread (if found).

This research consists of several stages. The steps of the research carried out can be seen in the following flow chart.

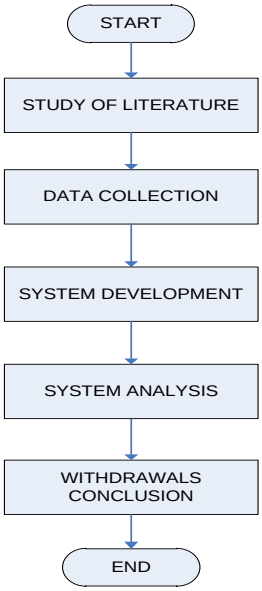


Figure 1. The Research of Flow Chart

The diagram above can be explained as follows:

- Study ofLiterature
  Literature study is carried out to understand related material from several literatures.
- Data Collection
  Data collection from Pontianak City Health Office, puskesmas or hospitals by conducting interviews and observations.
- System Development
  The development of the system begins with the conceptual design of the system being built, the design of the system prototype, the testing and validation of the system and the analysis of test results.
- System analysis

In this step, an analysis of the overall system is made to make it easier to draw conclusion

- Withdrawals conclusions
  The conclusions are formulated based on the analysis that has been done whether the system designed is able to handle the history of DHF cases and provide regional information with a high number of DHF cases, the spread of DHF cases and their distribution patterns (if found) correctly.

3.1. Database Design

1. Design of Entity Relationship Diagram

Entity Relational Diagram (ERD) is a description of the relationships between entities that are used in the system. ERD design includes the stage of determining entities, determining inter-entity relations, the level of relationships that occur, and inter-entity connectivity. There are five entities in this system:

1. Hospital, which is a hospital where patients are treated.
2. Patients, namely people who suffer from dengue fever.
3. Urban village, the area where the patient lives, fogging and other preventive measures are taken.
4. Fogging, i.e. the fogging action taken
5. Other prevention, namely preventive measures other than fogging.

Relationships between each entity can be written in enterprise rules. In this system, a patient is treated in one hospital and one hospital treats many patients. A sufferer lives in one Urban Village and in one Urban Village lives many sufferers. One fogging activity is carried out in one Urban Village and in one Urban Village can be done in many fogging activities. One prevention activity is carried out in one Urban Village and in one Urban Village can be carried out many prevention activities.

The relationships and connectivity that occur from existing entities are as follows:

1. Be treated.
   The Patient(M) is hospitalized (1).
2. Stay
   The Patient(M) lives in the urban village (1).
3. Done.
   a. Fogging (M) is done in urban village (1).
   b. Other prevention (M) is done in the village (1).

The relationships and relationships between entities are illustrated through the ER Diagram as shown in Figure 2 below.

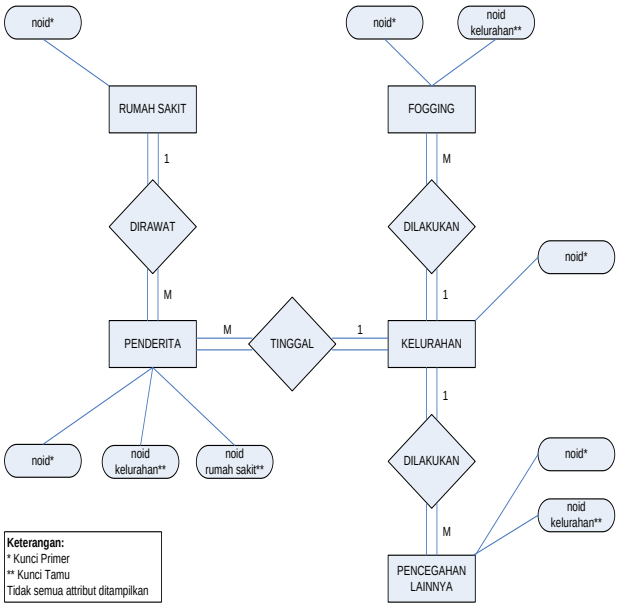


Figure 2. System ER Diagram

2. Relationship Diagram Between Tabular Data Tables

The relationship between tabular data tables in this geographical information system can be seen in the following Figure 3

