

Detection of Dengue risk areas of Nagapattinam district using Geo spatial technology

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ABSTRACT

This study is an attempt to identify the dengue risk areas (Taluk wise) of Nagapattinam district. Geographic information system (GIS) has been applied in the study of dengue fever in Nagapattinam district with the help of generated risk values (1, 2, 3, 4, and 5) and risk types (very low, low, medium, high and very high) for the variables registered dengue cases in 2012 and 2013, total population, house infested, container positive, primary health and sub-centres, rainfall (2012 and 2013), minimum and maximum temperature during 2012 and 2013, water stagnation areas in square kilometre and total risk. The present research investigates the epidemiology, ecology and prevalence of dengue in Nagapattinam district.

Key words: Risk, Infested, GIS,

INTRODUCTION

Dengue is a disease caused by a family of viruses that are transmitted by mosquitoes and hit people with low levels of immunity. In recent years it has become a major international public health problems and prevalent throughout the tropical and subtropical regions around the world mainly in urban and semi-urban areas. Dengue starts with chills, headache, pain upon moving the eyes, and low backache. Painful aching in the legs and joints occurs during the first hours of illness. The body temperature rises quickly as high as 104° F (40° C), with relative low heart beat rate. Dengue disease comes due to various spatial factors such as climate, environment, water quality and management, education, air pollution, natural disasters, social and many others. The prevention of dengue requires control or eradication of the mosquitoes carrying the virus that causes dengue.

Review of Literature

The Spatial and temporal distribution of mosquitoes (Culicidae) in Virudhunagar district [1] and Tiruchirappalli district [2] was surveyed for container breeding mosquito larvae (Dengue vector) in Tamil Nadu, India. The need for GIS based dengue surveillance with Google internet real time mapping for epidemic control in India. [3] The prevalence of dengue and the extent of work done by various groups of scientists in India [4]. The Dengue disease status in Chennai study conducted during 2006 to 2008[5] and applied GIS modeling for dengue fever endemic area based on socio-cultural and environmental factors in Delhi city zone[6]. The spatial-temporal distribution of dengue vectors and identified the high risk zones in Sonitpur district of Assam [7]. GIS modeling of dengue risk based on socio-cultural data used in Jalore of Rajasthan. [8] Applied remote sensing and GIS in risk area assessment for mosquito borne diseases in part of Gwalior city. [9]

Study Area

Nagapattinam Coast, with a coastline of 185 km is in the South Eastern part of India which is vulnerable to seasonal cyclones, frequent storms and even the 2004 Asian Tsunami that claimed 184,000 in Asian sub-continent and 6,064 in the Nagapattinam coast zone, alone. Major activity in this zone is 'fishing' and the people in this zone are concentrated in various coastal packets well within the vicinity of the sea. According to the recent Indian Census,

there are about 100,000 people are living in 20,626 households and about 40,000 are living in the coastal communities and they engaged in fishing activities. During North East Monsoon Season their coastal huts are turning down to favourable environment for the vectors to grow and multiply. Their children and elderly adult are most vulnerable to the vector-borne diseases and very particularly the 'Dengue Fever'. Thus the present research investigates the epidemiology, ecology and prevalence of dengue in Nagapattinam district.

