UNIVERSITI TEKNOLOGI MARA

Built Environment Journal

Faculty of Architecture, Planning and Surveying

Volume 11 No. 2 July 2014 ISSN 1675-5022

e-mail: penerbit@salam.uitm.edu.my

Built Environment Journal is jointly published by Faculty of Architecture, Planning and Surveying and UiTM Press, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia.

Built Environment Journal

Faculty of Architecture, Planning and Surveying

Volume 11 No. 2 **July 2014** **ISSN 1675-5022**

The Evaluation of Spatial Risk Factors for Leptospirosis Outbreak using GIS Application

Ahmad Afiq bin Hassan and Khairul Nizam Tahar
Faculty of Architecture, Planning and Surveying,
UiTM, Shah Alam, Malaysia
nizamtahar@gmail.com

ABSTRACT

The objective of this research is to determine the factor that increase incidence of leptospirosis in Petaling district based on leptospirosis risk map (LRM). Data involves in the research is leptospirosis cases data from Selangor State Health Department The factors used to determine leptospirosis risk area namely land use, population and temperature data. The determination of leptospirosis incidence is made by produce leptospirosis distribution map (LDM). The LDM is produce using overlay method which is intersecting method. The identification of factors that increase the leptospirosis incidence is made by produce a Leptospirosis risk map (LRM). A LRM is produce using Getis-Ord Gi technique. The determination of risk area is based on several factors including land use and population factors. The used of GIS application to evaluate the health problem is one of the suitable methods compared with conventional method that made analysis based on the graphs and tables only. GIS has advantage such as can facilitate a disease data that can be accessed quickly even in large numbers, providing a dynamic system analysis and has a good technique to display, monitors and manage disease outbreak well.*

Keywords: *Leptospirosis; Geographic Information System (GIS); Risk Mapping; Spatial Modeling*

INTRODUCTION

Leptospirosis is perceived as one of the important zoonotic diseases in the world including Malaysia (Ridzlan et al, 2010). It is one of the risky viruses in Malaysia and as of late has gotten expanding consideration because of the few late occurrences that have brought about human mortality which have frightened wellbeing experts in Malaysia. The capability of leptospirosis to happen in both tropical and calm climes, and both created and creating nation has gotten boundless media consideration. Leptospirosis is an irresistible disease brought on by pathogenic spirochete microorganisms of the sort leptospira that are transmitted straightforwardly or by implication from creatures to human (i.e., a zoonotic disease) and the rodent is the real bearer (host) of the infection (Ministry of Health Malaysia, 2011). There are a few conditions that are ideal for transmission of leptospirosis, for example, supply and bearer has, flooding and waste blockage, creature human interface and human host danger variables (Ministry of Health Malaysia, 2011). For the repository and transporter has, leptospirosis has extensive variety of common rat, and non-rat supply have, for example, rats, dairy cattle, mutts, foxes, rabbits, and so forth. The creatures demonstration as transporters that can discharge expansive number of leptospirosis in their pee and in charge of the pollution of substantial and little water bodies and soil. Flooding and waste blockage may hazard variables for sullying of water bodies contaminated by creature pee. The other potential for disease builds through recreational exercises without legitimate security. The recreational ranges that poor cleanliness can pull in creature have, for example, rat, hence expands the danger of pollution of the recreational range. This is on the grounds that poor support of offices, dishonourable transfer of waste furthermore open mentality. For the human host danger figures, a few segments of the populace are more helpless to contamination, for example, those not a while ago laid open to the microorganisms in their surroundings and those with constant sickness and open skin wounds.

Geographic Information System (GIS) are automated data framework or the framework itself being create that consider catch, stockpiling, control, examination show and reporting the topographically referenced information with their data or quality information (Chang, 2014). GIS can provide effective tool to visualise the geographical data which is study area and spatial analysis of epidemiology data and environmental exposure.

The final product which is either database or thematic maps can make user interesting with the information. Since leptospirosis is a topographical and regular disease controlled by natural and social elements, land data frameworks (GIS) may be valuable to distinguish these components and to focus potential danger territory (Daniele et al, 2012). GIS may serve as fundamental for wanting to control and deal with the Leptospirosis issue. By utilising GIS consolidated with spatial examination system permit to mapping the infection, recognisable proof and appraisal of the wellbeing danger variables.

