

## REVIEWING IN THE DENGUE EPIDEMIC IN THE GALLE DISTRICT FROM A MEDICAL GEOGRAPHICAL PERSPECTIVE

**Dr. G. Edirisingh\***

Senior Lecturer, Department of Geography, University of Ruhuna, Matara, Sri Lanka.

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**\*Corresponding Author**

**Dr. G. Edirisingh**

Senior Lecturer, Department  
of Geography, University of  
Ruhuna, Matara, Sri Lanka.

### ABSTRACT

Parasite diseases like dengue is one of the most serious public health hazards in Sri Lanka. Recently a high prevalence of the disease could be observed everywhere in the country. Those affected by the disease are at a high risk as the disease is deadly dangerous. This study is

aimed at analyzing the issue from a medical geography perspective with special reference to Galle district during the period from 2000-2014. The research was primarily based on both primary and secondary data collection. Primary data was collected through a questionnaires survey by in field research observations as well as by interviews and discussions conducted within the Galle district municipality. Secondary data was collected from MOH divisions and annual and monthly reports of the ministry of health. Finding of the research indicates that the disease is on the spread in the rural areas as well as in urban areas. Finding of the study confirms that the rainfall factor directly influences on spatial and temporal pattern of the dengue epidemic. When the area is experienced a continues rainfall it shows a dramatic reduction of the disease. At the same time it shows a high tendency of the distribution pattern when the area experienced less rainfall. It was concluded that both annual and monthly spatial and a temporal patterns have a direct impact on the dengue epidemic. Human activities in the urban areas are also caused severely for the spread of the disease. It was recorded that the majority of the patients were within age group between 15-25. That means younger generation have been suffered a lot. Proper management, planning and implementation of action through evaluation of observation should be administrated in order to mitigate the issue.

**KEYWORDS:** Dengue epidemic, medical geography, urban areas, rainfall.

## INTRODUCTION

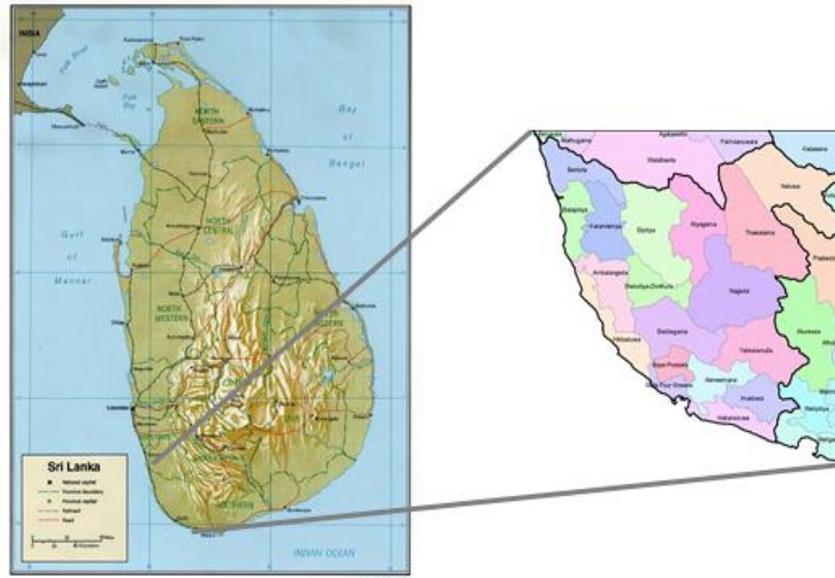
Dengue is developing and resurging as an island wide major public health challenge since 1989-2015. Dengue epidemic continues to be a great health hazard and also the leading cause to hospital admissions in the Galle district. Rapid and large - scale urbanization has increased the susceptibility to dengue through changes in the social environmental factors as well as natural environmental factors. Traditional and rural based cultural restraints can be traced as a major factor leading to major risk behaviors in the urban environment. 1188 critical cases were reported from the area in 2014 while the number of deaths confirmed was 11. In the past 10 years the incidence distribution and clinical severity of the disease has increased dramatically. A relatively higher prevalence of the disease can be observed particularly in the urban areas of the district.