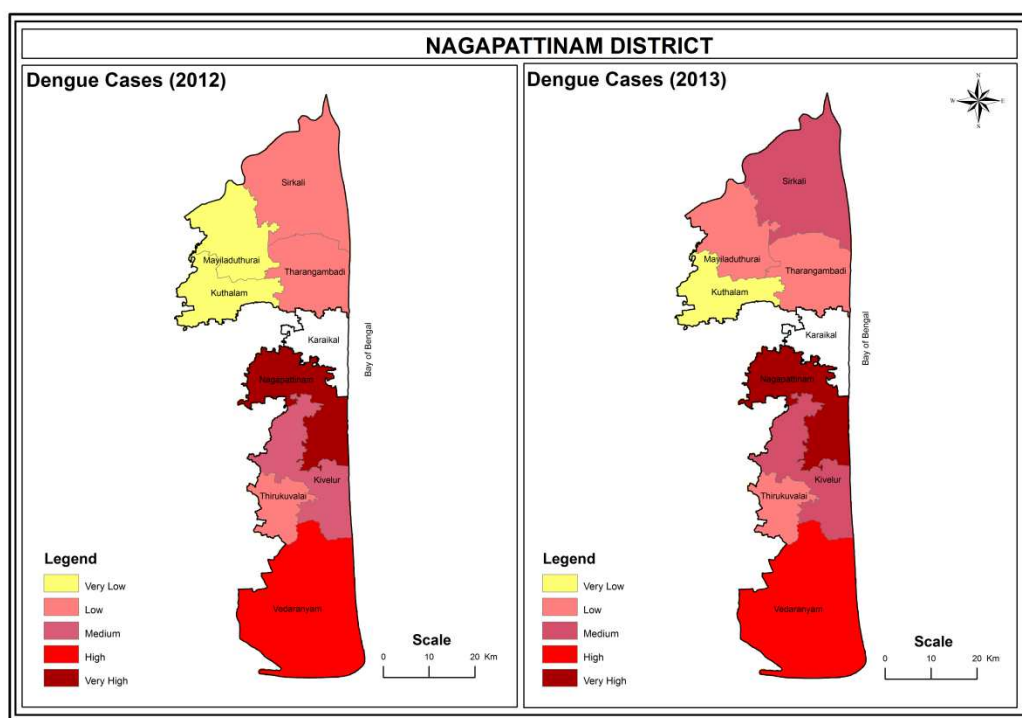
Analysis Plan

The present study analyses the prevalence of dengue, actual data collected from the Municipal office, government hospitals and primary health centres of Nagapattinam district. This study is an attempt to identify the dengue risk areas (taluk) of Nagapattinam district with the help of generated risk values (1, 2, 3, 4, and 5) and risk types (very low, low, medium, high and very high) for the variables registered dengue cases in 2012 and 2013, total population, house infested, container positive, primary health and sub-centres, rainfall (2012 and 2013), minimum and maximum temperature during 2012 and 2013, water stagnation areas in square kilometre and total risk. Therefore, these attributes were entered to the Arc GIS 9.3 software and the maps were prepared for above mentioned elements. The environmental and ecological factors are responsible for the occurrence of dengue fever in varying intensity in the Nagapattinam district. The data were synthesized and brought in the form of tables, diagrams and maps to explain the disease ecology of Nagapattinam district.

RESULTS AND DISCUSSION

Prevalence of Dengue

The figure dengue case map (2012) of Nagapattinam district shows that the very high risk was noticed in Nagapattinam taluk and it has generated as very high risk value 5. The high risk taluk were perceived in Vederanyam taluk with high risk value 4 and Kivelur taluk were comes under medium risk with medium risk value 3. In contrast, the low risks were observed in Sirkali, Tharangambadi and Thirukuvalai taluks and these were having low risk values 2. Similarly, the very low risk taluks were in Kuthalam and Mayiladuthurai and it is having very low risk values 1. Further, the figure dengue case map (2013) illustrating that the very high risk were observed in Nagapattinam taluk with very high dengue positive cases (350). The very high (120) population of dengue cases were registered in Vederanyam taluk. Sirkali and Kivelur taluks were having medium risk with medium dengue positive cases of 85 and 83 respectively. The low population of dengue cases 53 and 54 were noticed in Mayiladuthurai and Tharangambadi taluks as low risk areas. The very lowest dengue risk area was identified only in Kuthalam taluk with 45 dengue cases.