The objective of this study is to determine the incidence of leptospirosis in Petaling district, to identify the factors that increase incidence of leptospirosis in Petaling district and also to produce a leptospirosis risk map (LRM) in Petaling district. This study utilised a GIS application to integrate the locational data for the incidence of leptospirosis, along with data on land use and demography to identify areas that have potential to become risk area for these diseases. The ability to identify the probable areas for leptospirosis incidence allow for effective implementation of disease management and prevention activities.

STUDY AREA AND METHODOLOGY

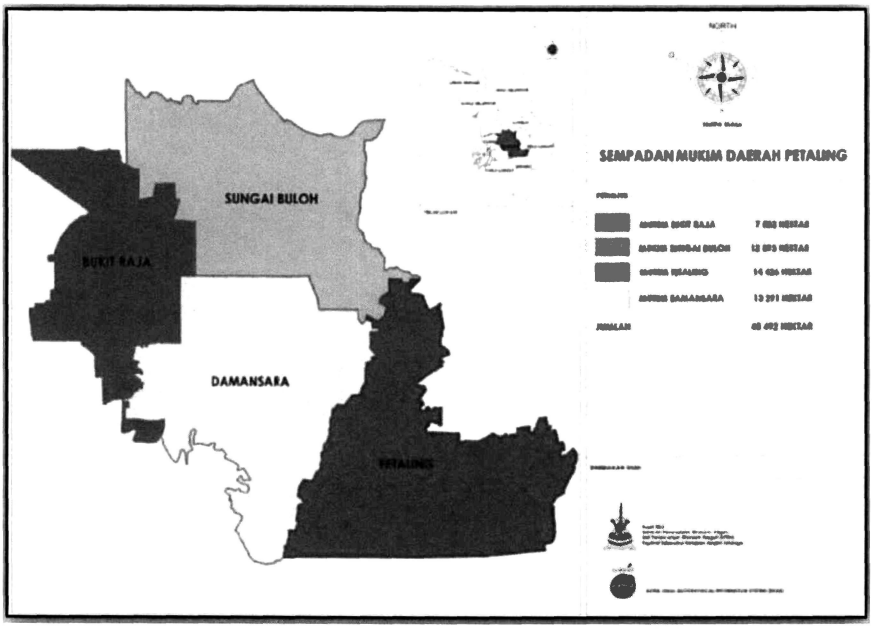

Figure 1: Petaling District

The study was carried out in the Petaling district at Selangor state. The district is selected because it is one of the highest leptospirosis incidence cases in the Selangor state. Basically, Petaling have five *mukim* which area Bukit Raja, Damansara, Sungai Buloh, Petaling and Bandar Petaling Jaya. Data involved in the study is leptospirosis cases data from Selangor State Health Department and Ministry of Health Malaysia. Another data is digital base map of Petaling district from Department of Survey and Mapping or JUPEM. For the factor to find the risk of the leptospirosis area, the data that being use is land use data, population data and temperature data. The land use data is from Town & Country Planning Department, population data is from Department of Statistics and temperature data is extract from satellite image using Landsat. Research method is simplified in Figure 2.