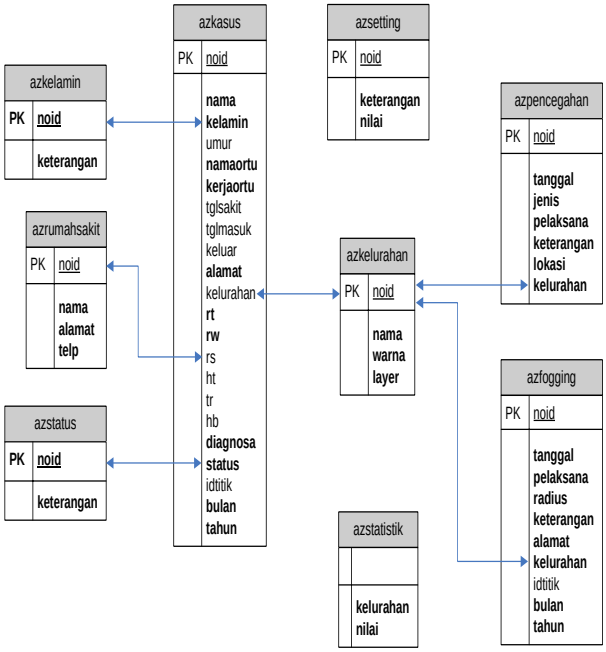


Figure 3. Relationship Diagram Between Tabular Data Tables.

3. Spatial Data Relationship Model and Tabular Data

In geographic information systems, spatial data can be combined with tabular data. The process of merging data, which in this system uses the AddRelate function, requires connecting fields in each data, both spatially and tabularly. Tabular data associated with spatial data must be in the form of tables, and cannot be query results. A data merging process can only involve one spatial data layer with a tabular data table.

After the data is combined, the data can be filtered based on fields in spatial data and fields in tabular data. The filter process, which in this system uses the Filter Expression function, functions so that only the desired data will be displayed..

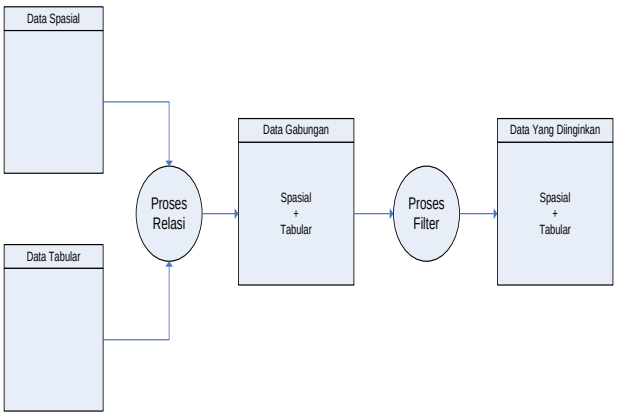


Figure 4. Model of the Relationship Between Spatial Data and Tabular Data.

This system will do some data merging for data analysis purposes. The layers and tables involved can be seen in the following Table 1.

Table 1
List of Layer Relationships and Tables in the System

Layer	Field Penghubung	Tabel	Field Penghubung
Fogging	Id	azfogging	idtitik
Kasus	Id	azkasus	idtitik
Urban Village	Label	azstatistik	Urban Village

4. Design Data Flow Diagram System Context Diagram

Context diagram is a diagram that provides a general description of the activities that take place in the system. Figure 5 below shows the context diagram of the dengue geographic information system..

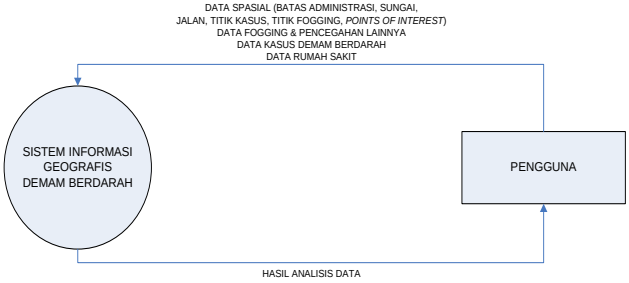


Figure5.System Context Diagram.

Dengue fever geographic information systems that are designed have only one level of user. Users referred to in this system are the Pontianak City Health Office, or related parties such as social organizations and research institutions that wish to use this system.

3.2. System Interface Design

1. Designing the System Interface Structure

This geographic information system is a desktop application that was built using Delphi. The system interface is designed in the form of forms that have certain functions in accordance with existing processes. These forms are accessed via the menu on the main form. The structure of the system interface is designed as follows.

1. Main Form
   This form is used to manage the map. In this form the user can see the map display, save points, identify points, delete points, or search for districts, villages and roads on the map. Users can access other forms through the menu on this form.
2. Reference
   This menu consists of two submenus, namely the urban reference that is used to manage urban data and the hospital reference that is used to manage hospital data.
3. Prevention Case
   This menu consists of two submenus, namely prevention of fogging which is used to manage fogging data and other precautions that are used to manage prevention data other than fogging
4. Case Data
   This menu is used to manage dengue fever data.
5. Data Analysis
   This menu is used to analyze dengue fever data.