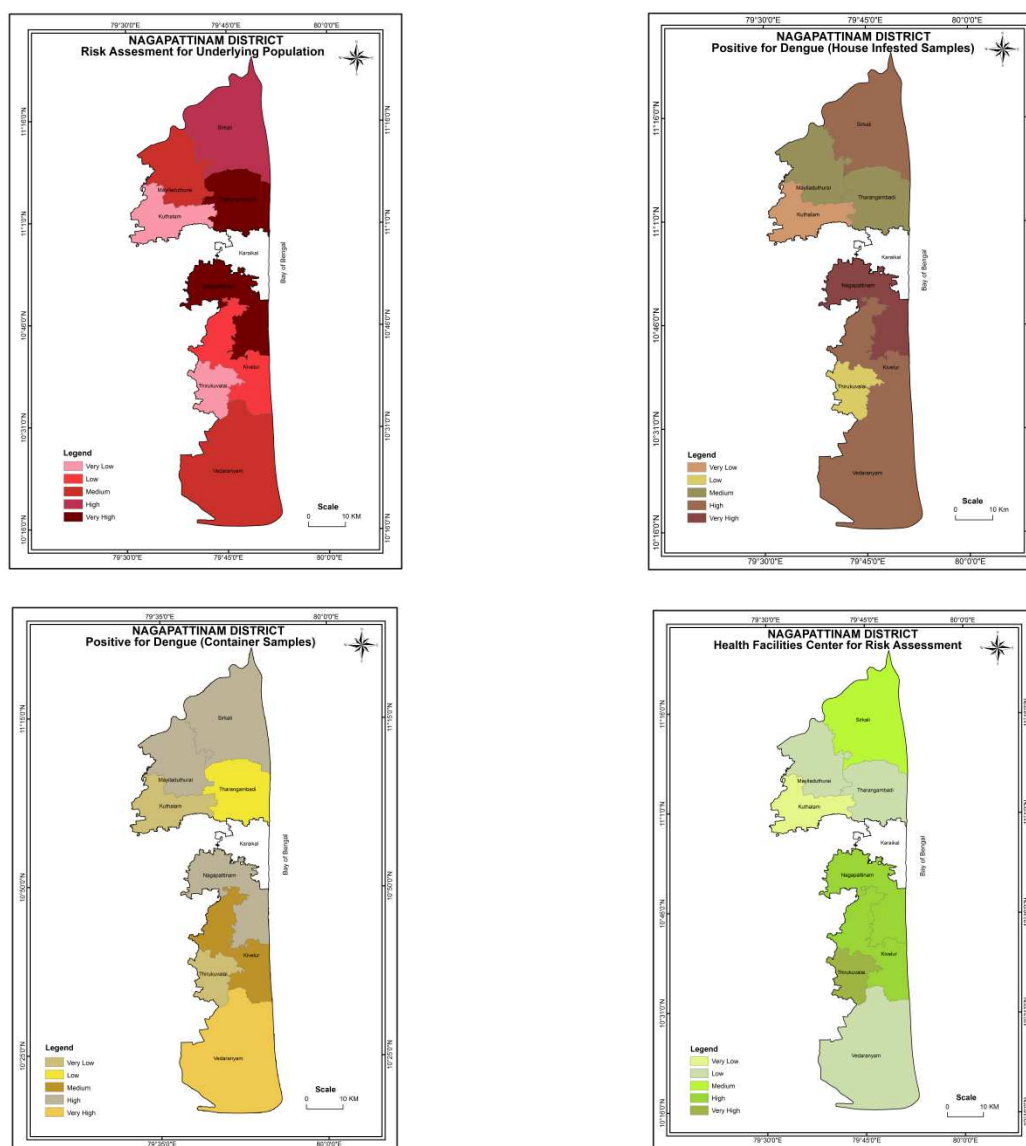


First, when compare to the registered dengue cases in 2012 and 2013, there were progressing trend of dengue cases were noticed in over all district. As a result of dengue risk areas were revealed that in the Nagapattinam (200 in 2012 and 350 in 2013) and Vederanyam (90 in 2012 and 120 in 2013) taluks were remaining as a very high risk and

high risk area respectively. Secondly, there were no change in Kivelur taluk and it was remain as a medium risk area. Thirdly, the Tharangambadi and Thirukuvalai and Kuthalam were constantly being as low risk and very low risk area respectively. Fourthly, it is interesting to note that the Sirkali taluk become low risk (2012) to medium risk (2013) area and Mayiladuthurai turn in to very low risk (2012) to low risk (2013) area.