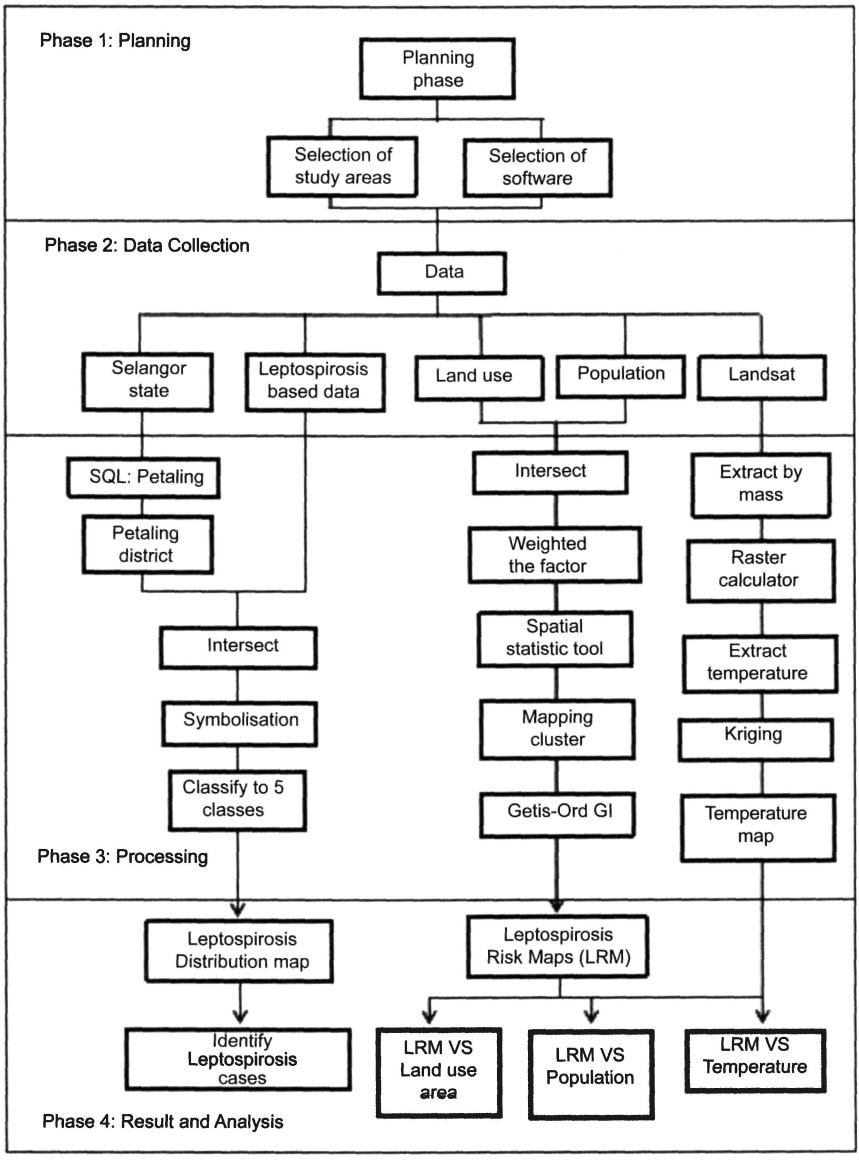

Figure 2: Research Methodology

The first part of data processing is to find the temperature map. The temperature data is extract from satellite image which is Landsat 8. Then, the temperature map is produce by using kriging technique in ArcGIS software. The temperature value of the sample point is referring the temperature data from Landsat image. The second part is to find the distribution map of Leptospirosis incidence in Petaling district. By using two layer which is Petaling district and leptospirosis cases, overlay these two layer using intersect technique and then symbology and classifies the output layer into five classes. Then, select suitable colour and product the map for the distribution data. The third part is to find the risk area for leptospirosis incidence in Petaling district. In the process, there are two layers that being used which are population and land use layer. The process to find the prediction of leptospirosis risk area is using spatial statistical method which is Getis-Ord Gi* technique. The Getis-Ord Gi* will calculated the Getis-Ord Gi* statistic for each feature in a dataset and the resultant z-scores and p-values will tell where features with either high or low values cluster spatially.

RESULTS AND DISCUSSION

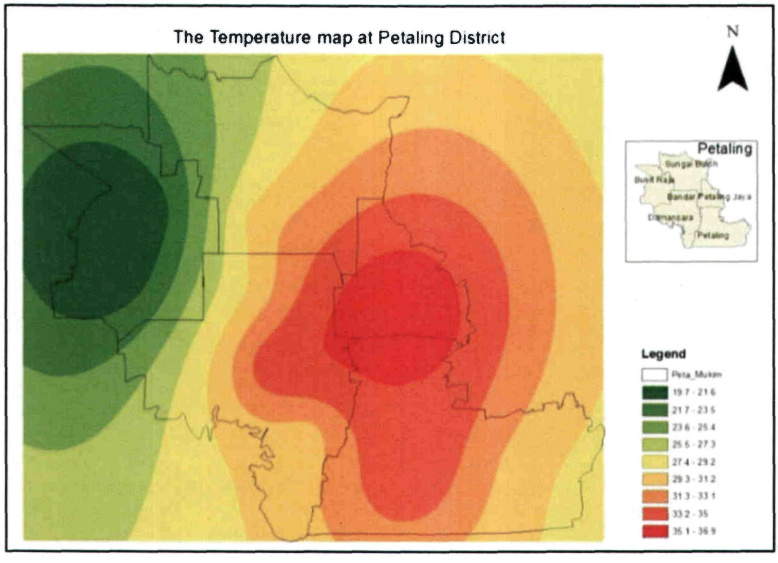

Figure 3: Temperature Map

The previous study stated that the potential of leptospirosis to occur in epidemics in both tropical and temperature climes. The comparison is made between temperature area and leptospirosis risk area and the result found that the temperature at high risk area is around 20 celsius to 30 celcius. The result explains that the leptospirosis virus can be survived at mild temperature.