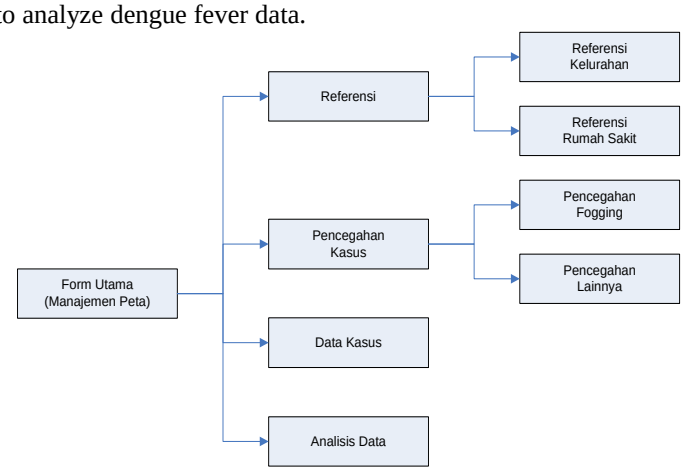


Figure 6. System Interface Structure.

IV. RESULTS

The system that was designed requires a computer with a minimum Windows XP operating system. On the computer also must be installed MySQL, MySQL ODBC Connector and MapObjects Runtime. The system that has been designed can be explained as follows.

The main form is used to manage maps and access other forms on the system. The interface of the main form design results can be seen in the following Figure 7.

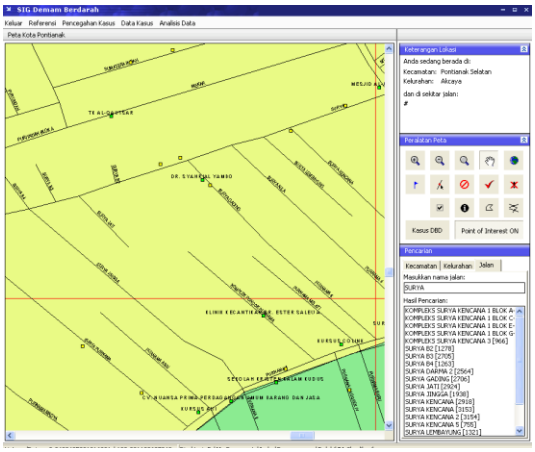


Figure 7. Main Form Interface

At the top of the main form there are five menus. The function of each menu can be seen in table 2 below.

Table2. Menu List Main Form and Function

Menu	Submenu	Fungsi
Keluar	-	Keluar dari aplikasi
Referensi	Daftar Urban Village	Menampilkan form Daftar Urban Village
	Daftar Rumah Sakit	Menampilkan form Daftar Rumah Sakit
Pencegahan Kasus	Fogging	Menampilkan form Data Fogging
	Pencegahan Lainnya	Menampilkan form Data Pencegahan Lainnya
Data Kasus	-	Menampilkan form Data Kasus
Analisis Data	-	Menampilkan form Analisis Data

At the bottom of the menu, there is a Map of Pontianak City. The map is the panel on the main form with the largest size. The size of the map panel can change according to the size of the main form if the main form is resized. The map displayed on this form consists of layers arranged in overlays, starting from the sub-district layer at the bottom, then the Urban Village layer, river layer, grid layer, road layer, fogging layer, case layer and location layer in the very top.

This system also handles administrative boundary history data (Urban Village), so that in this system it is possible to have more than one Urban Village layer. However, in the main form, the Urban Village layer that is displayed is the newest Urban Village layer. So that users do not get a full impression on the map, street names and points of interest will only be raised if the map displayed has reached a certain magnification level.

At the top right of the main form, there is a Location Remarks panel. This panel functions to find out the location on the map highlighted by the user. The information provided is in the form of names of sub-districts, sub-districts and roads. The appearance of the Location Remarks panel can be seen in Figure 8. below.

