HEALTH-GEOGRAPHIES

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Summary

Vector is an invertebrate, cold blooded animal which spreads disease from one host to another. The case study is done on Visakhapatnam city located on the east coast of India. The ward wise disease rate, population census and area are collected and summed up to shape zone wise disease rate. The severity of vector-borne diseases namely malaria, dengue and chikungunya are evaluated by statistical techniques using Location Quotient (L.Q) and Impact Factor (I.F).Efforts were made to map various diseases risk levels over a certain span of years.

KEYWORDS: 1. Location Quotient, 2. Impact Factor, 3. Risk Level, 4. Endemic, 5. Maps

1. INTRODUCTION

Vector-borne diseases are infectious illness transmitted by the bite of contaminated arthropod species, such as mosquitoes, ticks, bugs etc. vectors are normally considered to be an invertebrate, cold-blooded animals, generally arthropods. These are primitively affected to people living in areas that do not have adequate levels of sanitation, drinking water, and housing which cause a significant fraction of the global infectious disease burden. The case study is focused on 3 major diseases-Malaria, Dengue and Chikungunya. These are mosquito borne diseases endemic in degraded environment especially in tropical and sub-tropical ecosystems[1].

2. STUDY AREA

Visakhapatnam city is located on the east coast of India facing the Bay of Bengal (Fig.1). Surrounded by hills on three sides besides the seafront on the eastern side, the city is spread over an area of 533.00 km^2. The city's population is 1704470 (2011 Census) at an average density of approximately 3197 people per km^2. The region is under sub-tropical wet and savanna climate (Köppen-Geiger classification) with an annual rainfall of 955 mm and average temperature of 28^oC. The city receives almost 95% of its annual rainfall during the monsoon season (June to November).The monsoon in this region is extremely damp and humid with frequent showers favorable for proliferation of vectors, particularly mosquitoes. The city is divided into 6 zones comprising of 72 municipal wards.

3. METHODS OF STUDY

The ward wise disease rate, population census and area are acquired from Greater visakhapatnam municipal corporation(GVMC). The disease rate of each ward is summed up to shape zonal disease rate. According to the norms of GVMC the zones are classified as follows: Zone-1 (01-06 wards); Zone-2 (07-18 wards); Zone-3 (19-30 wards);Zone-4(31-49 wards);Zone-5(50-65 wards);Zone-6(66-72 wards). Based on the data the Location Quotient and Impact Factor are calculated for the analysis of high disease prominent zone.

3.1 LOCATION QUOTIENT

Location quotient (L.Q.) is an evaluating estimation of a share of the smaller geographic area relative to the larger geographic area.It is redefined as the ratio of fraction of number of people affected in the zone by the population of the respective zone to the fraction of number of people affected in the city by population of the city. The location quotient is given by the equation,

$$L.Q = \frac{N_{zone}/P_{zone}}{N_{city}/P_{city}} \quad (1)$$

Where, N_{zone} = Number of people affected in the zone.

P_{zone} = Population of the zone.

N_{city} = Number of people affected in the city.

P_{city} = Population of the city.

If LQ>1, then it indicates that the given zone has more than its share of disease rate relative to its population size.

LQ<1, then it indicates that the given zone has less share of disease rate than its population size.

3.2 IMPACT FACTOR(I.F.)

Impact factor is a relative approach in estimating the disease rate in the respective region based on the derived values of L.Q.The higher the value of I.F the greater will be the impact in the respective zone and vice-versa.

$$I.F.= \frac{L.Q_{Y1}+L.Q_{Y2}+L.Q_{Y3}+\ldots.+L.Q_{Yn}}{N} \quad (2)$$

Where, $L.Q_{Yn}$=location factor of a respective disease in the specific year.

N=number of years

If I.F value lies in the range of 0.00-0.50, it indicates the impact of disease found Low in the zone.

If I.F value lies in the range of 0.50-1.00, it indicates the impact is Moderate in the zone.

If I.F value is above 1.00, indicates the impact is High.

The values of location quotient and impact factor are calculated and tabulated in the table1,2 and 3.