Population and Risk

According to the total population of Nagapattinam district, the highly populated areas were having high risk values and high risk types and vice versa. Therefore, the Nagapattinam, and Tharangambadi taluk were observed as very high population with very high risk value (5) as well as very high risk type. Similarly, the Sirkali taluk were experiencing high risk value (4) and high risk type because of the high population. The medium risk values (3) and medium risk areas were found in the Mayiladuthurai and Vederanyam taluks. The Kivelur taluk were having low risk value (2) and low risk type. The very low risk values (1) and low risk types were noticed in the taluk of Thirukuvalai and Kuthalam.



Infested Houses

It is obvious that the highly populated areas were always having high chance of disease vulnerability. In view of that, the very high infested houses (119) of dengue prevalence's are identified in Nagapattinam taluk and it is ranked in higher order of risk value (5) and very high risk. In Vederanyam, Sirkali and Kivelur taluks are having observed as high infected houses 114, 113 and 105 respectively and it has high risk values (4) and high risk types. The medium risk type and values (3) of infected houses have been found in Mayiladuthurai (99) and Tharangambadi (97) taluks. The low (73) and very low (45) infected houses has been observed in the Thirukuvalai and Kuthalam taluks

and it has low risk value (2) and very low risk value (1) respectively. As a result, these two taluks were in the position of low and very low risk areas.

Dengue Positive Containers

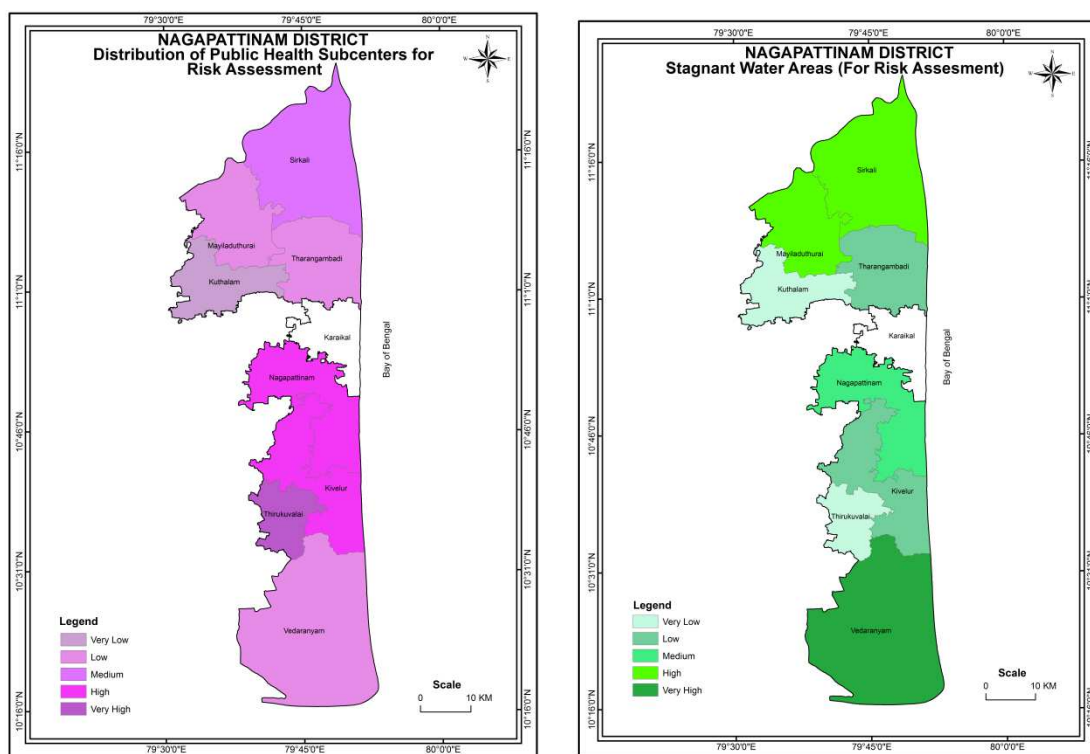
In the Nagapattinam district, the dengue positive container's results shows that the very high risk value (5) were loaded in Vederanyam taluk, so it has very high risk dengue positive containers (167). The high risk dengue positive containers in the Sirkali (147), Mayiladuthurai (144) and Nagapattinam (138) taluk and these were having high risk values (4) so; these taluks were under high risk of dengue positive containers. The medium risk value (3) was seen in the Kivelur taluk (112) and it has medium risk of dengue positive containers. The Tharangambadi taluk has low dengue positive containers (100) on the basis of low risk value (2). In Thirukuvalai and Kuthalam taluk have been noticed under very low dengue positive containers 53 and 68 respectively. Thus, it has very low risk value (1).

