Full Length Research Paper

Spatio Temporal Analysis of Vector Borne Diseases in Mysore District

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Abstract
Diseases vary spatially from one region to another. In recent years, Vector Borne Disease are cause many serious health problems to humans around the world. The problem has more significance to the developing and underdeveloped world, particularly in Asia, Africa and South America. The Worsening/declining of ecology environment has proved to encourage various vectors borne disease directly or indirectly. The problems of health are increasing in both Spatial and Temporal dimension to many newer places due to increased risk of disease transmission fuelled by development activities, demographic changes. Modern technology like GIS and RS has emerged as important tools of many projects in public health, it also useful for healthcare applications for covering database management, planning, risk assessment, service area mapping, location and identification of diseases surveillance, control, monitoring and evaluation etc. The comparisons are summarized here for the two period's i.e. 2005 and 2009. This Paper also attempts to know the distribution of vector borne disease and demarcation of high risk areas in the study area. Which, will be help full for risk assessment and disease prevention, promoting healthcare working towards overall District development.

Key words: *Vector Borne Disease, GIS, Demarcation, Diseases Surveillance*

Introduction
In Recent years, Vector borne disease are cause many serious public health problems to humans around the world. In India, several types of vector borne diseases are there like Malaria, Chikungunya, Dengue, Japanese Encephalitis (J.E) and etc, these Disease causing considerable morbidity and mortality. In Study area we can observe the Vector borne diseases like Malaria, Dengue and Chikungunya are the risk factors which plays an important role in spread and transmission of diseases which include poor and unhealthy sanitary condition, mosquitoes, polluted environmental condition, human migration, unplanned and uncontrolled urbanization and developmental activities. These are main causes for occurrence of vector borne diseases. In this paper an attempt as been made to study the Spatio temporal analysis of Vector Borne Disease incidence in Mysore district, the comparisons are also summarized here for the two period's i.e. 2005 and 2009. This Paper also attempts to know the distributions of vector borne disease and demarcation of high risk areas in the study area are done using GIS.

Methodology
Data for the spatial distribution of diseases have been collected from various offices like District Health Office i.e. "Diseases affected area data" and the "population data" from District Statistical Office. This Paper is mainly based on Secondary Data. The Base Map of Study area has been Geo-referenced and digitized using GIS Software. Various thematic Maps have been generated to show the Spatio temporal Distribution of Diseases pattern, analyzing the taluk wise distribution of vector borne disease and demarcation of high risk areas in the study area for Diseases Prevention and Control.

Study area
Mysore District is situated in the southern part of the state of Karnataka, India. This district has a prominent place in the history of Karnataka. Mysore district is located between latitude 11°45' to 12°40' N and longitude 75°57' to 77°15' E. It is bounded by Mandya District to the northeast, Chamarajnagar District to the southeast, Kerala State to the south, Kodagu District to the west, and Hassan District to the north. The District spreads across an area of 6854 sq.km (ranked 12th in the state) constituting 4% of the state's total area and is situated in Southern Karnataka.

Mysore district is divided into seven taluks namely, Mysore, Tirumakudal_ Narsipur, Nanjangud, Heggadadevanakote, Hunsur, Piriyapatna, Krishnarajanagara for administrative purposes. Mysore city is the administrative centre of the district and second largest city in Karnataka after Bangalore. Mysore is a moderately sized district both in terms of area as well population. According to the

2011 Census Mysore District has a population about 30 lakhs making it third largest district in Karnataka. The District Population density is 437 inhabitants per square kilometers. Mysore district has moderate type of climate throughout the year.
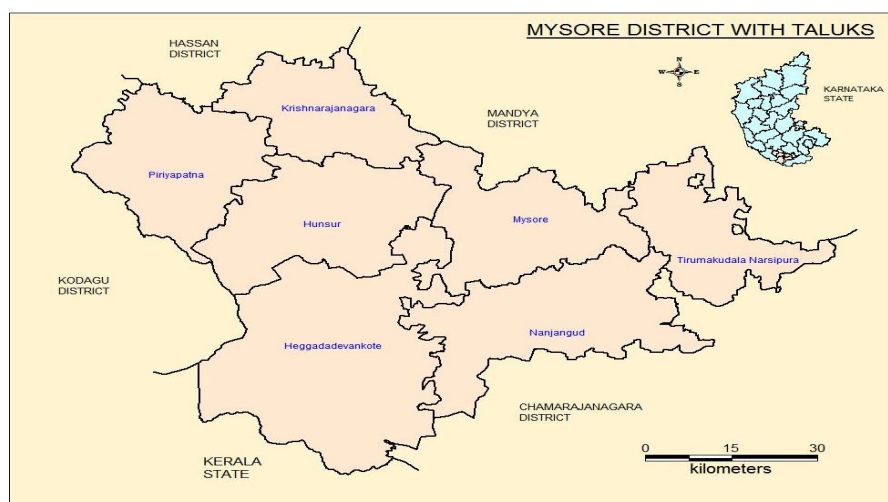

