

An Application of Geo-Informatics for Web Development of Public Health Database in Mahasarakham Province, Thailand

Satith Sangpradid¹, Ilada Aroonsri²

¹Department of Geoinformatics, Research unit of Geo-informatics for Local Development, Faculty of Informatics, Mahasarakham University, Kantarawichai District, Maha Sarakham 44150, Thailand

²Department of Business Digital, Faculty of Management Sciences, Valaya Alongkorn Rajabhat University Under the Royal Patronage, 1, Moo 10, Klong 1, Klong Luang, Pathum Thani 13180, Thailand

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ABSTRACT: Dengue Hemorrhagic Fever (DHF) is a disease caused by the dengue virus (Dengue Virus) from the common Aedes mosquito which is a contagion and that is a significant public health problem. Therefore, the study used GIS as a tool to assessment the risk area of dengue Hemorrhagic fever. The five factors for spatial analysis of risk area include house Index, land use, distance from the stream, distance from the water bodies, and annual rainfall. The results of the risk areas divided into 4 levels were low risk area was 2.20 sq.km., moderate risk area was 3754.09 sq.km., high risk area was 3549.04 sq.km., and very high risk area was 246.21 sq.km. The web development of public health database to represent the estimated dengue hemorrhagic map using GIS by the open-source software. The evaluations of the content quality and template of web GIS show the significance of the mean value was 4.34, the standard deviation was 0.66, and the overall questionnaire satisfied was a good level.

KEYWORDS: Free and open-source software, Geographic Information System, House Index, Inverse Distance Weight, Dengue Haemorrhagic Fever.

I. INTRODUCTION

Thailand has been the site of a dengue hemorrhagic fever (DHF) since 1958, causing hundreds of deaths every year. One of the four dengue virus strains can be transmitted to humans through mosquito bites. DHF is found throughout the year, but it peaks in the rainy season, when there is a lot of water logging, allowing mosquitoes to hatch. Epidemiological studies of dengue fever are not easy for many reasons. The first reason is a very quiet transmission there only severe cases have been reported show that the patients with mild or mild

symptoms are not considered by the health system [1].

Geographic Information System (GIS) Technology has been widely used in public health and related issues such as epidemics during regional or national natural disasters to assess and identify risk factors of DHF included socioeconomic, climate, population and physical environment variables to prediction of the DHF risk area [2]. The use of GIS for analysis of DHF risk area for several factors such as land use factors, seasons, rainfall, temperature, humidity, height, river, population density and applying GIS tools to predictor define risk areas by linking, analysing, processing and displaying the relationship of data [3]. The traditional method of GIS technique for spatial analysis based on Boolean methods or overlay operation methods. Boolean overlay of binary thematic layers offers a simple and quick approach to a risk analysis with GIS. In general, with Boolean methods, all influencing factors are of equal importance [4].

The application of GIS has been utilization in environment management, public health, urban management, and several managements for the development of the country. In the past, the represent of GIS map was to displayed the static image on the HTML page for interactive maps. Presently, the trends of technology the methods and tools for design and making maps available on the web have changed. The origins of early web mapping applications were simply tools that allowed agencies and individuals to publish maps with user options limited to browsing. Zooming, panning, and turning on/off layers [5]. Web based GIS is mainly to make the spatial data available everywhere that anyone can be search and access. The data on web

bases GIS can easily to updated and displays in the real time whenever data change [6].

This paper proposes of the spatial analysis of DHF risk area maps and design and web development of spatial database of public health database.

II. MATERIALS AND METHODS

Study area

Maha Sarakham province of Thailand the located are lies between 15.43° to 16.63° N Latitude and 102.72° to 103.54° E Longitude shown in Figure 1. The Nhong Bua has a population of about 963,047 people. The general geography of study area is low elevation variation. The region is bound by the prominent topography or low hill on the north and the east. The land use covered by the rice paddy field.