Availability of Primary Health Centres

Healthcare centres are playing vital role in the treatment of diseases for the public people and control the diffusion of disease especially in vector borne diseases. Accordingly, those places/taluks were having more number of primary health centres where the risk value registered as very low (1) and vice versa. This has been evidently proved in Nagapattinam district by this study. There were seven primary health centres in Kuthalam and it has generated as very low risk value (1) and in Vederanyam, Mayiladuthurai and Tharangambadi are also having the low risk values (2) and types due to the high number of primary health centres (5) in each taluk. The Sirkali taluk is registered as medium risk value (3) and risk type because it has three primary health centres. In contrast, the high risk values (4) and risk types in Nagapattinam, Kivelur and it has two primary health centres each; in Thirukuvali there is only one health centre and that is why it has very high risk value (5) and very high risk type.

Primary Health Sub Centres

The availability of primary health sub centres in Nagapattinam district also reveals that the dengue risk values and risk types of each taluk. Therefore, more number of sub centres is having low and very low risk values for the incidence of dengue. Thirukuvalai taluk is having only one sub centre but it has very high risk value for dengue; Nagapattinam and kivelur taluks are having high risk for dengue and it has only fourteen and twelve sub centres respectively. The Kuthalam taluk is having seventeen sub centres so; it has medium risk for the incidence of dengue. However, the low risk is noticed in the taluks of Sirkalai and Mayiladuthurai since it has twenty five and twenty one sub centres respectively. The very low risk of dengue registered in Tharangambadi taluk because it has thirty six sub centres.