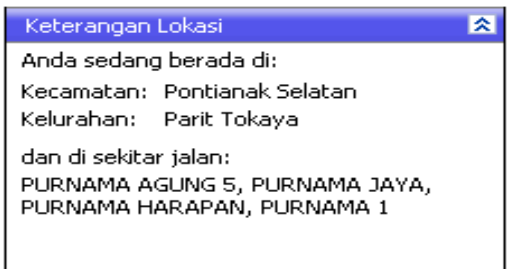


Figure 8.Panel Description Location On Main Form

1. **Urban Village Registration Form**
   The Urban Village list form is used to manage Urban Village data and add a new administrative boundary map (Urban Village layer). In this form, users can see a list of village names, colors and color codes of each village. The data displayed is in accordance with the choice of data year contained at the top of the form.
2. **Hospital Registration Form**
   The hospital register form is used to manage hospital data. In this form, users can add new hospital data, change or delete existing hospital data.
3. **Form Data Fogging**
   The fogging data form is used to manage dengue prevention data in the form of fogging. Fogging data management is distinguished from other preventive management because fogging data is mapped (has spatial data). In this form, users can add new fogging data, change or delete existing fogging data. Fogging data can be displayed based on the data year, or based on relations with spatial data. Users can also highlight points on the map if the fogging data has spatial relations.
4. **Other Prevention Data Forms**
   Another form of prevention data is used to manage dengue prevention data in addition to fogging. In this form, users can add new prevention data, change or delete existing prevention data. Prevention data is displayed based on the data year
5. **Dengue Fever Case Data Form**
   Dengue case data form is used to manage dengue case data. In the dengue case data form, users can add new case data, change or delete existing case data. Case data can be displayed based on the data year, or based on relations with spatial data. Users can also highlight points on the map if dengue case data have spatial relations. Users can search case data by name or address.
6. **Data Analysis Form**
   Data analysis form is used to analyze dengue case data and case prevention. If you want to compare the results of the analysis, users can open the data analysis form for up to five windows at once. The query page interface of the data analysis form can be seen in Figure 9.

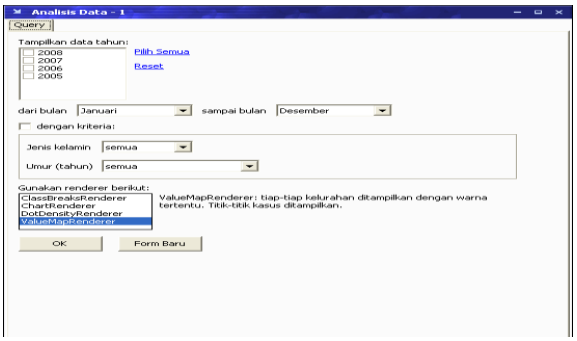


Figure 9. Interface Query Form Data Analysis Page.

In this form, users can analyze data based on year and month of data. Users can also determine data criteria for dengue cases that will be analyzed based on the gender and age of the patient. Users can choose to display the map analysis results in four different display options, namely:

a. *ClassBreaksRenderer*. In this option, each Urban Village will be displayed in color gradations based on the number of cases per Urban Village. Case points are not displayed.
b. *ChartRenderer*. Under this option, a graph will be displayed in each Urban Village showing the number of cases per Urban Village. Case points are not displayed.
c. *DotDensityRenderer*. In this option, in each Urban Village certain points are displayed whose number and density indicate the number of cases per Urban Village. Case points are not displayed.
d. *ValueMapRenderer*. In this option, each Urban Village will be displayed in certain colors according to user settings. Case points are displayed.

The results of the analysis are divided into three pages, namely spatial data pages, tabular data and statistics. The display of the spatial data page can be seen in Figure 10 through Figure 13 below.

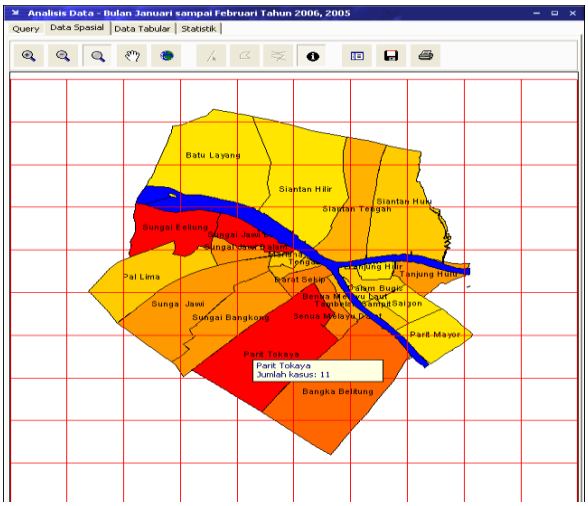


Figure 10. Interface of Spatial Data Pages Data Analysis Form Using ClassBreaksRenderer.