## LITERATURE SURVEY

Currently as the disease is on increase almost in the entire district people in the areas are potentially at a risk from the dengue (Epidemic unit, 2015). In Sri Lanka (Kanakarathna, et al., 2009). They point out dengue is hyper endemic in Sri Lanka with detected co-circulation of multiple serotypes. As well as WHO have studies a number of key factors that contribute in a dengue outbreaks. Further, they point out the (WHO, 2010) high human population density many people might be exposed even if the mosquito abundance index shows a low density value low mosquito numbers. Canyon, 1999 said that disease stimulating factors include climate such as rainfall, humidity and temperature. According to tropical areas are potential high risk areas for mosquito-borne disease such as dengue and point out that the locally acquired dengue transmission in Northern Queensland, Australia (John, 2014). They have contributed the several conditions that favour vector, density, distribution survival and longevity. Today GIS technology and the remote sensing have provided an alternatives potential tool for infectious diseases surveillance and the control of many types of vector borne diseases (Russel 1969). Mapping the spatial and distribution of dengue cases against the vulnerability towards dengue with these studies mapping tools, the public and health authorities will be able to identify and locate the source of epidemic outbreak as well as spatially identify the high risk areas (Edirisinghe, 2016).

### Study area

This study was mainly based on Galle Municipal area. The total extent of the Galle district is about 1652 km<sup>2</sup> and which 35 km is covered by water and the remaining 1617 Km<sup>2</sup> Island. Galle district bounded from the north by Bentara River South and west by coast of the Indian Ocean and east by Matara and Rathnapura Districts. Annual rainfall of this area is 2000-2500mm.



Galle district is bounded from the north By Benthara River south and West by coast of the Indian ocean and south and west by Matara and Rathnapura districts.



Figure 1: Study area Galle district.

## MATERIALS METHODS

This study was based on the following Health Medical Officers of Galle city Chinakoratuwa, Galwadugoda, Thapitiya, Magalla, Katugada, Dadalla, Kubalwella, Dangedara, Minuwangoda, Athligoda, and Madawamulla, Hiburana. Out of the above six divisions eight families were selected from each division and the total number of families were 48 families. Forty five families were selected from public health officers divisions called Niyagama, Pitigala and Matthaka which belong to Niyagama Health officers division. Fifteen families were selected from each division. Out of 48 families selected from Galle MOH 40 families were considered as families victimized by the dengue epidemic and eight families were considered as free of the same. Out of 45 families selected from Niyagama HOH 40 families were considered as victimized and 5 families were not. The above information was gathered from the PHI of the relevant area. GIS analysis would be useful evaluations based describing use making in identification of the dengue risk areas and risk factors (Sumith, et. al 2009).

The two methods of the data collecting consist of both primary and secondary data that have been gathered from the various sources. Primary data was collected by circulating a detail questionnaire among the 60 selected sample of families in the areas with a view of studying their perceptions and attitudes towards the human environmental in which they live. The secondary data were collected from MOH divisions of the area. Both forms of data were primarily designed with a view of determining the factors affecting the spread of the epidemic in the Galle district.

## OBJECTIVE OF THE STUDY

The main objective of the study to analyses the reviewing the medical geographical perspective.