Area under Stagnation Water

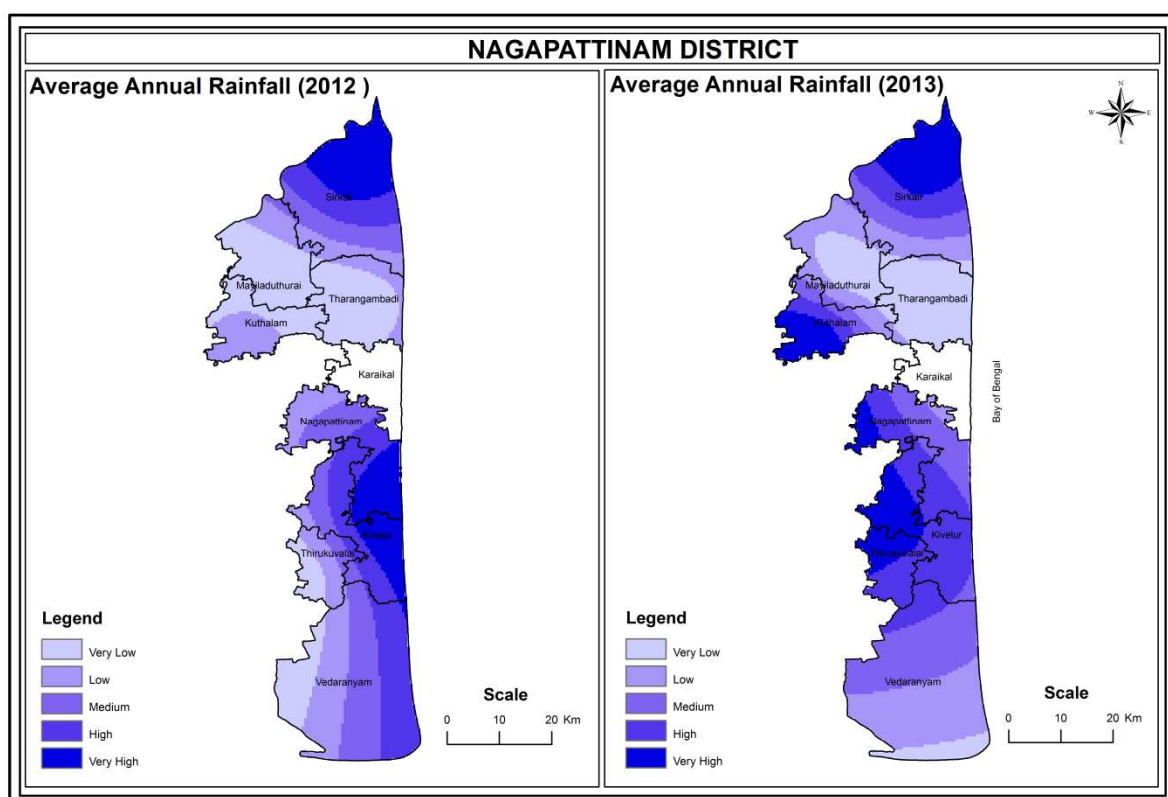
The dengue vector is well thrives in stagnant/stored clean water; thus the occurrence of dengue epidemic is depends upon the area covered by the clean water. In Vedaranyam taluk the area of stagnant water is covering in an area of 672.32sq.km, so; this taluk have been under very high risk for the occurrence of dengue. Sirkali and Mayiladuthurai taluks are having water stagnation of 471.482sq.km and 452.79sqkm respectively; for this reason these taluks are under high risk for dengue prevalence. Medium risk of dengue is observed in Nagapattinam taluk 305.32sq.km. In Tharangambadi and Kivelur taluks are covered by the 258.89sq.km area of stagnation water, so; these taluks are very low risk for the incidence of dengue. The very low risk of dengue prevalence in Thirukuvalai and Kuthalam and it has water stagnation of 132.46sq.km of area in these taluks.

Rainfall – 2012

Absence or presence of rainfall is increasing/decreasing the temperature of a place; breeding of dengue vector is also depends upon the climate or weather condition of a place. Therefore, the incidence of dengue in Nagapattinam district is highly influenced during North-East Monsoon rainfall. In 2012, Tharangambadi taluk has received 156.9cm of average annual rainfall so, the dengue risk is very low, Mayiladuthurai taluk has receives 147.1cm of rainfall since it has low risk of dengue and Vedaranyam has received 115.3cm of rainfall and it has registered as medium risk for the occurrences of dengue. However, the Nagapattinam taluk has received 105.8cm of rainfall so; it has high risk of dengue prevalence. Thirukuvalai, Sirkalai and Kivelur taluks are received rainfall 80.3cm, 80.0cm and 78.3cm respectively. So the incidence of dengue noticed as very high in these taluks.