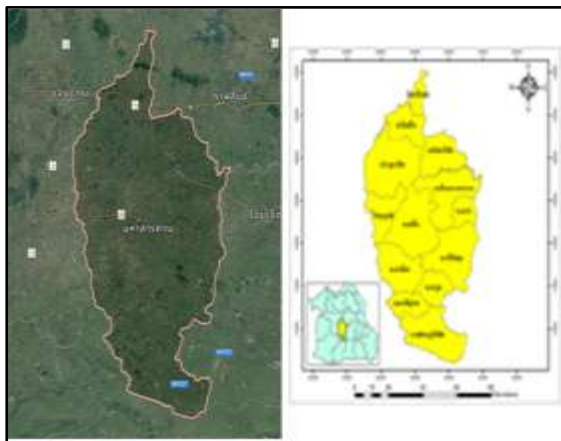


Figure 1. The location of the study area

Data collection and Factors

The five factors were used to spatial analysis of the DHF risk maps include house index (HI), land use, stream, water bodies, and an average annual rainfall. Overlay techniques were used to discover DHF risk areas, and the scale of importance was added to the input maps layer. The survey tools used were three dengue vector indices for mosquito density levels for analysis of HI factor. Data collection was conducted by inspection of each household and a family member of each household was interviewed and completed a questionnaire.

Spatial interpolation of House index using Inverse Distance Weighting (IDW)

Inverse Distance Weighted (IDW) is a method of interpolation that estimates cell values by averaging the values of sample data points in the neighbourhood of each processing cell. The IDW assumes that the similarity of values of a spatially distributed numerical variable z decreases with

distance d or a power p of the distance [7][8]. This decline of similarity is incorporated in the interpolation as

$$\hat{z}(s_0) = \frac{\sum_{i=1}^n \frac{z(s_i)}{d_i^p}}{\sum_{i=1}^n \frac{1}{d_i^p}}$$

where

s_0 : indicates the location to be interpolated to, s_i ($i = 1, \dots, n$) indicates the n location

z : has been observed

d_i : the distance between x_0 and x_i .

Ranking of factors for DHF risk assessment

Risk assessment requires an understanding of the causes of a potential risk area which the factors. Each factor are variables used in the DHF risk analysis and their classification into risk classes and identify of importance of each factor into sub class. The ranking of sub class of the factors divides into four classes and represented the number of classes were low risk (1), moderate risk (2), high risk (3), and highest risk (4), respectively.

Free and Open Source for development of public health database

The FOSS model provides interesting tools and processes with which women and men can create, exchange, share and exploit software and knowledge efficiently and effectively. FOSS can play an important role as a practical instrument for development as its free and open aspirations make it a natural component of development efforts in the context of the Sustainable Development Goals (SDGs) [9]. MapServer is an open source platform to publish spatial data and interactive mapping applications to the internet. MapServer is a high-performance, interoperable and open source web mapping and geo-spatial analysis system. MS4W package can be used for easy installation of MapServer on Windows platforms [10]. Pmapper framework is based on MapServer and PHP/MapScript and is used to create the graphical user interface (GUI) of the application. It offers broad functionalities like pan, zoom, identify, search, select, distance/area measurement and various ready to use plugins. It uses HTML, CSS, Javascript, PHP and XML [11][12].

Mapfile is the core of MapServer. It helps MapServer to locate the data, style it and create relationship between various map objects. It contains links to the data layers (Shapefile, PostGIS, Raster layers etc.) or services (WFS, WMS), details about the query and symbology/styling of the layers, extent

and projection information of the map and reference map details etc [13].

III. RESULTS

The results of classification spatial factors map

The result of data collection from the conduct of each household were calculate for the HI index to classification divide into four classes using the IDW method. The results of classification of HI map found that the percentage of highest risk area was 34.34 %, high risk area was 25.25 %, moderate risk area was 30.30% and low risk area was 10.10 %, respectively show in figure 2.

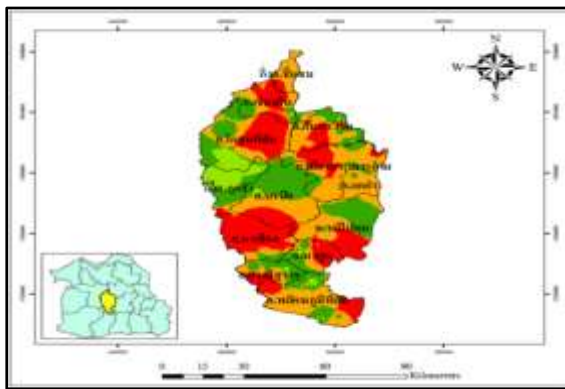


Figure 2. Map of HI classes.