### Specific objectives are

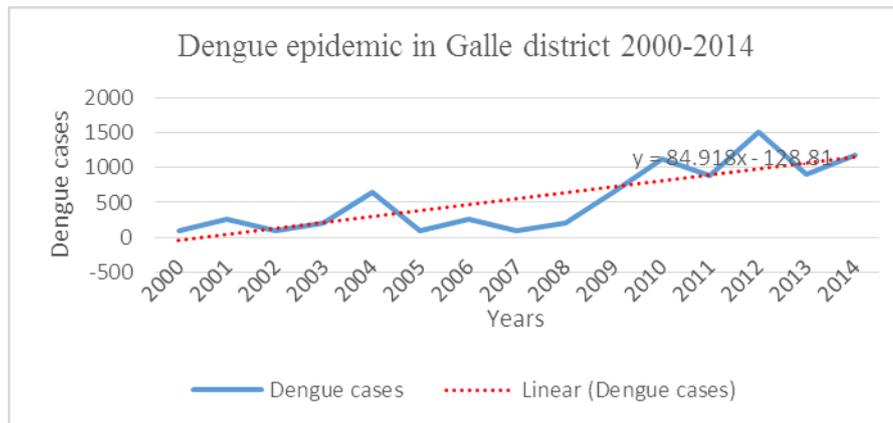
To analyses spatial and temporal factors

To identify the spatial and temporal pattern of the dengue epidemic of district, during the period from 2000 to 2014.

## RESULT AND DISCUSSION

There was a high incidence of dengue in the district annually reported from 1989 to 2014. It annual occurrence of dengue cases for each MOH areas were calculated from the number of annual reported cases, divided by total population 100,00. This was used for spatial association analysis and spatial statistical analysis. Figure 2 shows the dengue trend in during

the period 2000-2014 in the district. Trend line value is  $Y=84.91x-128.81$ . There was a high tendency.



**Figure 2: Dengue epidemic in the Galle district 2000-2014.**

In this study main attention is paid in relation to the following areas the social economic status of the official families, age structure of population, gender , number of family members, and nature of employments. The following table 1 shows the age wise distribution of the population and the percentage of patients within the MOH divisions of Galle Municipal Council (GMC).

**Table 1: Age wise distribution of affected families in Galle MC 2014.**

Age Grope	Total population	%	No of cases	%
0-10	27	14.3	8	20.0
11-20	45	24.0	13	32.5
21-30	22	11.7	7	17.5
31-40	31	16.5	4	10.0
41-50	27	14.4	4	10.0
51-60	17	9.0	3	7.5
61<	19	10.1	1	2.5
Total	188	100	40	100

Source: Data RDHS Galle, 2014.

According to the table 1 although the age group 11-20 between showed the highest population, the highest rate of patients were recorded from the age group less than 10 years. Age group over 61 represents less amount of population and this group was considered as the less affected group. According to this table shows a high tendency age group under age 30. It is also evidenced in the age group 11-20 school children have been victimized severely.

**Table 2: Age wise distribution of affected families in Niyagama, 2013.**

Age Grope	Total population	%	No of cases	%
0-10	25	14.5	3	7.5
11-20	35	20.7	8	20.0
21-30	38	22.5	12	30.0
31-40	25	14.7	7	17.5
41-50	20	11.8	5	12.5
51-60	16	9.4	2	5.0
60<	10	6.0	3	7.5
Total	109	100	40	100

Source: Data from RDHS Galle 2013

According to the table 2 although the population under 20 showed a higher rate this age grope has not been affected severely. But the age group over 20 has been affected severely. Age group between 21-30 which represent younger generation has also been severely affected. Tendency of spread disease among school children has also been increased rapidly.

When comparing these two areas 53% of children under 20 have been victimized within the GMC unit. 27% of children under 20 in Niyagama Division have been victimized percentage recorded relevant to the age group 20-40 was 27.5% within the Galle MC. The percentage in relation to the same age group in to Niyagama division was 47.5%. Therefore it was evidenced that tendency of spreading dengue was high among school children within the Galle MC and younger generation in Niyagama division respectively. Labour force of the country consists of younger generation. There is a direct impact on their contribution towards the developed process of the country.

Percentage of patients within GMC and Niyagama according to the gender.

**Table 3: Gender wise distribution of affected families in Galle MC and Niyagama 2013.**

Gender	Galle MOH cases	%	Niyagama MOH cases	%
Male	21	52.5	18	45
Female	19	47.5	22	55
Total	40	100	40	100

Source: Data from RDHS, Galle 2014

When comparing the two areas males as well as females have been victimized. Therefore it was evidenced that there wasn't considered relationship between the gender and the disease.