Rainfall – 2013

In 2013, the very low risk of dengue is noticed in the taluks of Mayiladuthurai and Tharangambadi because this region has received the highest amount of average annual rainfall 200.3cm and 163.1cm respectively. The low risk of dengue is observed in the taluks of Thirukuvalai and Kuthalam and these taluks has received 88.8cm and 89.0cm of average annual rainfall respectively. The Vedaranyam taluk has been received 81.2cm of rainfall and it has medium risk for the incidence of dengue. The rainfall of Nagapattinam taluk was 87.3cm so; this taluk is considered as high risk of dengue. The very high risk of dengue regions are perceived in the taluks of Sirkalai and Kivelur on the basis of low annual average rainfall 79.6cm and 76.2cm respectively.



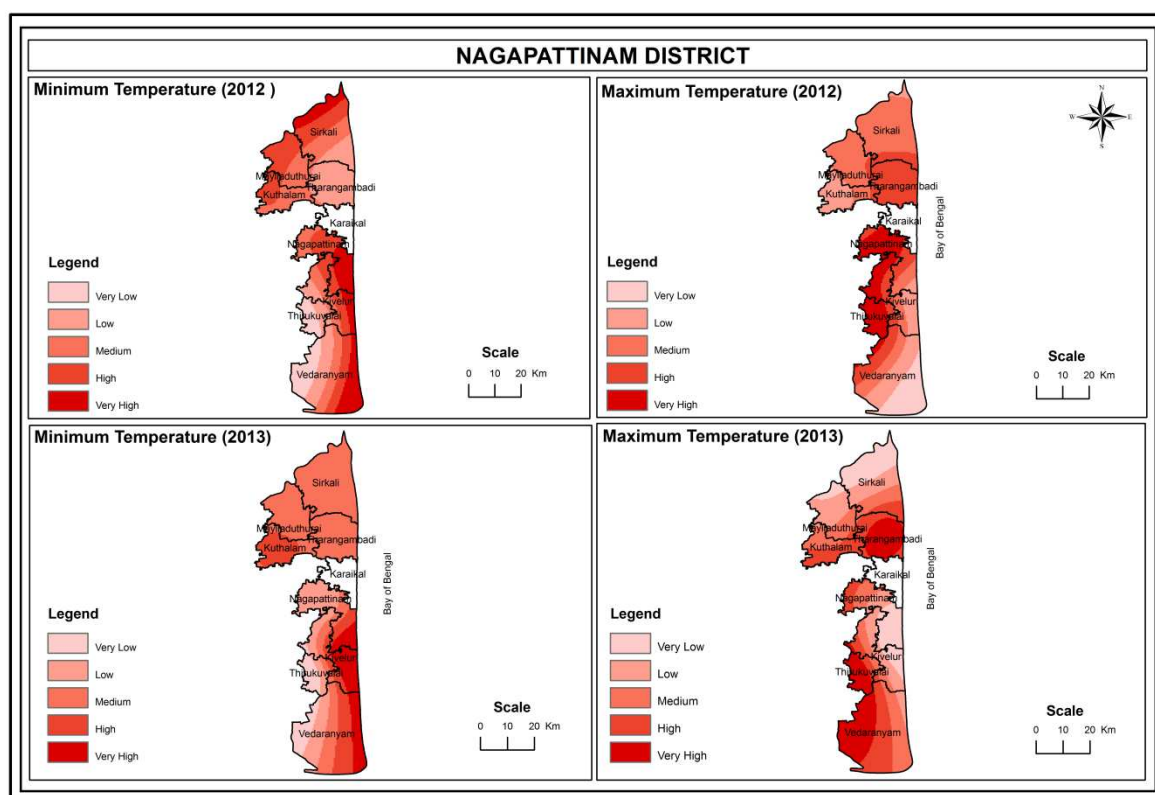
Temperature 2012

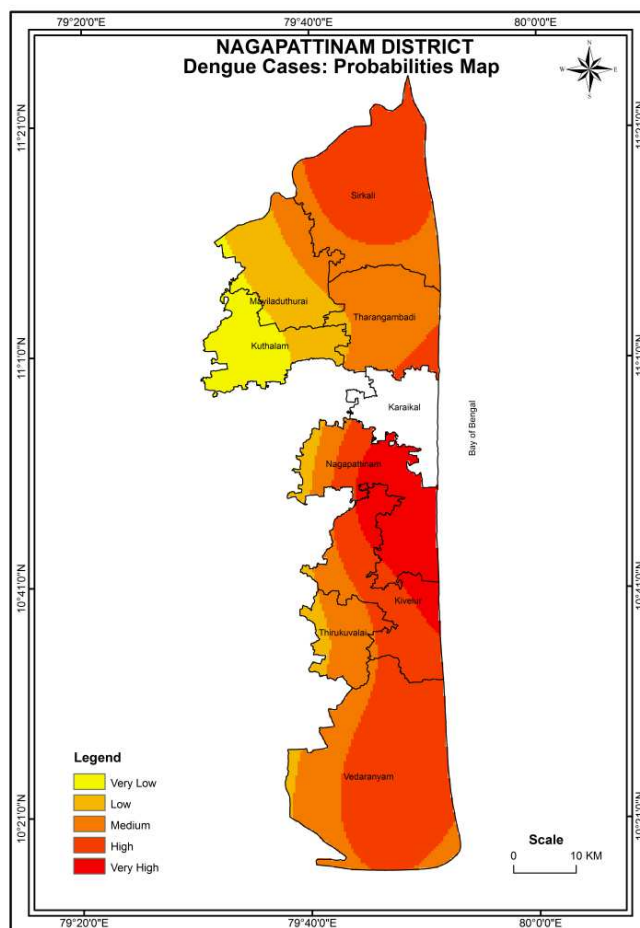
Temperature plays a vital role in modifying the environmental conditions of a region. Accordingly, the existence and the prevalence of vector borne disease like dengue and its diffusion is depends upon the nature of climatic

variations. Accordingly, the average minimum monthly temperature was very low (21.0°C) and low (22.2°C) in the Thirukuvalai and Nagapattinam taluk so; these two taluk has very high risk of dengue prevalence. In Tharangambadi the monthly average temperature was medium (23.0°C) and it has medium risk of dengue. High monthly average temperature was registered as high in the Sirkali (23.8°C), Kivelur (24.0°C) and Mayiladuthurai (24.3°C) and these three taluks are having low risk of the occurrence of dengue. The very high monthly