The land us classes show that the highest risk area was 6.38 %, high risk area was 1.37 %, moderate risk area was 88.60% and low risk area was 3.6 % was show in figure 3. The distance from stream classes show that the highest risk area was 18.34 %, and low risk area was 81.66 % was show in figure 4. The distance from water bodies the highest risk area was 29.52 %, and low risk area was 70.47% was show in figure 5. An average annual rainfall classes the highest risk area was 59.0 %, high risk area was 33.40 %, moderate risk area was 5.50% and low risk area was 2.10 % was show in figure 6.

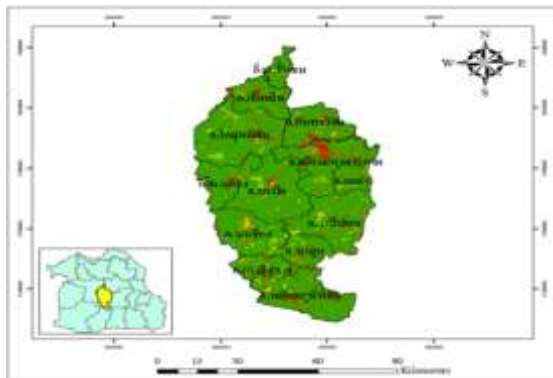


Figure 3. Map of land us classes.



Figure 4. Map of distance from stream.



Figure 5. Map of distance from water bodies.

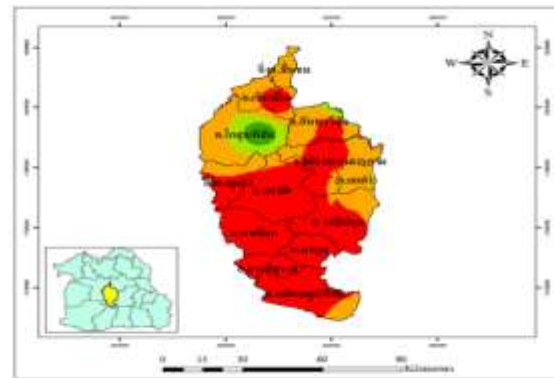


Figure 6. Map of an average annual rainfall.

The results of spatial assessment for DHF risk map

The results of the risk areas divided into 4 levels was low risk area was 2.20 sq.km., moderate risk area was 3754.09 sq.km., high risk area was 3549.04 sq.km., and very high risk area was 246.21 sq.km. was show in figure 7.

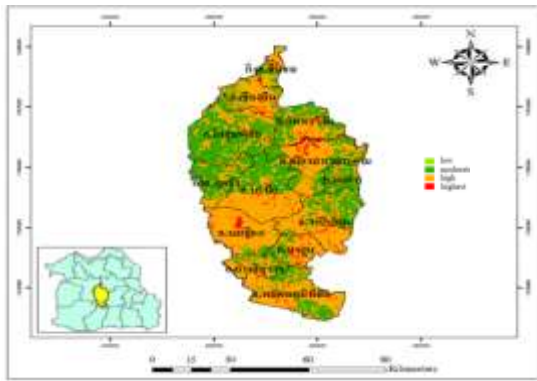


Figure 7. Map the result of spatial assessment for DHF risk area

The result of web development for public health database using open source software

The result of the classified map of all factors and the result of an assessment of the DHF risk map was provided for the public to web map the GIS application. An application presented the spatial data on the internet based on the Pmapper software was provided for the original function and includes displayed the DHF risk map divide into the level of district and tambon (sub district) of Maha Sarakham province. Moreover, the basic of administrator map such as the boundary of district, tambon (sub-district), and village maps was show in figure 8, 9, 10, and 11.

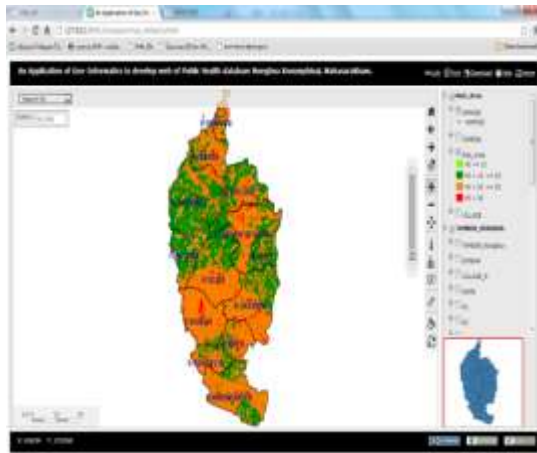


Figure 8. result of web mapping for spatial assessment for DHF risk area (district level).