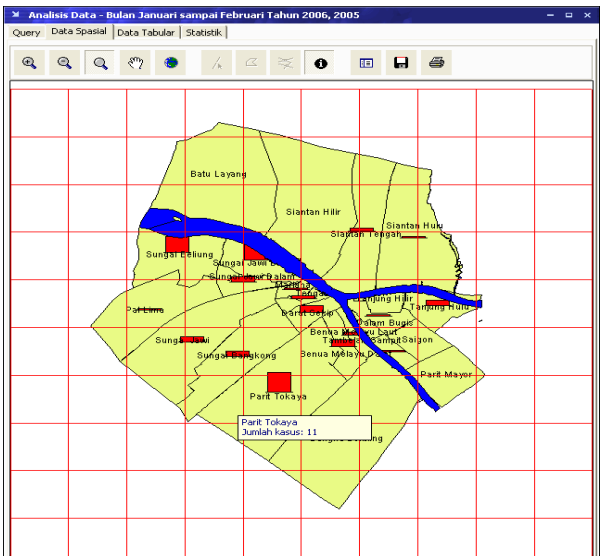


Figure 11. Page Spatial Data Interface Form Data Analysis Using Chart Renderer.

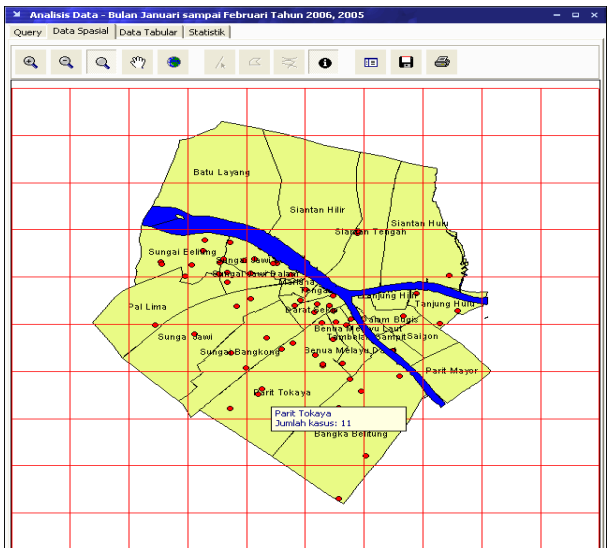


Figure 12.Page Spatial Data Interface Form Data Analysis Using Dot Density Renderer.

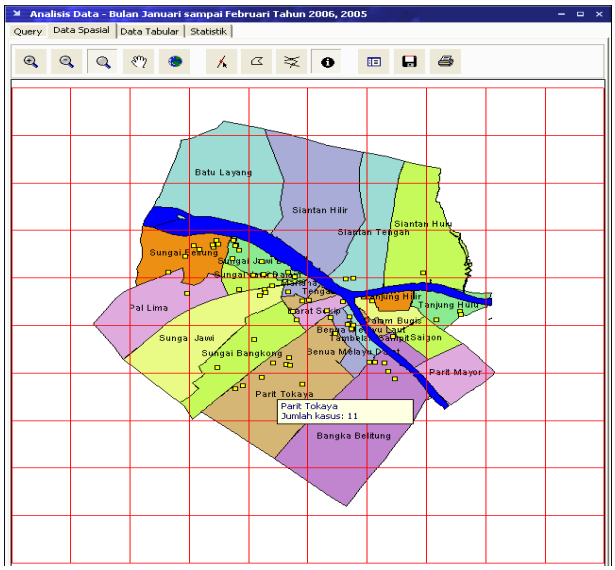
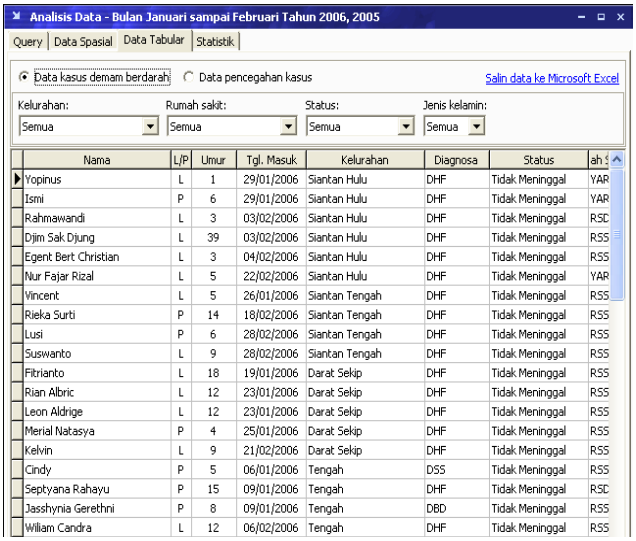


Figure 13. Page Spatial Data Interface Form Data Analysis Using Value Map Renderer.