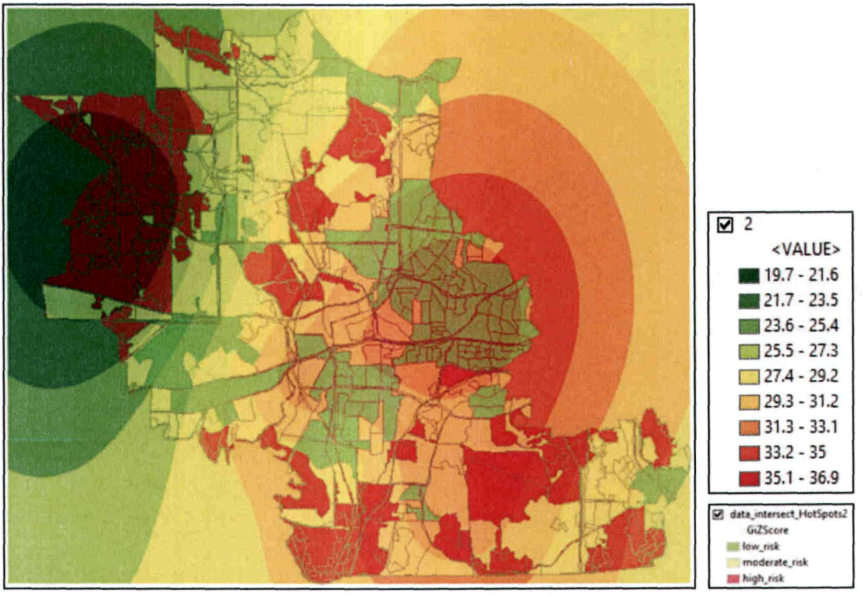

Figure 4: Comparison Between Temperature Area with LRM

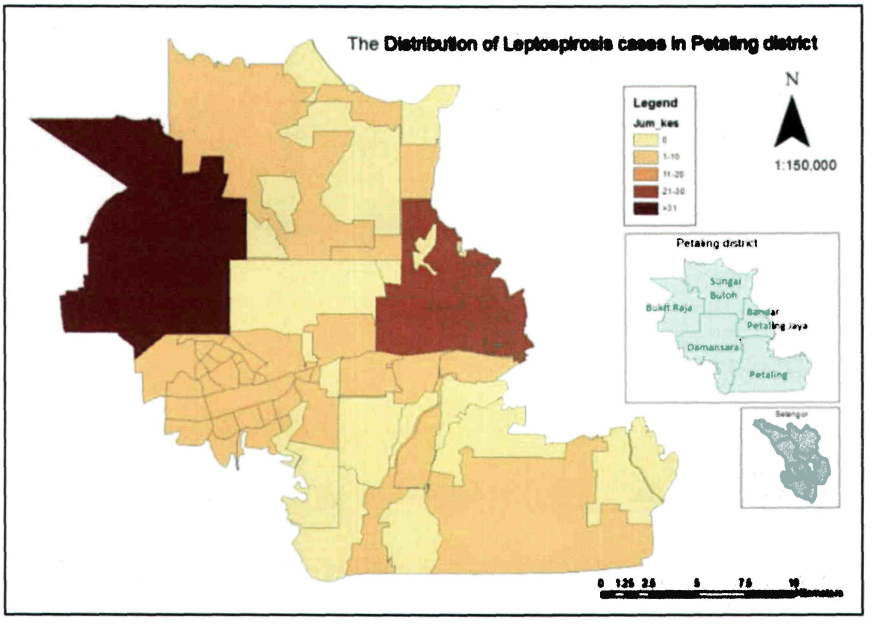

Figure 5: Leptospirosis Distribution Map

Based on the leptospirosis distribution map shows that the higher distribution cases that happen in Petaling district are at Bukit Raja area. Basically, the distribution of leptospirosis cases is shows using different colour display. The darker the colour display, the more cases that happen at that place. For example at Bukit Raja area, the colour that display is the darker colour because this place has more cases compare to other area. Damansara, Petaling and Sungai Buloh has display the bright colour because at these places have less cases compared to other.