Fig. 1 Study area

Discussion

Vector Borne Diseases are infectious diseases that are carried by insects from one host to another. In the Study area we can observe the vector borne disease like Malaria, Dengue and Chikungunya. In these diseases the mosquitoes that carries the virus, it may spread to humans, birds and other animals. "Mosquito breeding sites can arise in any site with standing water and commonly occur in areas without running water because people often store large uncovered barrels of water around their homes for bathing and drinking". In this paper an attempt has made to study the Spatio temporal analysis of Vector Borne Disease incidence in Mysore district, the comparisons are also summarized here for the two period's i.e. 2005 and 2009.

1. **Spatio-Temporal Analysis of Vector Borne Disease in Mysore District during 2005 and 2009**

Table: 1

Vector Borne Diseases during 2005 and 2009

Sl. No	Name of the Taluk	No. of Malaria Positive Cases		No. of Dengue Positive Cases		No. of Chikungunya Positive Cases		Total Positive Cases	
		2005	2009	2005	2009	2005	2009	2005	2009
1	MYSORE	41	28	55	24	8	14	104	66
2	T.NARSIPURA	21	1	10	3	-	7	31	11
3	NANJANGUD	7	0	6	3	-	6	13	9
4	H.D.KOTE	10	4	2	2	-	6	12	12
5	HUNSUR	7	6	7	2	-	1	14	9
6	P.PATNA	11	1	10	2	-	5	21	8
7	K.R.NAGAR	110	1	11	6	1	7	122	14
	TOTAL	207	41	101	42	9	46	317	129

Source: District Health Office, Mysore

  Online version available at: www.crdeep.com

When we observe the table No.1, in Mysore district totally 317 vector borne cases are noticed in 2005. Among 317 cases, 207 cases are Malaria positive, 101 cases are Dengue positive and 9 cases are Chikungunya positive.   Where, in 2009 in the study area totally 129 vector borne cases are noticed in 2009. Among 129 cases, 41 cases are Malaria positive, 42 cases are Dengue positive and 46 cases are Chikungunya positive. The vector borne diseases are present in this area, because People often store uncovered barrels of water around their homes for bathing and drinking in slum areas, washing the clothes in stream/canal, Increasing population, increasing migration, lack of adequate healthcare facilities it is also matter of concern, poor drainage and sanitation system, in corporation areas contribute in the breeding of mosquitoes. So, these are main causes of vector borne diseases.