The tabular data page displays data on dengue cases and prevention of cases being analyzed. Users can filter the data displayed in the table based on certain criteria. For dengue case data, filtering can be done based on Urban Village, hospital, status and gender. For case prevention data, filtering can be done based on Urban Village and activities. The amount of data in the table can be seen at the bottom of the tabular data page. Users can also copy these data to Microsoft Excel for further processing. The display of the tabular data page can be seen in the following Figure 14.



Nama	L/P	Umur	Tgl. Masuk	Kelurahan	Diagnosa	Status	ah
Yopinus	L	1	29/01/2006	Siantan Hulu	DHF	Tidak Meninggal	YAR
Ismi	P	6	29/01/2006	Siantan Hulu	DHF	Tidak Meninggal	YAR
Rahmawandi	L	3	03/02/2006	Siantan Hulu	DHF	Tidak Meninggal	RSD
Djim Sak Djung	L	39	03/02/2006	Siantan Hulu	DHF	Tidak Meninggal	RSS
Egent Bert Christian	L	3	04/02/2006	Siantan Hulu	DHF	Tidak Meninggal	RSS
Nur Fajar Rizal	L	5	22/02/2006	Siantan Hulu	DHF	Tidak Meninggal	YAR
Vincent	L	5	26/01/2006	Siantan Tengah	DHF	Tidak Meninggal	RSS
Rieka Surti	P	14	18/02/2006	Siantan Tengah	DHF	Tidak Meninggal	RSS
Lusi	P	6	28/02/2006	Siantan Tengah	DHF	Tidak Meninggal	RSS
Suswanto	L	9	28/02/2006	Siantan Tengah	DHF	Tidak Meninggal	RSS
Fitrianto	L	18	19/01/2006	Darat Sekip	DHF	Tidak Meninggal	RSS
Rian Albric	L	12	23/01/2006	Darat Sekip	DHF	Tidak Meninggal	RSS
Leon Aldrige	L	12	23/01/2006	Darat Sekip	DHF	Tidak Meninggal	RSS
Merial Natasya	P	4	25/01/2006	Darat Sekip	DHF	Tidak Meninggal	RSS
Kelvin	L	9	21/02/2006	Darat Sekip	DHF	Tidak Meninggal	RSS
Cindy	P	5	06/01/2006	Tengah	DSS	Tidak Meninggal	RSS
Septyana Rahayu	P	15	09/01/2006	Tengah	DHF	Tidak Meninggal	RSD
Jasshynia Gerethni	P	8	09/01/2006	Tengah	DBD	Tidak Meninggal	RSS
Wiliam Candra	L	12	06/02/2006	Tengah	DHF	Tidak Meninggal	RSS

Figure 14. Tabular Data Interface Form Data Analysis.

The statistics page displays the number of cases in spatial data, the number of cases in tabular data and the number of uncharted cases (no spatial relations). This page also displays statistics on the number of cases per Urban Village. Statistics on the number of cases per Urban Village are calculated by two methods, based on spatial data and based on tabular data. Users can copy these data to Microsoft Excel for further processing. A view of the tabular data page can be seen in the following Figure 15.

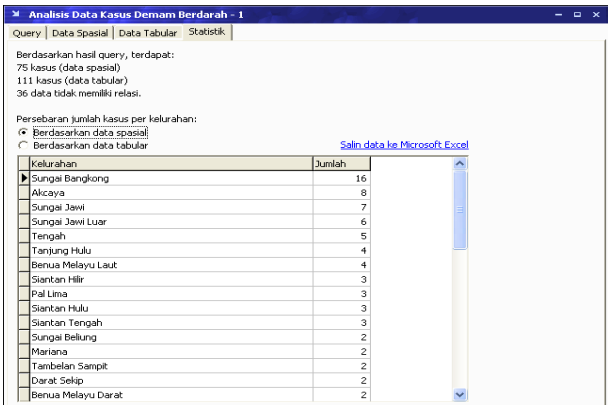


Figure 15. Interface statistics page analysis form data.

On the spatial data page, users can also plan the implementation of fogging in areas where there are cases. The system provides an Add Point button which functions to help the user make estimates of the fogging area, the number of cases in the fogging radius and the names of the roads within the fogging radius.

For this, the user must activate the Add Point button. The system will ask the user to enter the fogging radius to be performed, then the system will display a description panel. The description panel functions to display the estimated results. After that, the user can choose a location (by clicking) on the map, and see the results in the description panel. Display information panel when planning the implementation of fogging can be seen in the following Figure 16.

