

## EMERGING FACTORS DENGUE EPIDEMIC IN MATARA DISTRICT IN SRI LANKA

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### ABSTRACT

Dengue disease as a still prevailing main health issues in tropical and sub-tropical countries including Sri Lanka. A staggering number of 47000 cases with 78 deaths cases were recorded in 2016. Both natural and socio-economic factors have provided a conducive environment to conveyance of the disease. This study consists of two data components. Data collecting for this research is based on the primary and secondary data. Primary data were collected specifically for the research through a questionnaire, an interview, observations, and a case study. Primary data and information were gathered using a questionnaire with 75 patients and by in-depth interviews. However, the aim of this study is to analyze the geo-spatial pattern immersing factors of dengue epidemic in the Matara District. Correlation, regression analysis and the ARC GIS 10.1 techniques were used in the process to mapping and statistics analysis. There are two important trends related to dengue outbreak in the district and whole district seemed to be at the epidemic levels. The study area was selected because of the highest number of dengue cases recorded during the period from 1997-2014 and monthly cases from January 2011-December 2015. Urban areas seemed to be favourable for mosquitoes with a copiousness supply of plastic containers, discarded bottles, tins, tires, water coolers, house plants, air conditioners and places where rain water set stuck or stored providing the suitable mosquitoes breeding grounds. Matara district is an area with high population density expediency a development of transport system as well as a climatic change. Upon the observation of the distribution of annual dengue cases in 2015, spatial pattern of the district has played a major role. It is clear that the epidemic cannot be eradicated totally without proper community reaction, changes in attitudes and acquiring knowledge.

**KEYWORDS:** dengue epidemic, correlation, immerging factors, regression, urban areas.

## INTRODUCTION

Dengue epidemic has been in Sri Lanka since 1989 cases 203 with 20 deaths and the continuously sprung up in the 2016. The highest number of dengue cases have been reported 47,000 cases in 2016 with 78 deaths. Annual dengue incidence rates in Sri Lanka in 2016 were calculated from the number of annual confirmed dengue cases, divided by the total population year and they multiplied by 100,000. According annual rates of dengue case in Sri Lanka 234The disease has been continuously increased 2009-2016. Dengue is the most prevalent in the Southern region of the country. Currently, Matara Municipal Council is faced so many environmental health issues in the district, especially which is increased epidemic levels in dengue. Three District consist and can be identified as highly affected areas such as respectively, Galle, Matara and Hambantota. Among these most seriously affected district is Matara with the most outstanding features with 1835 in 2012.

## LITERATURE SURVEY

It is clear that the dengue epidemic has been a major health issue in Matara district during the last three decades (Edirisinghe, 2016) Dengue is an epidemic disease which spreads throughout the Island. There is a popular saying called health is wealth. Human factor of the country plays a vital role in the development process of the same. Therefore, it is essential to build a healthy nation. Health factor should be given priority when implementing development policies. It should be aimed at mitigating deadly epidemic diseases such as dengue. There is a popular saying called health is wealth. Human factor of the country plays a vital role in the development process of the same. Therefore, it is essential to build a healthy nation. Health factor should be given priority when implementing development policies. It should be aimed at mitigating deadly epidemic diseases such as dengue. As a result of that government has to spent large sum of money with the intention of eradicating dengue menace from the land forever. (Seng, et al., 2005) dengue hemorrhagic fever is more serious form of the diseases would be characterizes by bleeding, liver enlargement and failure of the circulatory system. Dengue fever the fundamentals Pakistan. (Wen, & Lin, 2012) studied population Movement and vector borne disease Transmission differentiating spatial and temporal diffusion pattern of commuting and non-comminuting dengue cases in Thailand. On the other hand it reduces the investments flowing towards the development process of the country (Edirisinghe, 2015). Climate factors such as rainfall, humidity and temperature have

been considered as stimulating factors of the disease, according to Canyon, 1992, John, et al., 2014 point out that tropical areas are potential high risk areas for mosquito-borne disease such as dengue and reveal that the internally acquired dengue outbreak in Northern Queensland in Australia. for mosquito-borne disease such as dengue and point out that the locally acquired dengue transmission in Northern Queensland, Australia. (Russell, et al.,2009) have contributed the several conditions that favour vector, density, distribution survival and longevity.(Beebe, et al.,2009) studied in Australia combination of flooding and heavy rainfall has resulted in dengue epidemics across Australia.