Fig. 1 Spatial Distribution of Vector Borne Disease in 2005 & 2009
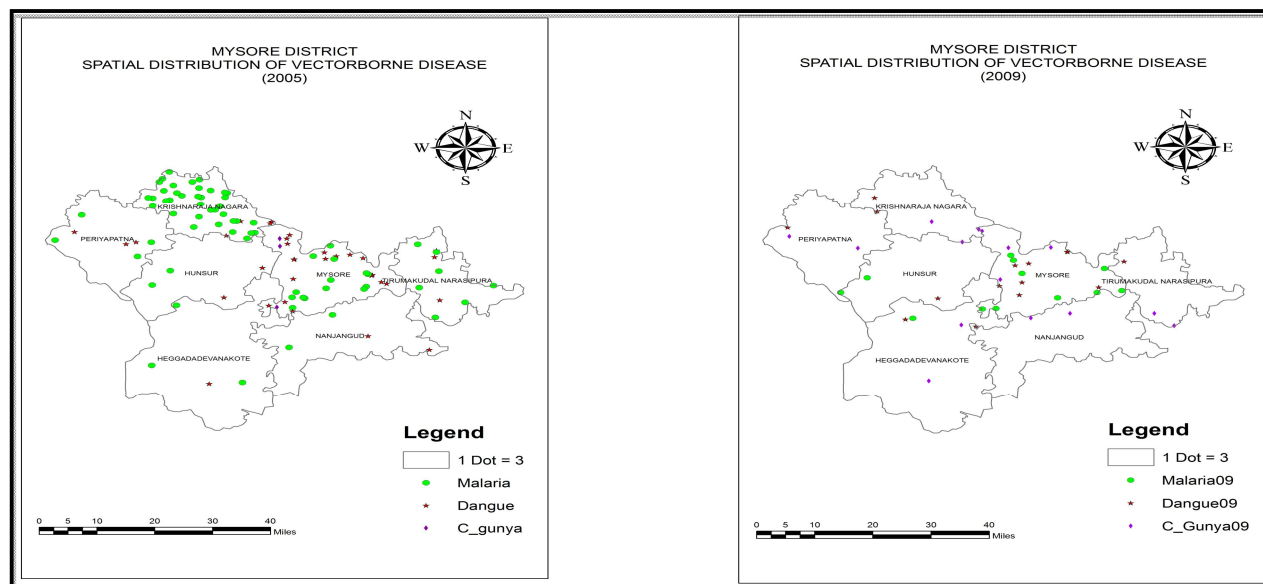
In the study area, among the three Vectors Borne Diseases Malaria positive cases and Dengue Positive cases are highest in 2005. Chikungunya disease emerged in the study area in 2005. K.R.Nagar taluk had highest Vector borne diseases compare to other taluks i.e. 122 Vector borne diseases in 2005. Mysore taluk is second highest it has 104 Vector cases, whereas, T.Narsipura is third highest totally 31 vector cases and Periya patna fourth highest it had 21 Vector borne diseases cases. And lastly, Nanjangud, H.D.Kote and Hunsur taluk the vector borne diseases are concentrated lowest only 14 to 13 cases respectively. It's mainly because of the district comprises of Marshy lands, water logged areas, unhygienic condition, inaccessibility of most of the Inhabited rural areas are stated to be the causative factors of Vector Borne Diseases.

But, in 2009 the Vector Borne Disease it has decreases up to 129 cases. Among 129 Vector borne disease cases, 41 cases are Malaria positive, 42 cases are Dengue positive and 46 Chikungunya positive cases are noticed in the study area. Diseases mainly noticed in the slums. Such areas have poor drainage and sanitation system as a result these areas helps in the breeding of mosquitoes. These are main causes for occurrence of vector borne diseases. In Mysore taluk Vector borne diseases are highly found compare to other taluks, totally 66 Vector borne diseases are noticed in Mysore taluk because of slums and haphazard urbanization is also one of the problem for occurrence of vector borne diseases in Mysore taluk because daily large quantity of wastages are dumped to outside which has generated from small scale industries like tyres, clothes, plastic, fruits and waste vegetables etc., K.R. Nagar is second highest having 14 Vector cases, whereas, H.D.Kote and T.Narsipura are third highest having totally 12 to 11 vector cases respectively. Lastly, Nanjangud, Hunsur and P.patna taluk the vector borne diseases are concentrated lowest only 9 to 8 cases respectively. But, No deaths were occurred by vector borne diseases in the study area in both the year 2005 and 2009.

2. Disease Wise Analysis:

A. Malaria:

Vector borne disease acquired through the bite of an infected arthropod. Malaria is a major public health problem. It is spread by single cell parasitic protozoan organism plasmodium, transmitted to humans. The malaria spread by the bite of the female anopheles mosquito, Malaria, is a parasitic disease that involves infection of the red blood cells. Malaria caused by four different species of plasmodium. i.e., Vivax, Falciperum, Quartan, Ovale

1. **Vivax**: It is caused by plasmodium Vivax, the Fever recurs after every 48 hours. Death rate is low.

2. **Malignant tertian:** It is due to plasmodium falciperum. Fever recurred every second of third day that is after 36 to 48 hours. Death rate is very high because the infected red blood corpuscles tend to clump into brain, spleen, lungs, etc. it is known as aestico-autumnal or the tropical epidemic malaria of man.

3. **Quartan:** It is caused by plasmodium malaria. The fever recurs every fourth day that is after 72 hours, death rate is low, but, Chronic infection may result in lethal kidney conditions.

4. **Ovale or mild tertian:** It is caused by plasmodium ovale. The fever recurred every third day or after 48 hours. It is not greatly harmful and is mainly confined to tropical Africa.