4. DISCUSSIONS

The zone having more population and urbanization (zone-2,zone-3) (table-1,2,3) has more disease rate. The factors affecting increase in disease rate are urbanization, population growth, poor sanitation facilities, malnutrition(less immune)and global warming.[2] Optimum temperature, precipitation, and humidity are critical to mosquito survival, reproduction, and development and can influence mosquito

presence and abundance. The average rainfall recorded in the year 2013 was 1303.4mm (table-4) accordingly disease rate of malaria is higher in that year (table-1 4th column).Among all the three vector-borne diseases which are discussed, malaria is found to be more hazardous when compared to dengue and chikungunya based on L.Q and I.F. Mortality rate among population is found to be severe due to malaria.

5. CONCLUSIONS

Maps showing the risk level are generated on the basis of location quotient and impact factor. Each map has been given a specific color to identify the level of risk for a specific disease (Fig 2a) (Fig 2b) (Fig 2c). The area with more urbanization, i.e. Zone 2 is found to be more prominent with diseases. The complete disease rate according to the zonal classification is given in a pie chart (Fig 3).

6. REFERENCES

1. Snow, R.W., Guerra, C. A., Noor, A.M., Myint, H.Y. and Hay, S.I., *Nature*,2005, **434**, 214–217.

2. Jamieson A, Toovey S, Maurel M (2006). *Malaria: A Traveller's Guide*. Struik. p. 30. ISBN 978-1-77007-353-1.

7. BIOGRAPHY

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9. FIGURES AND TABLES

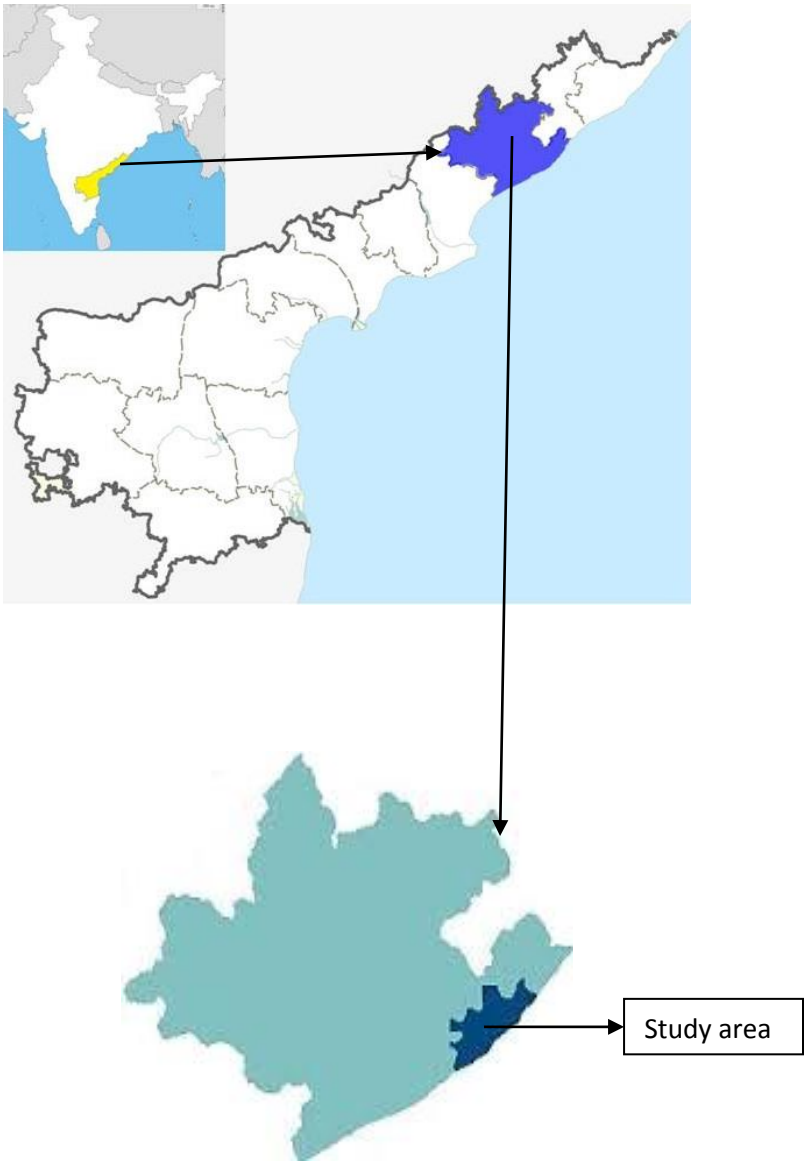

FIGURE 1 SHOWING STUDY AREA

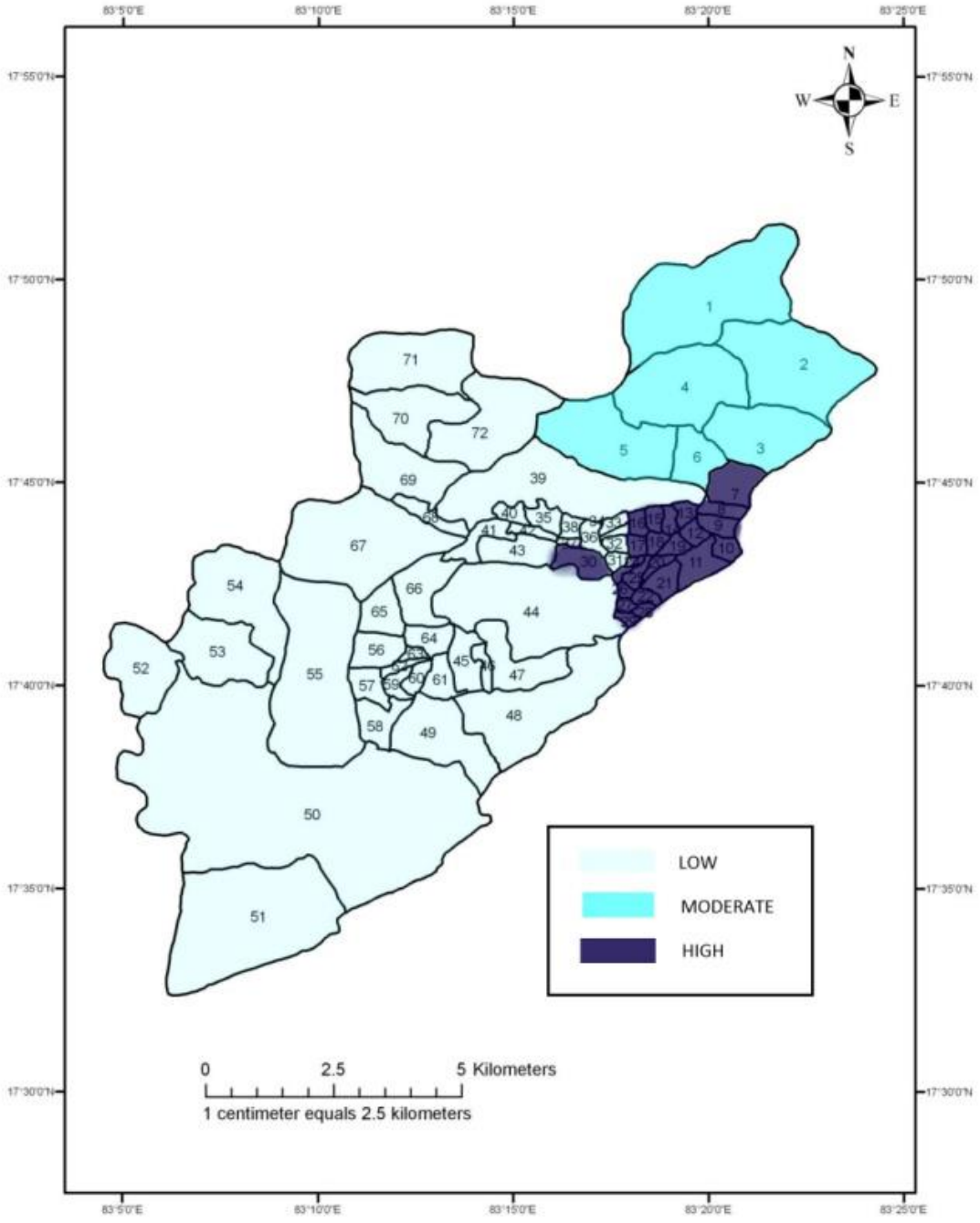