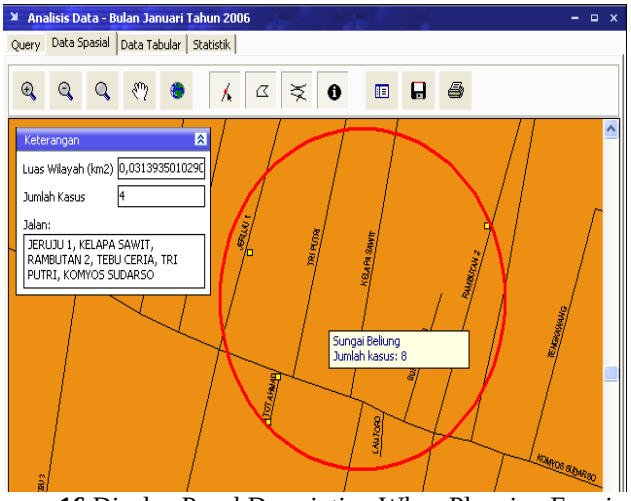


Figure 16. Display Panel Description When Planning Fogging.

In spatial analysis, the user's ability to understand the results of the analysis is very necessary. The system will display the results of analysis on the map, then the user will translate the results of the spatial analysis. The system only shows the results of the analysis on the map, such as regarding the distribution of cases, patterns of distribution of cases, the areas that most often occur cases, areas that must be prioritized to be handled, the effect of preventive actions (especially fogging) that have been carried out on the number of cases that occur and so on. The system does not state the results of spatial analysis in sentence form and also does not provide recommendations to users. This system only helps users in conducting spatial analysis, visualizing the results of data analysis on the map to be interpreted by the user.

On the tabular data page, users can see detailed data of each case that occurred as well as detailed data of each prevention that has been done. Users can filter the data displayed in the table based on certain criteria and see the amount at the bottom of the page.

On the statistics page, users can see the total number of cases as well as the number of cases that occur per Urban Village. The number of cases that occur per Urban Village is displayed in tabular form and sorted by the highest number of cases.

This system helps and supports users to conduct data analysis in efforts to prevent dengue fever, and it can be said that this system is included in the decision support system.

V. CONCLUSIONS

After analyzing and testing the Dengue Fever Geographic Information System, it can be concluded that:

1. Testing shows that when inputting data with data that is easily checked (easy value) as well as simple and easily calculated data (typical realistic value), the system can handle the data according to what is expected.
2. When users input data, users may enter data that is extreme (extreme values) and exceeds the fairness limit. Tests show that if a user inputs data with extreme data, the system will display an error message. Error messages contain extreme data information, including permissible limits.
3. When users input data, users may enter data that is not allowed (illegal values). Tests show that if a user inputs data with data that is not allowed, the system will display an error message. Error messages contain data that is not allowed.
4. When users input data, there are fields that must be filled in and there are fields that can be empty (null). Tests show that if the user inputs data with all data blank or there is blank data in the fields that must be filled, the system will display an error message. Error messages contain information that must be filled in.
5. When users input data with the correct data, the system will execute the data input. The system will immediately save in the database and not display any messages.
6. The system does not prevent users from entering the same data. Data such as dengue fever data, fogging data and other prevention data do not have unique identification attributes, so handling the same input data is difficult. Therefore, handling the same data input is left to the user. To make it easier for users, data is not displayed in the order in which data was entered, but is displayed in sequence according to the date attribute, so that the same data will appear close together.
7. Spatial functions such as map navigation, point management on the map, map information, map export, data analysis queries and fogging planning can work well. When conducting data analysis, only points that have a relation with tabular data will be displayed.
8. Based on the data used, namely data on dengue cases for the period 2006 to 2008 obtained from the Pontianak City Health Office, the system is able to handle the history of dengue cases and display them in map form. Historical data on dengue fever cases handled by the system during this period totaled 1,582 cases.
9. In this study, not all historical data on dengue cases can be mapped. Out of a total of 1,582 cases, only 1,030 cases (around 65.11%) can be mapped, while 552 cases (around 34.89%) cannot be mapped. This is due to the limitations of digital maps that are owned, especially on the road layer. Another cause is due to lack of clarity in the patient's partial address data, for example not writing the full address, but only writing the name of the alley.
10. Through data analysis, users can view the history of dengue cases with certain criteria and time periods. The results of data analysis can show the spread of dengue fever cases that are configured in the form of a map so that users know more clearly which areas are most common cases of dengue fever. By comparing the distribution of dengue cases in each period, users are able to find patterns of spread of dengue cases.
11. The system can assist users in analyzing the effect of preventive actions (especially fogging) on the number of dengue cases that occur. The system can also help users plan fogging actions to be taken.
12. The results of system design and testing show that this system can be an alternative solution for Pontianak City Government and related parties to support efforts to prevent dengue fever.