Table: 2 Types of Plasmodium Species

Incubation Period of Plasmodium Species		
Sl. No.	Type of Plasmodium species	Incubation Period (days)
1.	P. falciparum	7 – 14
2.	P. vivax	8 – 14
3.	P. ovale	8 – 14
4.	P. malariae	7 – 30

Signs and Symptoms of Malaria: It will cause a High fever, chills, Headache, Vomiting.   In study area we can observe two types of malaria cases: 1. Plasmodium Vivax, 2. Plasmodium Falciparum.

Table: 3   Types of Malaria

Sl. No.	Malaria types	2005	2009
1.	**PV**-plasmodium Vivax	138	36 cases
2.	**PF**-plasmodium Falciparum	69	5 cases

The study area experiences two types of Malaria only that is Plasmodium Vivax (PV) and Plasmodium Falciperum (PF). 'The growth of both the vectors its temperature between 20^0 C and 30^0 C are ideal for malaria parasite. The Parasite ceases to develop at temperatures between below 16^0C and above 30^0C, the relative humidity should always be above 60% for the normal life span of the host mosquitoes. In the low humidities mosquitoes die soon, whereas in the high humidities they become active and feed more rapaciously. As a result, more and more parasites are released into the human blood. Hence, the high incidence of malaria is always more in high humid conditions (Park and Park, 1977)'. In this paper, here Researchers concentrated only two year 2005 and 2009 malaria incidence to analysis the variations and taluk wise analyses are done to focus on high risk areas. It can be observed in the Table No.4.

Table: 4 Incidence of Malaria in Mysore District

Sl. No	Name of the Taluk	Malaria Positive Cases	
		2005	2009
1	MYSORE	41	28
2	T.NARSIPURA	21	1
3	NANJANGUD	7	0
4	H.D.KOTE	10	4
5	HUNSUR	7	6
6	P.PATNA	11	1
7	K.R.NAGAR	110	1
	TOTAL	**207**	**41**

Source: District Health Office, Mysore

Fig: 2 Incidence of Malaria in 2005 & 2009
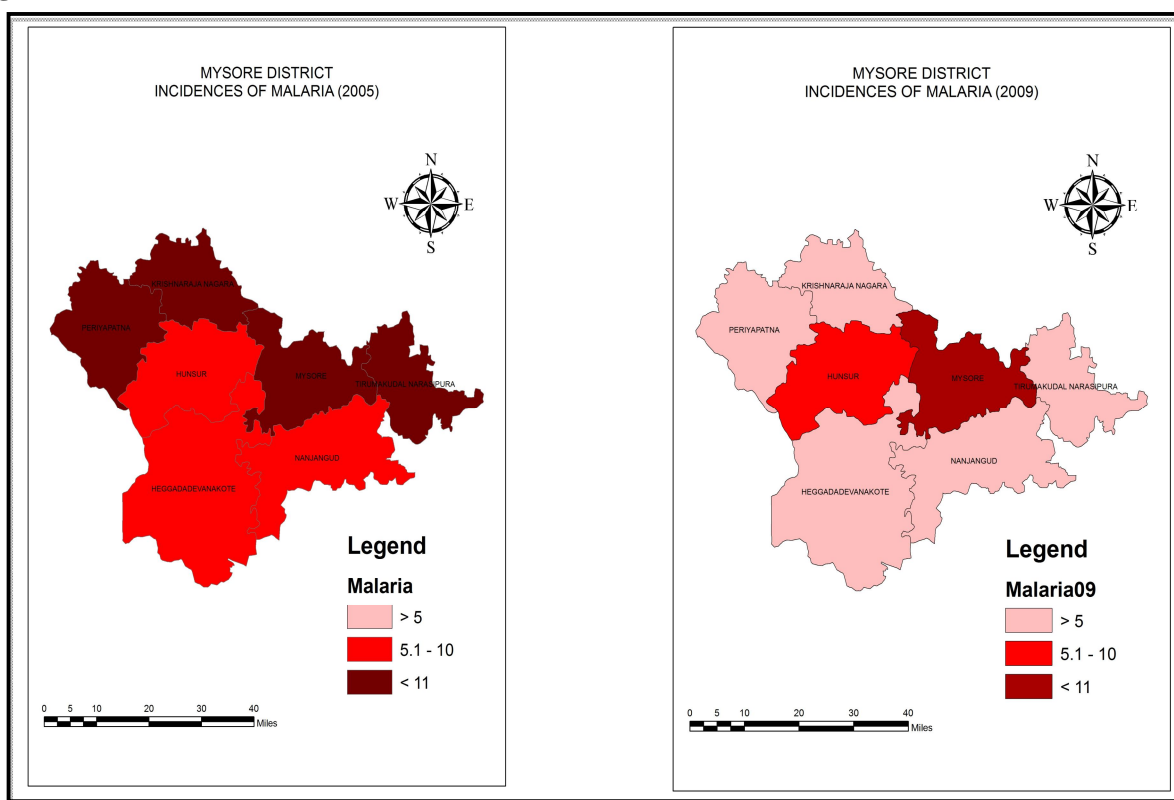
The above Figure2, it shows that during 2005 all the taluks of the Mysore district have Malaria Positive Cases. Totally 207 cases were noticed. Whereas, during 2009 out of 7 taluks Malaria positive cases are registered in 6 taluk except nanjangud in the study area. During the year 2005, total malaria positive cases were 207 in the Mysore district; among 207 cases K.R.nagar taluk had 110 malaria positive cases. Mysore taluk is noticed second highest malaria positive cases i.e 41 malaria positive cases.