### Trends caused spreading the Dengue epidemic

Field investigation revealed that the patients who were victimized by the disease stayed outside their permanent residence. Before one week they were caught by disease. Patient who employed in another are or students who stayed in another area for their studies fall in to this category.15% of patients in Galle MC were caught by the residence. Most of the cases were recorded from Colombo area. People those who employed and engage in their studies more victimized.

**Table 4: Percentage of patients who stayed outside the residential are before the disease.**

Causes	Galle MC no of patients		Niyagama MOH no of patients	
Patients who stayed at home before caught	22	45.8	26	65.0
Patients who were stayed at home before caught (Colombo or outside)	26	54.2	14	35.0
Total	48	100	40	100

Source: Field survey 2014

According to the field survey carried out on employees and students who stayed outside their native places before the disease revealed following factors 54.2 % of patients of Galle MC were caught by the disease from the outside of their permanent residence. Especially this segment is included by persons who employed and engaged studies in Colombo area. According to this table revels the study area including Galle MC limit and Niyagama area and it shows that a higher percentage of potential were victimized outside the area. There is a high tendency of spreading the disease in the Galle MC due to the urbanization. The highest amount of patient have been recorded from the Colombo area of present. When we compare the two study areas it revealed that the majority of patients were recorded from Colombo.

**Table 5: Mosquito breeding places in the area.**

Reasons	Galle MC		Niyagama MOH	
The area with mosquito breeding places	21	45.0	19	42.2
Free mosquito breeding places	27	55.0	21	57.8
total	48	100	40	100

Source: Field survey 2014

Table 5, shows 48 families of the study area were utilized for the study out of them.40 families were victimized and 8 families weren't victimized out of entire 48 families mosquitoes breeding grounds in the area. Forty victimized families and five families (free of

dengue) were based on the study. Out of 45 families were residential at 19 families were residential at risk areas which were mosquito breeding grounds.

When considering the two study areas around 45% of mosquito breeding grounds were identified. These places were identified as within the premises and out of the premises. They were mainly caused human activities as well as environmental factors (Edirisinghe, 2014).

### Indoor and outdoor surveys

According to the above survey which was conducted in house and outdoor reveals following information. Mosquito breeding places analysis according to the survey. Survey conducted by assist Health officers of Galle DHS the District in 2014 revealed following factor It was recorded a high tendency of spreading mosquito breeding places in the vessels such as, boats, tires, artificial places made by people in banner, barrels, water container, tanks, machine parts, polytheine, plastic items are so on. In addition to that its reveled gathers bamboo parts banana leaves instrumentals placed to beautify the environment are the places that encourage mosquito breeding places in outdoor (Edirisinghe, 2014). The survey further reveals that they mosquito possibility of creating a breeding places outside the houses are comparatively higher than the in house premise.

**Table 6: Possibility of creating mosquito breeding places.**

Suspected vulnerable areas	Number of observation places	Dengue mosquitoes places	With the dengue mosquitoes	%
Government and private institute	15	10	2	8
Barren land, channel side	24	23	4	16
Schools	10	9	3	12
Public places	6	4	1	4
Houses	75	25	3	12
Temples and Kindergarten	12	8	7	28
More risky areas with workshop, garage	25	16	5	20
Total	167	95	25	100

Sources: Field survey 2014

According to the table 6 and field survey conducted based on premises revealed higher rate of mosquito born within the premises such as garbage dumps. Institutions such as schools and temples showed a higher rate PH value prevailing in the garbage dump is favourable for mosquitoes. It was showed a higher rate within the both government and private institutions. They only focus their attention on their day to day activities and don't have a proper garbage

disposal system at present schools and religions places are the premises that contributed a higher rate in creating mosquito breeding places. Although several programme were launched in school premises, they were not implemented in a fruitful manner. Houses and shops showed a lower rate comparatively than the other premises. This was mainly due to the continuous cleaning process in house survey (Edirisinghe, 2017).