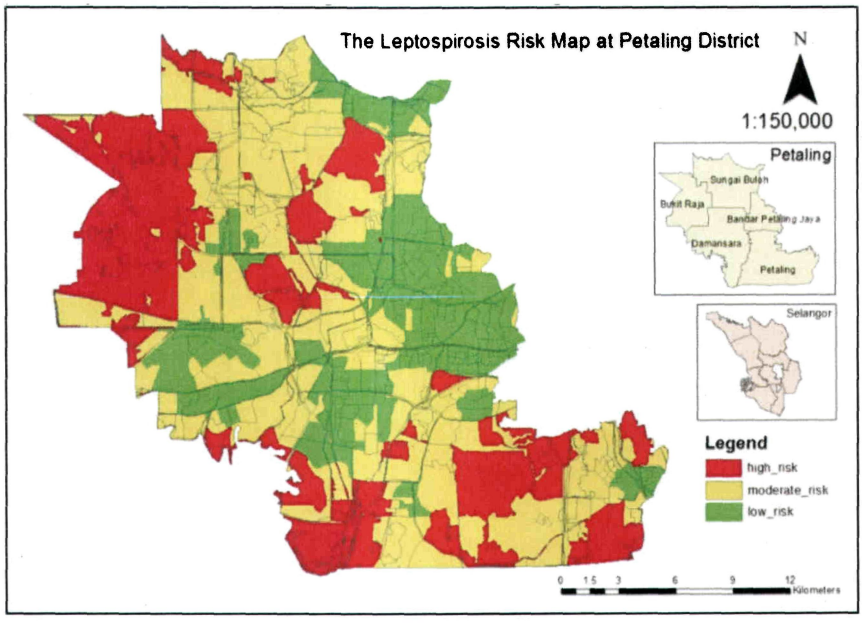

Figure 6: Leptospirosis Risk Map (LRM)

The leptospirosis risk map (LRM) is a creations using ArcGIS software that shows the risk area or potential area for incidence of leptospirosis will happen in Petaling district. The level of risk area for incidence of leptospirosis will be distinguished using different colour. The comparison is made between land use area and Leptospirosis risk area and the result found that the high risk area are located at agriculture area, forestry area and recreational area.The moderate risk area is located at industrial area and for the low risk area is located at residential area. The figure also shows that the agriculture area, forestry area and recreational area is contributed to the high risk area for the Leptospirosis incidence and the people that involved on that area especially at recreational area or work on that area including agriculture area and forestry area have high potential to get leptospirosis disease if the virus of the disease has on the place.

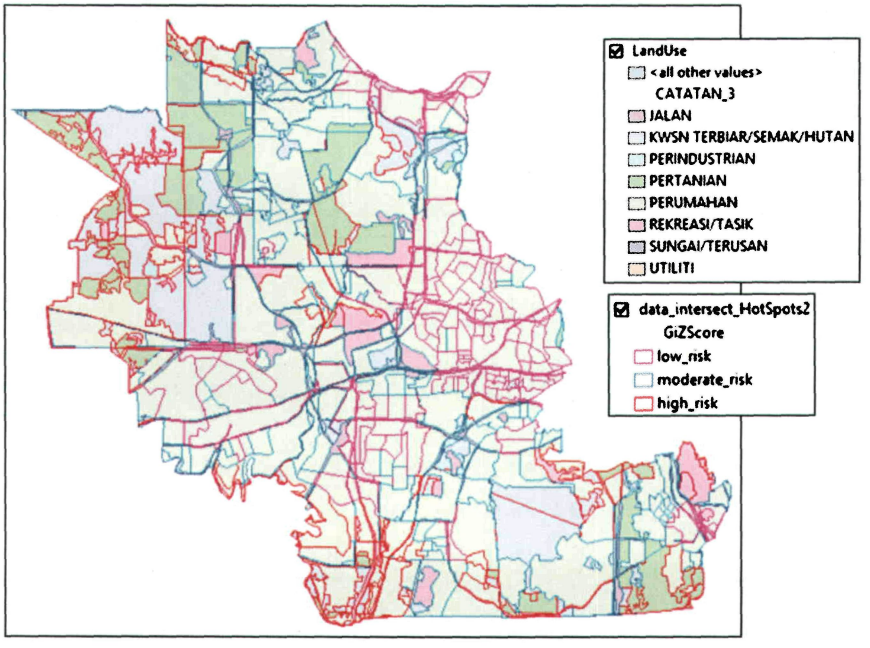

Figure 7: Comparison Between Land Use Area and LRM

The comparison is made between three ranges of population density which are 100000 populations, 300000 populations and 500000 population and the result shows that the higher population density is one of the risk factor for leptospirosis incidence will happen on that place.