T.Narsipura, H.D.Kote and P.Patna are the third highest which consisting 10 to 20 Malaria positive cases. Lastly, in other taluks like Hunsur and Nanjangud only 7 cases are noticed respectively. Whereas, in the year 2009 the total malaria positive cases were 41, among 41 cases 28 cases are noticed in the Mysore taluk. The remaining 5 taluks i.e., K.R.nagar, Hunsur, T.Narsipura, H.D.Kote and P.Patna taluks this area which consist 1 to 6 malaria positive cases. And, lastly nanjangud this area didn't registered of Malaria positive cases. There is no deaths were occur in the study area. Because after 2004 By identifying the high risk area government as has adopted some program to eradicate so the Vector borne diseases so it gradually decreases slowly.

Malaria Control:

1. **Vector Control:**
- Use of insecticide treated bed nets
- Use of indoor residual spraying of houses with insecticide
- Seeding of streams with larvivorous fishes
- Cleaning of streams

2. **Personal Control:**
- Use of mosquito nets
- Use of repellants (Off lotion)

B. Dengue:

Dengue is a Viral Diseases, it is transmitted by the infective bite of Aedes Aegypti Mosquito, it occurs in two forms i.e., Dengue fever (DF) and Dengue Haemorrhagic fever (DHF). Dengue fever is a severe flu like illness. In Mysore district we can observe only Dengue Haemorrhagic fever (DHF), Dengue Haemorrhagic fever is a more severe form of disease, it may cause death. Dengue Haemorrhagic fever affected person must see a doctor at once. Dengue fevers cases are more during rainy season.

Vector of Dengue/Dengue Haemorrhagic Fever: Dengue haemorrhagic fever is spread by the bite of an Aedes mosquito, primarily Aedes Aegypti. It is caused by a small, black mosquito with white stripes and is approximately 5 mm in size. It takes about 7 to 8 days to develop the virus in its body and transmit the disease.

Signs and Symptoms of Dengue Fever:

- High fever
- Pain behind eyes
- Muscle and joint pains
- Stomach pain and severe headache
- Frequent vomiting with or without blood.

When we observe the table no.5 the incidence of Dengue positive cases are registered in all taluks of Mysore District both in the year 2005 and 2009. Totally, 101 cases were noticed in 2005. Whereas, in 2009 it decreases up to 42 cases.

**Table: 5** Incidence of Dengue in Mysore District

Sl. No	Name of the Taluk	Dengue Positive Cases	
		2005	2009
1	MYSORE	55	24
2	T.NARSIPURA	10	3
3	NANJANGUD	6	3
4	H.D.KOTE	2	2
5	HUNSUR	7	2
6	P.PATNA	10	2
7	K.R.NAGAR	11	6
	TOTAL	101	42

Source: District Health Office, Mysore

In the year 2005, among 101 Dengue positive cases, Mysore taluk had highest Dengue cases it had 55 Dengue positive cases. K.R.nagar, T.Narsipura and P.Patna taluk are the second highest Dengue affected area were 10 to 11 Dengue positive cases are noticed. Lastly, in other taluks like Hunsur, H.D.Kote and Nanjangud taluks had only 2 to 7 cases are noticed here. Whereas, in the year 2009 total Dengue positive cases were 42, among 42 cases 24 cases are noticed in the Mysore taluk. 6 Dengue positive cases are noticed in K.R.nagar taluk, and lastly, remaining 5 taluks i.e T.Narsipura, nanjangud, Hunsur, H.D.Kote and P.Patna this area which consist 2 to 3 Dengue positive cases are noticed here and there was no deaths were occur in the study area.