FIGURE 2(a) MAP SHOWING IMPACT LEVEL FOR MALARIA

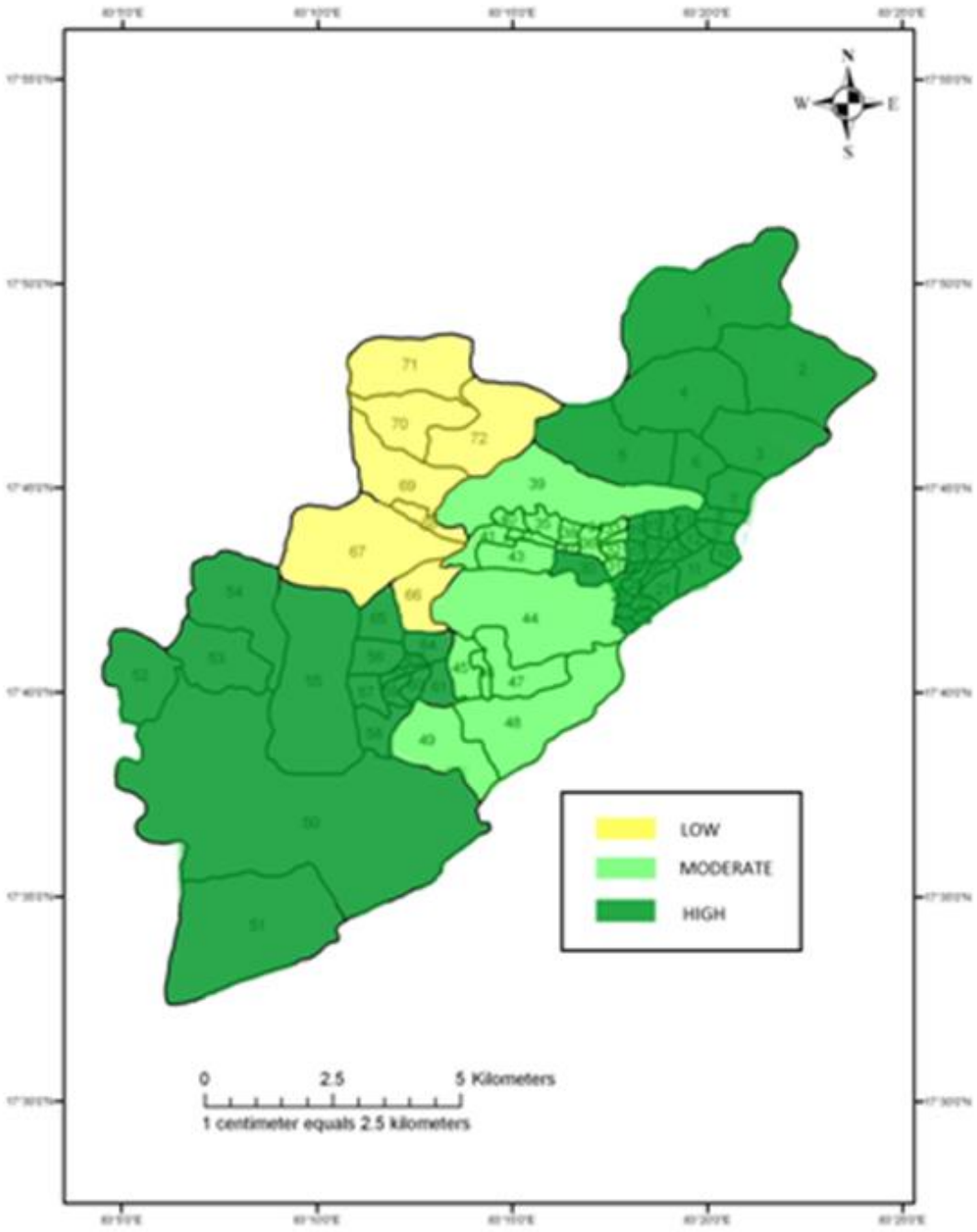

FIGURE 2(b) MAP SHOWING IMPACT LEVEL FOR DENGUE

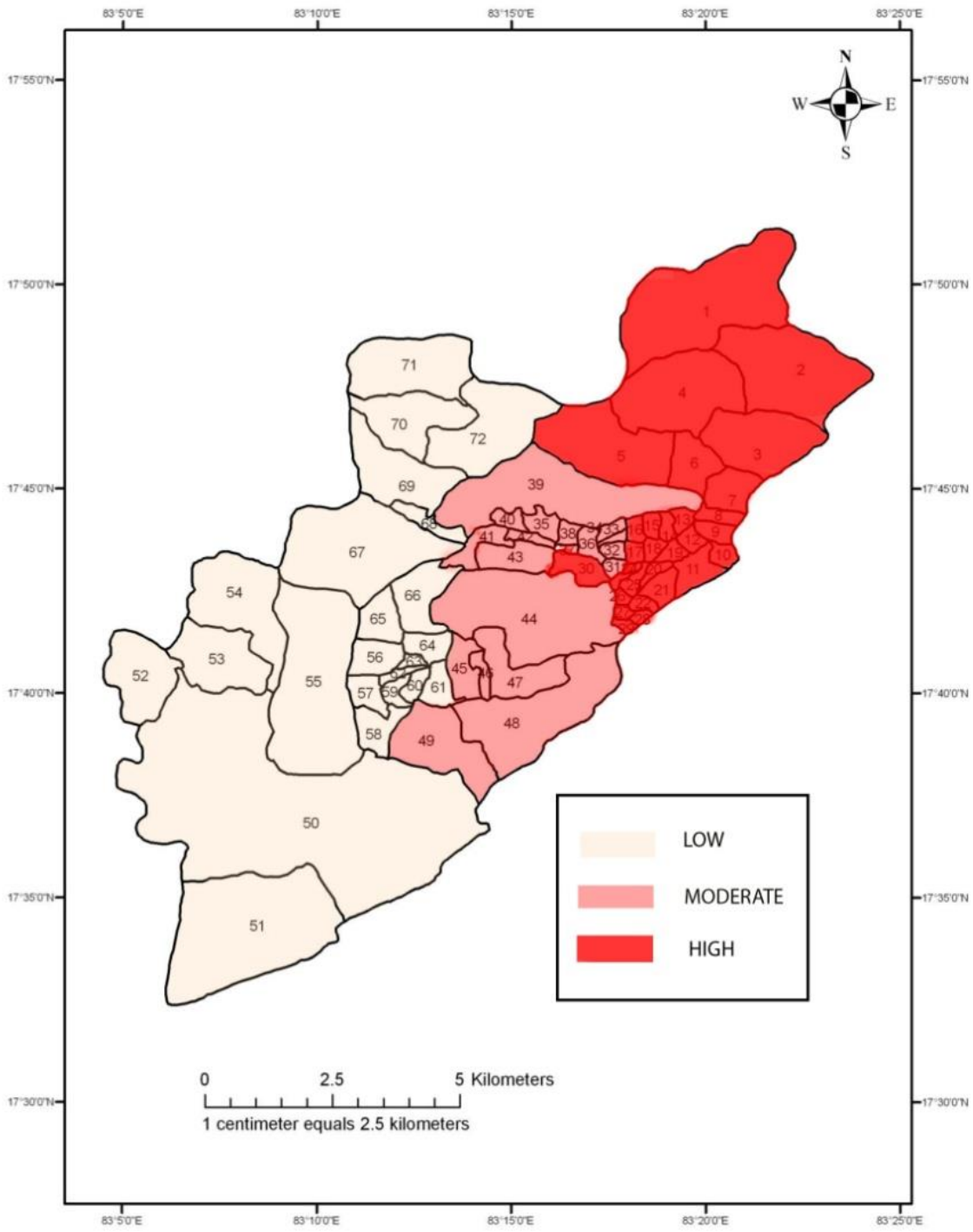

FIGURE 2(c) MAP SHOWING IMPACT LEVEL FOR CHIKUNGUNYA

	2011	2012	2013	2014	2015	2016	I.F	Risk Level
Zone-1	0.0	0.89	0.86	1.49	0.72	1.06	0.84	Moderate
Zone-2	6.21	3.61	2.92	2.76	3.72	3.00	3.70	High
Zone-3	2.26	2.35	2.88	2.05	2.24	2.48	2.38	High
Zone-4	0.0	0.0	0.14	0.20	0.03	0.18	0.09	Low
Zone-5	0.0	0.0	0.0	0.27	0.0	0.0	0.04	Low
Zone-6	0.0	0.0	0.0	0.0	0.0	0.06	0.01	Low