According to the housing survey revealed that the houses belong to the upper income category paid a major role in creating mosquito breeding places in their grounds. This was mainly vessels such as flower vessels, ponds, water tanks and fridges available in these houses.

### **Spot analysis of mosquito breeding places survey**

Consequently to the dengue activities and survey which was conducted Galle MC and Niyagama HO under the guidance of Galle district DHS reveals following factors.

According to the table 7 places inspect such as lands irrigation canals were the places that experienced higher rate of mosquito breeding places, schools and religion places also recorded a higher rate tire shops bus depots government and Non-Government Organization institutes have been identified as positive places with mosquito breeding sites.

According to the figure 9 Municipal council is treated as an urbanized area and comprised with Niyagama MOH. Schools in urban area showed a higher rate of distribution than the rural areas. Although house premises showed a lower rate comparatively, with the urbanization process that has been changed rapidly (Edirisinghe, 2017). Further the dengue incidences was also significantly related with the represented of absence of built-up areas considered to represent urbanization (Sumiko, et al.,2014).Dengue promoting factors include climate such rainfall, humidity and temperature, changes land cover particularly rapid unplanned expansion with inadequate housing and infrastructure (Gublar, 2011, Tam, 2013).

### **Correlation between Number of patients and monthly distribution**

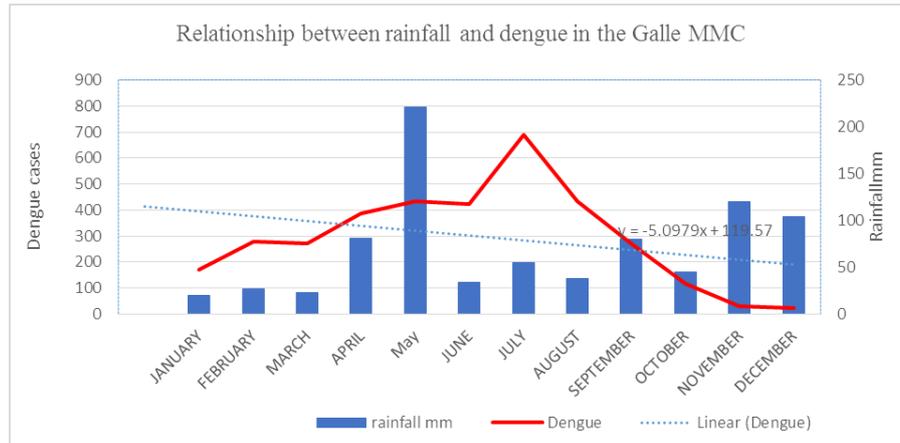
In order to find out relationship between number of patients and monthly distribution of the year 2010 time serious analysis can be utilized see the table(patient based on the monthly case) First the table is to be prepared with trend values to analysis the expected values including time series analysis. The following formula is to be applied to get the trend line.

Predicted value was estimated in relation to the each month (for the table with trend value see 3).4. Graph shows the monthly distribution of the patients during the year 2010.

According to the figure 3 and 4 the line with observed values has been created in relation to the patient on monthly basis. At the same time trend line which represents expected value has also been created. When considering the rest tendency the highest aimed of patients were recorded in the month July and this was the highest value recorded exceeding the expected values. There was a continuous increase from January to July. From August to December it decreased gradually and the least number of cases were recorded in December. Therefore it reveals that there is a relationship between second variation the growth patients density.

There has been a considerable growth of rainfall during the month of May due to the South West Monsoon. But number of patients have been decreased in May and once again it showed a rapid expansion during the month of June, July and August. This was mainly due to the recorded rainfall in May and as a direct result of that spreading of mosquito breeding grounds had been taken places. It takes three four weeks recorded dengue patient become of the life cycle of dengue mosquito. Normally it takes around  $\frac{3}{4}$  weeks to record dengue patients. It also taken around one week for the evaluation of a mosquito. It taken 8-12 days for the growth of the virus inside the body of the mosquito (Derouich, 2003).The virus where infected into a human body takes 5-6 days to be show symptoms of the disease (3-15) (WHO,2010). Therefore it is evident that it taken  $\frac{3}{4}$  weeks to identify patients after experience the rainfall.