CONCLUSION

Based on result and evaluation on the result show that there are certain factor that can contribute the increasing of leptospirosis incidence such as agriculture area, recreational area, forestry area and also high density population factor that contribute the increasing of leptospirosis incidence. Furthermore, the used of GIS application to evaluate the health problem is one of the suitable methods compared with conventional method that made analysis based on the graphs and tables only. Based on the study conducted, there are several suggestions which may beneficial for the further study in the future. Firstly, the study area of the research can be expanded in the

all district in Selangor state and in the whole of Peninsular Malaysia state. Secondly, use of GIS with integration with remote sensing can also be used as another method or technique to find the leptospirosis risk area. Thirdly, use additional factors such as rainfall factor and floor area factor to make the prediction of risk area is more accurate. Lastly, use other technique to predict the leptospirosis risk area. There are several technique can be used to predict the risk area including regression analysis technique such as geographically weighted regression (GWR) or ordinary least squares (OLS) and also kernel density estimation technique.

ACKNOWLEDGEMENT

The support and encouragement from Center of Studies Surveying Science and Geomatics, Faculty of Architecture, Planning and Surveying Universiti Teknologi MARA (UiTM) is acknowledged with great appreciation.

REFERENCES

Ann Florence BV, Lee DS, Nina Gloriani B, Lolita LC, Takeshi K, Khanchit L, et al. Leptospirosis in the Asia Pacific region. *BMC infectious disease.* 2009 Sept 4; 9(147): 2-6

Ashford, D. A., Kaiser, R. M., Spiegel, R. A., Perkins, B. A., Weyant, R.S., Bragg, S.L., Plikaytis, B., Jarquin, C., De Lose Reyes, J.O., & Amador, J.J. (2000). Asymptomatic Infection and Risk Factors for Leptospirosis in Nicaragua. *The American Society of Tropical Medicine and Hygiene,* 249-254

Assimina Z, Fotoula B. Leptospirosis: Epidemiology and preventive measures. *Health Science Journal.* 2008; 2(2): 75-82.

Aziz, S. (2011) Evaluation of the spatial risk factors for high incidence of dengue fever and dengue hemorrhagic fever using GIS application. *Universiti Sains Malaysia 40,* pp. 937-943.

Daniele, B., Flavia, T. Martins-bede, Vivien, M.M., Leila, S.U., Mariana, K., Hello, L., Ricardo, J.C., Alexander, W.B & Marcelo, B.M. (2012) Spatial distribution of seropositive dogs to leptospirosis spp. And evaluation of leptospirosis risk factors using a decision tree. *Acta Scientiae Veterinariae* 40, pp. 1-7.

Ministry of Health Malaysia (2011) Guidelines for the diagnosis, management, prevention and control of Leptospirosis in Malaysia. *Disease control division, Department of Public Health,* 1st edition, 2011.

Monahan, A.M., Miller, I.S., Nally, J.E. Leptospirosis: risks during recreational activities. *J Appl Microbiol. 2009; 107*(3): 707-16.

Ridzlan, F.R., Bahaman, A.R., Khairani-Bejo, S. & Mutalib, A.R. (2010) Detection of pathogenic leptospirosis from selected environment in Kelantan and Terengganu, Malaysia. *Tropical Biomedicine 27,* pp. 632-638.

Sthayaparan, ID Robertson, A. Fairuz., & M.T. Abdullah. (2013) Leptospirosis, an emerging zoonotic disease in Malaysia. *Malayisan J Pathol 35*, pp. 123-132.

Teerawong, L. (2012) Online Web GIS-based services for spatial data and sharing of leptospirosis epidemiology information; Development of pilot project in Mahasarakham province Thailand. *International Journal of Geomatics and Geosciences 3,* pp. 121-133.

Vincent, H., Florent, D., Wasana, K., Jean-pierre, H., Jean-paul, G., Pattamaporn, K., & Marc, S. (2005) Use of geographic information system and remote sensing for assessing environment influence on leptospirosis incidence, Phrae Province, Thailand. *International Journal of Geoinformatics 2,* pp. 43-50.

World Health Oragnization. (2011). Report of the Second Meeting of the Leptospirosis Burden Epidemiology Reference Group. *Department of Food Safety and Zoonoses,* 1-37

World Health Organization [Internet]. Informal Expert consultation on Surveillance, Diagnosis and Risk Reduction of Leptospirosis; 2011. Retrieved from

http://www.who.int/water_sanitation_health/diseases/leptospirosis/en