The below figure no.3 shows that, the Incidences of Dengue of the year 2005 and 2009 in Mysore District.

Fig: 3 Incidence of Dengue in 2005 & 2009
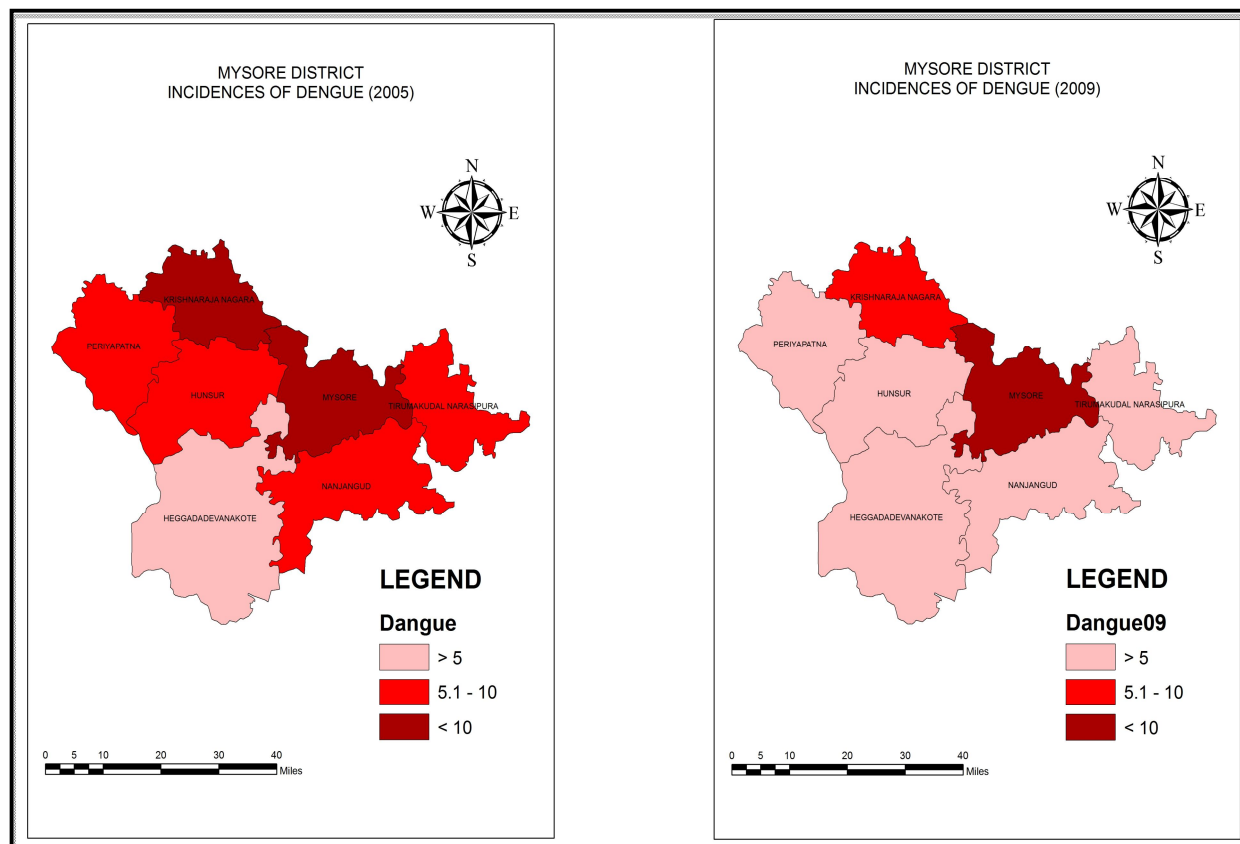
c. Chikungunya:

Chikungunya is virus disease or viral fever, it spreads viral illness by the bite of an Aedes mosquito, primarily Aedes Aegypti, and it resembles Dengue fever. Mosquitoes having Plasmodium which bite the human is the main causing for spread the Chikungunya disease. Chikungunya virus is classified into 2 types i.e., 1. Togaviridae, genus 2. Alphavirus. The time between the bite of a mosquito carrying chikungunya virus and the start of symptoms ranges from 3 to 7 days.