REFERENCES

[1]. Abdul Kadir, (2010), Easily Learn My SQL Database, Andi Offset, Yogyakarta.

[2]. Ajriansyah Putra,Ambar TriRatnaningsih,MuhammadIkhwan, (2018), Mapping of Forest and Land Fire Prone Areas Using Geographic Information Systems (Case Study: Bukit Batu District, Bengkalis District), Wahana Foresta, Forestry Journal, Vol. 13, Number 1 January 2018.

[3]. AndrianiN.Study of Management of DHF Treatment TherapyAvailable from: Journal.unsrat.ac.id/4771-9184-1-SM.pdf.May 2014.

[4]. Arianti,Iin. (2006). Modeling Levels and Zones of Forest and Land Fire Hazards Using GIS in the Kapuas Tengah Subdistrict, West Kalimantan Province. Bogor: Bogor Agricultural University.

[5]. Barus, B. dan U.S. Wiradisastra. 2000. Geographic Information System. Bogor: Resource Management Facility. Cartography and Remote Sensing Laboratory, Department of Land, Faperta, IPB

[6]. Indonesian Ministry of Health. 2000. Guidelines for the Management of Dengue Hemorrhagic Fever. Jakarta: Indonesian Ministry of Health.

[7]. Electronic Visualization Laboratory. 2009. Information Exploration, Presentation Styles. Mei 04, 2010. http://www.evl.uic.edu/aej/422/week02.html.

[8]. Geografiana. 2004. Maps Can Stop Disease. October 22, 2009.http://geografiana.com/index.php?option=com_content&task=view&id=1& Itemid=55

[9]. MedicineNet.com. 2004. Definition of Medical Geography. Nopember 29, 2009. http://www.medterms.com/script/main/art.asp?articlekey=18879

[10]. Parents Guide Online. Dengue Fever is Still Lurking. October 22, 2009.http://www.parentsguide.co.id/dsp_content.php?kat=3&emonth=04&eyear=2007&pg=hns

[11]. Public Health Image Library. 2006. Photographs, Illustrations, Multimedia FilesID#: 9258. April 24, 2010. http://phil.cdc.gov/phil/details.asp

[12]. "Tempo" Data and Analysis Center. 2005. Dengue Fever in Data: Dengue Fever. October 28, 2009.http://www.pdat.co.id/hg/political_pdat/2005/11/14/pol,20051114-01,id.html
[13]. Puspitasari, Rina. (2011).Mapping the Potential of Forest Fires in Forest Areas in Banyuwangi Regency. Yogyakarta: Office of Consolidation of Forest Areas Region XI Java-Madura.
[14]. Purnama ES, JayaINS. (2007) Spatial Modeling of Hutanan Land Fire Hazards Using Geographic Information System (GIS) Technology and Remote Sensing in Riau Province. Journal of Tropical Forest Management 8 (1): 85-97.
[15]. Prahasta, Eddy. 2002. Basic Concepts of Geographic Information Systems. Bandung: Informatics.
[16]. Ririh Y dan Anny V Relationship of Environmental Conditions, Containers, and Community Behavior with the Existence of Aedes Aegypti Mosquito larvae in Endemic Areas of Dengue Hemorrhagic Fever in Surabaya. [accessed on 20 September 2014]. Available from: Journal of environmental health, Vol 1, January 2, 2005.
[17]. Ruliansya A, Gunawan T. Geographic Information System For Mapping Dengue Hemorrhagic Fever Prone Areas.Availablefrom:journalof Vector- bpk.litbang.depkes.go.id/2961-2380-1-SM.pdf. tahun 2011
[18]. Syarif I.S,Public Knowledge of Dengue Hemorrhagic Fever in Maen Village, East Likupang District, South Minahasa Regency. Journal of e-Biomedics (eBM),volume1, March2013 ./4372-8339-1-SM-3.pdf
[19]. Ummi Athiyyah Yuniarti, Bambang Sudarsono dan Arwan Putra Wijaya. (2014). Application of Geographic Information Systems for Web-Based Spread of Dengue Hemorrhagic Fever (Case Study: Kudus Regency). Geodetic Journal. UNDIP. Semarang.
[20]. Widodo, Arif. 2007. Improvement of Knowledge, Attitudes, and Skills of PKK Haji Makam Village Women for Dengue Hemorrhagic Fever (DHF). News. Vol. 10. p. 10-18.

Muhammad Saleh. "Dengue Hemorrhagic Fever Mapping Spread Information System." *The International Journal of Engineering and Science (IJES)*, 9(5), (2020): pp. 01-15.