TABLE 1 SHOWING IMPACT FACTOR AND RISK LEVEL FOR MALARIA

	2012	2013	2014	2015	2016	I.F	Risk Level
Zone-1	1.33	1.95	1.01	0.75	1.22	1.25	High
Zone-2	0.77	1.15	1.55	0.99	0.92	1.08	High
Zone-3	1.56	1.04	1.03	1.31	1.11	1.21	High
Zone-4	0.54	0.69	0.2	1.01	0.95	0.78	Moderate
Zone-5	1.41	1.15	1.23	1.16	1.14	1.22	High
Zone-6	0.57	0.31	0.37	0.53	0.63	0.48	Low

TABLE 2 SHOWING IMPACT FACTOR AND RISK LEVEL DENGUE

	2014	2015	2016	I.F	Risk Level
Zone-1	1.45	2.54	1.24	1.74	High
Zone-2	1.56	0.66	1.51	1.24	High
Zone-3	2.10	2.32	1.44	1.95	High
Zone-4	0.92	0.90	1.15	0.99	Moderate
Zone-5	0.22	1.16	0.37	0.25	Low
Zone-6	0.0	0.30	0.40	0.23	Low

TABLE 3 SHOWING IMPACT FACTOR AND RISK LEVEL FOR CHIKUNGUNYA

S.NO	YEAR	AVERAGE RAINFALL(mm)
1	2012	845.4
2	2013	1303.4
3	2014	1277.3
4	2015	1165.7

TABLE 4 SHOWING AVERAGE RAINFALL

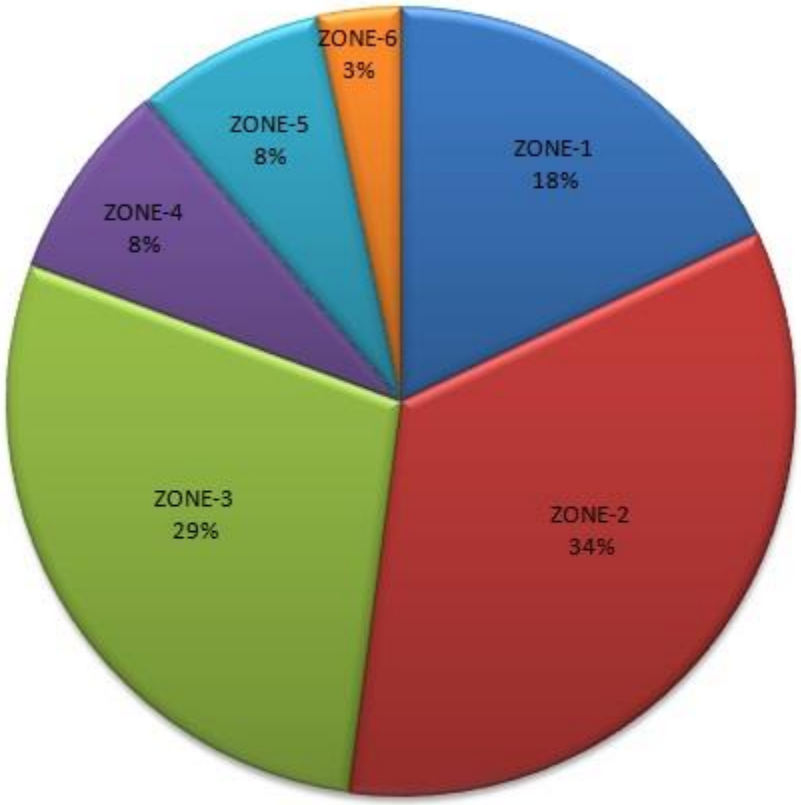

FIGURE 3 PIE CHART SHOWING DISEASE RATE IN ZONES