Signs and Symptoms of Chikungunya Fever:
- Severe Fever and rash
- Chills, Headache,
- Severe Joint pain
- Vomiting
- Frequently, the infection causes no symptoms, especially in children.

Table: 6 Incidence of Chikungunya

Sl. No	Name of the Taluk	Chikungunya Positive Cases	
		2005	2009
1	MYSORE	8	14
2	T.NARSIPURA	-	7
3	NANJANGUD	-	6
4	H.D.KOTE	-	6
5	HUNSUR	-	1

6	P.PATNA	-	5
7	K.R.NAGAR	1	7
	TOTAL	**9**	**46**

Source: District Health Office, Mysore

After 41 years Chikungunya disease reappeared in Feb 2005 and Oct 2005. About 151 districts in 8 states reported a case of Chikungunya. Due to migration is also one of the causes for Chikungunya disease. In India Chikungunya diseases are identified in the states like: Andhra Pradesh, Delhi, Gujarat, Karnataka, Kerala, Maharashtra, Madhya Pradesh, Tamil nadu. In Karnataka mainly Chikungunya disease is observed in Mangalore, Kasargud, Madikeri. Chikungunya disease emerged in the study area in 2005(Park 1977). When we observe the above table no.6 in Mysore District Chikungunya positive cases are registered in 2 taluks totally 9 cases noticed in 2005, among 9 positive cases 8 positive cases are noticed in Mysore taluk and one positive case in K.R.Nagar taluk.

Fig: 4 Incidence of Chikungunya in 2005 & 2009
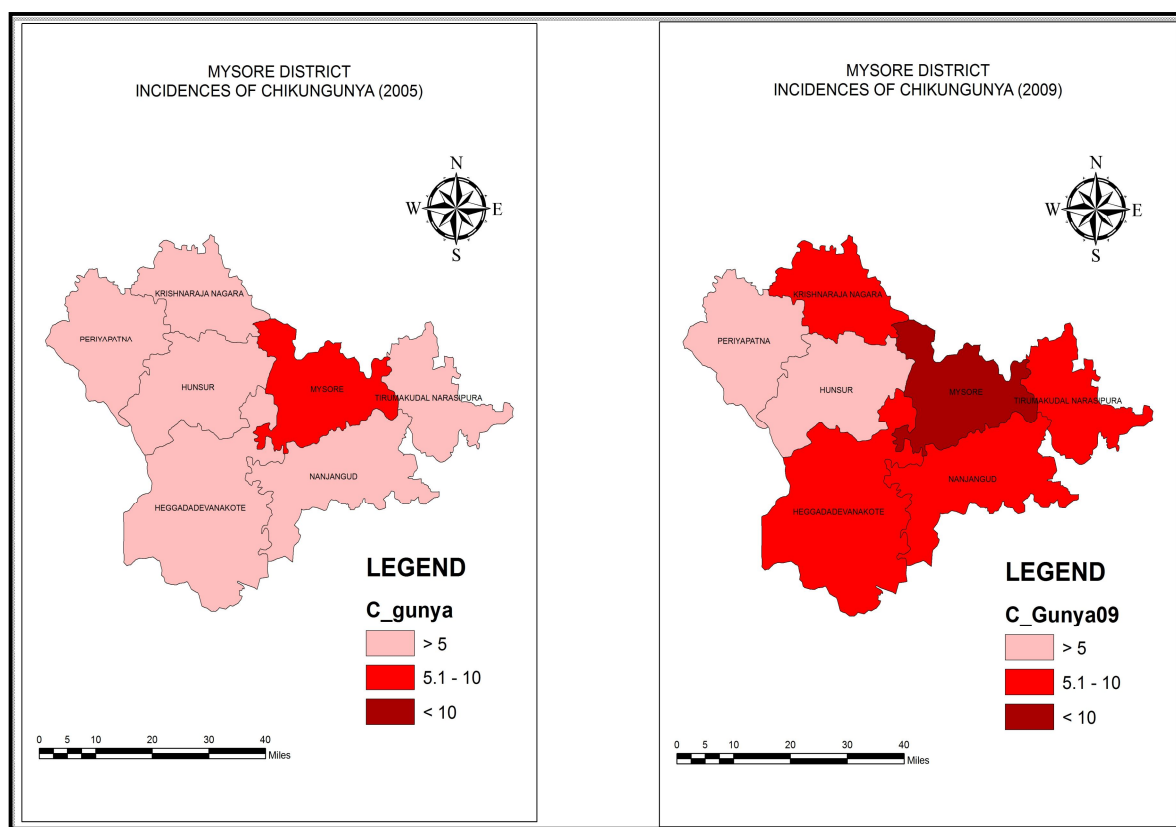
The remaining taluks are not affected by Chikungunya disease. Where, in 2009 Chikungunya positive cases are registered in all taluks of Mysore District. Chikungunya positive cases increase up to 46 cases. Among 46 positive cases, Mysore taluk had highest Positive cases it had 14 chikungunya positive cases.