Due to the heavy rainfall it starts to washout the environment and destroy the mosquito eggs. As result of that it is evidenced that the tendency of decreasing the patient population during these days. Rainfall is experienced on and off caused to increase the mosquito density. Because of the above reason. It was recorded a lower rate during the month of May. Once again there was a considerable growth during the month of June and July. With average rainfall experienced in September and October it was recorded a lesser amount of patients in November and December respectively. Once again due to the heavy rainfall experienced in the month of November and December it was recorded the highest number of patient during the month of January to February.



**Figure 3: Relationship between rainfall and dengue in the Galle district.**

On and off rainfall experienced in the months of June and July. This type of rain creates favorable atmosphere for the distribution of dengue mosquitoes. Eggs laid on wet surface such as walls can be survived more than one 6-12 months even in a dry weather condition

### Seasonal Pattern

Galle district has been affected by dengue epidemic for several years in the past. As annual, seasonal and monthly reoccurrences have been reported in almost every MOH division in the district. The spatial pattern of dengue can be detected clearly in the divisional secretariat divisions (DSD). In all MOH areas of the Galle District comparatively. In addition to that, a higher prevalence of dengue cases have been reported during the SW monsoon season. In contrast, only a fewer number of dengue cases were reported during the North East monsoon season. The data exhibits a significant variations of spatial and temporal pattern of dengue incidence during the period 2004-2014. The high risk areas of dengue are also happened to be in the urban and suburban areas.

**Table 7: Seasonal pattern of dengue in the district 2004-2014.**

Year	May to Sep SW monsoon	%	Oct-April NE monsoon	%	Total
2004	194	72.0	74	26.0	268
2005	53	56.0	41	44.0	94
2006	69	26.0	199	74.0	268
2007	28	28.0	72	72.0	100
2008	46	42.5	62	57.5	108
2009	475	73.0	175	27.0	650
2010	730	65.6	382	34.4	1112
2011	574	71.0	240	29.0	814
2012	856	57.0	656	43.0	1513
2013	464	49.0	476	51.0	940
2014	586	48.0	638	52.0	1224

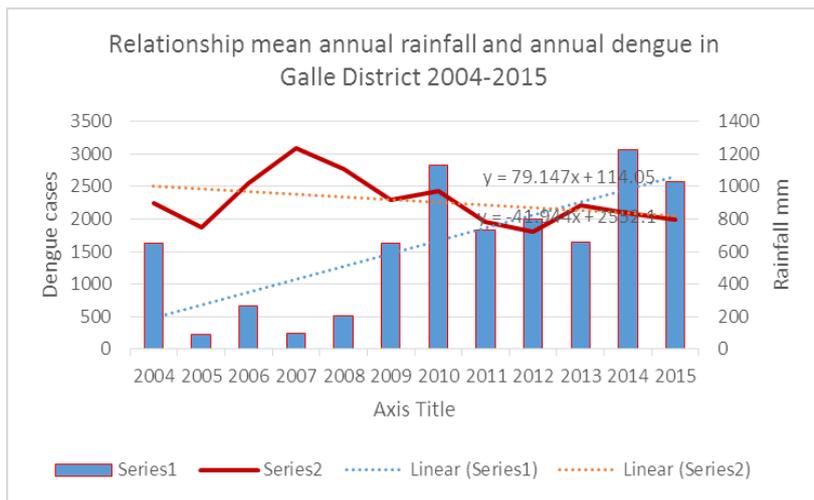
**Relationship between number of patients and mean annual rainfall**

To observe the factor simple regression analysis can be applied. See the table X is considered as patients. The aim of the analysis is to observe. How does it influence the changes of rainfall patterns to create changes in patient population. To find out the correlation between the above two factors it was drawn a regression line and coefficient spread sample.