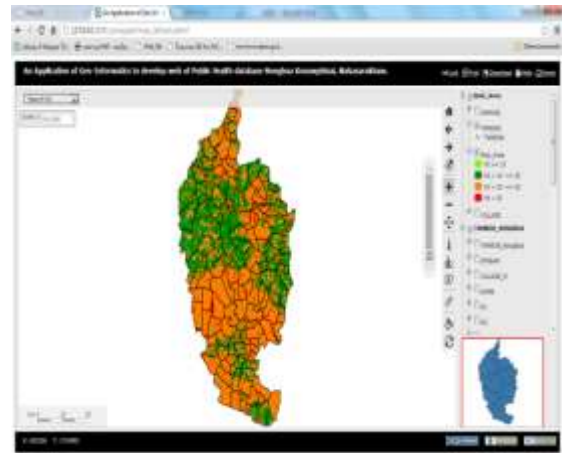


Figure 9. result of web mapping for spatial assessment for DHF risk area (Tambon level).

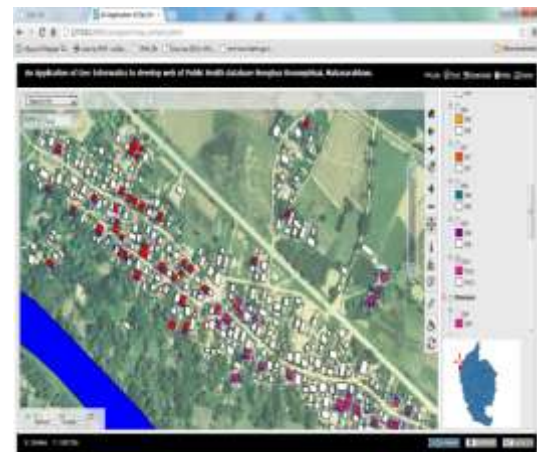


Figure 10. The result of web mapping for displayed built-up area.

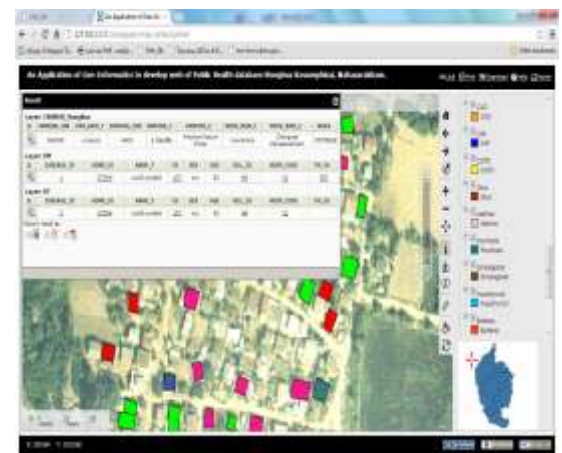


Figure 11. The result of web mapping for displayed built-up area and show the attribute of the spatial data.

The results satisfaction assessment for the web design and development

The satisfaction assessment in terms of content quality from the respondent were the satisfied was show the significance of the mean value was 4.34, the standard deviation was 0.66, and the overall questionnaire satisfied was a good level.

IV. CONCLUSION

The results of assessment the DHF risk area found that the highest risk area of DHF in the urban land use, the most found of DHF in the community area. The caused of higher than of each area is the community area has more containers that are breeding grounds for mosquito more than other areas, such as tires, plastic, and other. The high-risk area of DHF map found that the agriculture, stream, and water bodies area.

The development of spatial data a web base GIS mapping application for storing and presenting spatial and non-spatial data of the factor, DHF risk, and administrator maps. The attribute data can be showing the characteristics of the spatial map. The Pmapper is open source software has been create the graphic user interface can be displayed, pan, zoom, and query data from spatial database. The Pmapper is easily for developer to build complex web GIS application [11].

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In term of the design the web or graphic user interface the significance of the mean value was 4.33, the standard deviation was 0.48, and the overall questionnaire satisfied was a good level.