The remaining 5 taluks i.e., T.Narsipura, Nanjangud, H.D.Kote K.R.nagar and P.Patna taluks, this area which consist of 5 to 7 positive cases. And lastly, only one positive case was noticed in Hunsur taluk. This is the clear indication that, the spread of this disease is in faster manner in the recent years in the study area.

Prevention and Control of Dengue and Chikungunya
1. Personal protection
   ➢ Use of mosquito coils and aerosols
   ➢ Use insecticide impregnated curtains and mosquito nets
   ➢ Use repellants and protective clothing
   ➢ Screening of windows in the house.

2. Space spray applications
  ➤ Thermal fogs and low volume aerosol spray
  ➤ Use of Insecticide formulation for spraying.

3. Environmental management
  ➤ Elimination of breeding sites
  ➤ Container management.

4. Community based education
  ➤ On Elimination of mosquito habitats and protection against day biting mosquitoes
  ➤ Community activities (4 o'clock habit) and community / entomological survey.

The Vectors Borne Disease is decreasing rapidly in this study area, because several Vector Borne Diseases Control Programs has been adopted by "Government",   through the Directorate of National Vector Borne Disease Control Program. They provide the basic facilities like drinking water, health and education are giving to people for cleaning of indoor water storage containers, public awareness, mobilizing the community for preventive measures to keep environment clean through various schemes. In 2005 K.R.nagar taluk had 122 Vector borne diseases in 2005 but in 2009, it has decreases up to 14 because the government adapted the program like:

1.   House hold survival activities:
2.   Source Reduction Measures:
3.   Educate the people through IEC and BCC Activities:
I.   IEC: Information Education and Communication
II.   BCC: Behavioral changing communication

First they noticed the high risk areas and spray the temofos it is an insecticide using to destroy the larvas and fogging activities it will use in the areas where the density of mosquitoes are high, based upon outbreaks of fever cases. Now , the various local bodies spraying yearly twice fogging in rural areas and in city region yearly once so the vector borne diseases are decreasing.

Results

1. Comparing to 2005 and 2009 the Vector borne disease up to 188 Cases has been decreased. Since, the government has adapted some program to eradicate the vector borne disease in study area.
2. In slum areas like these which have poor drainage and sanitation system are noticed in the district and also daily large quality of wastages are dumped to outside which has generated from small scale industries like tires, clothes, plastic, fruits and waste vegetables etc which is the root cause of vector borne disease in the study area.
3. Increasing population and lack of adequate healthcare facilities, it also matter of concern. In one side development of science and technology and another side large proportion of population has no safe drinking water (it is major problem) disposal of water and industrial effluents enters into water, increasing migration and others are the main causes for vector borne diseases in the study area.
4. Public awareness and mobilizing the community for preventive measures. Health Education must be provide to people for cleaning of indoor water storage containers. Several vector borne disease control programmes has been made by government. By Directorate of National Vector borne Disease Control Program but the public should follow it.

Conclusion

In this paper Vector borne disease are studied through both the spatial and temporal context. It is an important factor to consider in relation to disease surveillance, research and prevention. Though, some remarkable achievements have been gained in the battle against vector borne disease. With the help of modern techniques GIS spatial analysis can been done easily which is very helpful to explain how it is useful especially in healthcare Applications covering database management, planning, risk assessment, service area mapping, location and identification of diseases surveillance, control, monitoring and evaluation etc., and also for analyzing and monitoring environmental targets associated with vector borne diseases which will helpful for risk assessment and disease prevention. The prevention and control of vector borne is besetting with many challenges and requires high political commitment and community/ society participation.

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