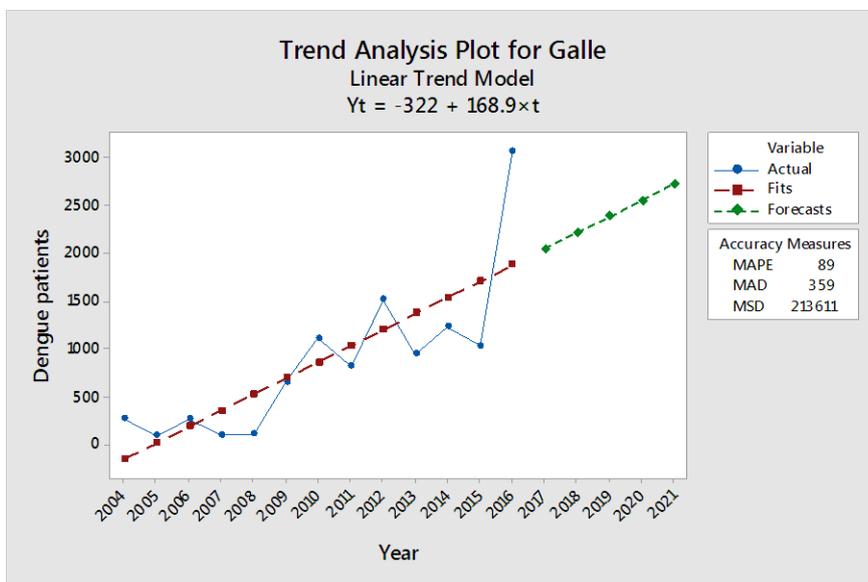
Simple regression analysis helps to understand the relationship between the rainfall and the number of patient

$Y=a+bx$

$Y= 69.72+0.0280X$



**Figure 4: Relationship between mean annual rainfall and the annual number of patient in Galle district 2004-2015.**



**Figure 5: Dengue trend in Galle district 2004-2021.**

According to the above figure axis X represent rainfall and Y represent number of patient. In November and December rainfall was recorded is 431.5 mm and 373.7mm. Consequently number of patient in have been decreased during the two months. At the same time in the month of May it was recorded a higher rate of dengue during the month June, July and August. The rainfall prevailed within the above period was around 200mm.

Spots identified too close to the regression line shows a close relationship between the rainfall and the patient capacity. Spots away from the regression line shows a negative relationship on the same. It was recorded high amount of patient after the month of May which experienced a heavy rain. Therefore obviously it reveals the relationship between the rainfall and the number of cases.

Pearson coefficient correlation was used to assess correlation. To analysis further it was calculated Pearson's Correlation Coefficient Formula as follow.

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

According to the Pearson's coefficient correlation close to +1 or -1 means, that there is an ascending or descending relationship between variable. The result of above calculation was =1.0. Thus reveals a close relationship between the rainfall and the dengue cases this relationship can be further defined as positive relationship.

## CONCLUSION

Analyzing performed in relation to the distribution of dengue epidemic within the Galle district during the period between 2004-2014, that revealed many factors. Sub urban areas including Galle district were critically affected by the dengue. It was evidenced a significant reduction of the distribution in the rural areas. But after 2010 rural areas too have been paralyzed by the dengue hazard. November and December rainfall was recorded 431.5 mm and 373.7 mm. Findings of the research confirms that the rainfall factor directly influences on spatial and temporal pattern of dengue epidemic. When the area is experienced a continues rainfall it shows a dramatic reduction of the disease. As a result number of patients have been decreased during the two months. At the same time in the month of May it was recorded a higher rate of dengue during the month June, July and August. The rainfall prevailed within the above period was around 200mm. In addition to the dengue, a higher prevalence of

dengue cases has been reported during the SW monsoon season. In contrast, only a fewer number of dengue cases were reported during the North East monsoon season. Human activities in the urban areas are also caused severely for the spread of the dengue epidemic. Dumping garbage blocking gutters are some of the root causes for the same. It was recorded that the majority of dengue patients were within the age group between 15-25. That means younger generation have been suffered a more severely.

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