average monthly temperature is recorded in Vedaranyam (24.8°C) and Kuthalam taluk (24.4°C), so; this two taluk has very low risk for the occurrence of dengue. As a result, it has been observed that the increasing of temperature with decreasing trend of incidence of dengue in the Nagapattinam district.

Temperature 2013

Subsequently, the minimum monthly average temperature of Thirukuvalai taluk was 21.7°C, so; it has high risk of the occurrence of dengue. The high risk of dengue was observed in Nagapattinam taluk because it has 21.1°C of minimum monthly average temperature. In Mayiladuthurai, Tharangambadi, Sirkali and Kuthalam taluk has the minimum monthly temperatures are 23.9°C, 23.8°C, 23.7°C and 23.6°C respectively. So, this taluks are observed as medium risk for the prevalence of dengue. The low risk of dengue is experienced in the Kivelur taluk and it has 24.2°C of minimum monthly temperature. The very low risk of dengue taluk is Vedaranyam due to high minimum monthly temperature 24.6°C. As a result, the dengue vector cannot thrive in high temperature.





CONCLUSION

Finally, in viewing and compiling all the above risk for the prevalence of dengue, the Nagapattinam taluk is emerged as very high risk of dengue; the Kivelur and Sirkali taluk appeared as high risk for the occurrences of dengue. The Mayiladuthurai and Vedaranyam taluks comes out as medium risk taluks. Thirukuvalai and Tharangambadi taluks are in low risk condition for the occurrence of dengue. The Kuthalam is the only taluk emerged as very low risk for the prevalence of dengue.

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