In Sri Lanka (Kanakarathna, et al., 2009) they point out dengue is hyper endemic in Sri Lanka with detected co-circulation of multiple serotypes. Dengue outbreaks are affected by biological, ecological, socio-economic and demographics factors that vary over time and space. According to that the spatial and temporal relationships between these factors dengue associated with mosquito breeding sites and habitats in the northern Sri Lanka. Similarly, studied with GIS used at the field of environmental health with location and spatially to detect disease cluster spatial distribution pattern. GIS technologies have the competence to integrate many types of data and to analyze spatial and temporal data to produce new models (Eisen,et al.,2011, Doncombe, J, et al 2012).

### **Study Area**

This study was carried in Municipal Council in Matara District, Southern province of Sri Lanka. It possesses a striking land containing about 1282.5 km<sup>2</sup>, or 128,250 hectares. Matara district falls in between 5.8-6.4 North latitude and 80.4-80.7 longitude. The district is divided into 16 administrative sub divisions. Each sub division is under a Divisional Secretariat. District is demarcated in North by the Rathnapura District, South by the Indian Ocean East by the Hambantota District, West by the Galle District. Length of the beautiful coast belt from Dickwella to Midigama in Matara district is 55 km. Mean width from east to west is 35 km. Fig 1 shows, the study area Matara district total land extend 1.96 belongs to Southern Province, it is 23.14% of land cover extend in Sri Lanka. When the situation of land of the district is considered land extent of about 10%- 20% are hilly areas between 300m-750 m.



No of dengue patients reported from Matara district were 748 case in 2015. Majority of patients were recorded from Matara divisional secretariat. The study mainly focused on the identification of families victimized by the disease and root causes for the same. There for this study aimed at the urban areas of Matara district such as Hittatiya West, Kotuwegoda, Welegoda and Matara Fort. The dengue epidemics had created in the urban sector and later crept into rural areas in the district. No proper medicine or vaccine or medicine have so far been found to treat dengue patients. There is a famous saying called “prevention is better than cure” destroying mosquitoes is the best way to be free of the disease.

## **OBJECTIVES**

The main objective of this study is to identify emergent factors of dengue epidemic in Matara district.

### **Specific objectives**

To identify the socio-economic status of the affected area

To identify the distribution pattern of the disease and to identify the risk areas

## **MATERIALS AND METHODS**

The main objective of this study to identify the emergence of dengue epidemic factors that contribute to the dengue out breaking using the Arc GIS 10.1. Generally gathered geo-spatial data can analyses through Arc GIS (Arc Map version 10.1) Data from all the dengue reported cases was geocoded using Matara MC, location from the address of the dengue patients. Primary assessment for geographical accuracy at the village level revealed sufficient information to study the spatial pattern of the disease, and allowed to use the patient address as the location of the dengue patient. For each year, dengue incidence with temporal pattern per year by gender (male and female) and the age groups was analyzed. Moreover, the gender and the age groups were also analyzed. Both annual dengue and rainfall from 1989-2015 and monthly dengue cases and rainfall data from 2010 -2015 was generated. Consequently, the temporal patterns of dengue incidence were analyzed. To investigate the close risk factors of logistic regression analyses, correlation, in addition, several statistics methods including flow charts and picto-graphs will also use when needed Specific objectives such as to correlated monthly dengue cases and rainfall 2004 -2016 in the district, and predicted potential risk areas for an outbreak.

## RESULTS AND DISCUSSIONS

Temporal pattern of the dengue epidemic in the area various number of dengue occurrence during the period 1989-2015. Annual occurrence rates for all MOH areas were calculated from number of annual established dengue cases, divided by the total population years and then multiplied by 10,000. These rates were expressed as annual confirmed dengue cases divided by total population \*10,000. The average annual occurrence at the district to define the inclusive trend of annual occurrences. There were used for together spatial association analysis and spatial statistics analysis. The temporal pattern of dengue related to gender wise.

### Gender wise occurrences dengue

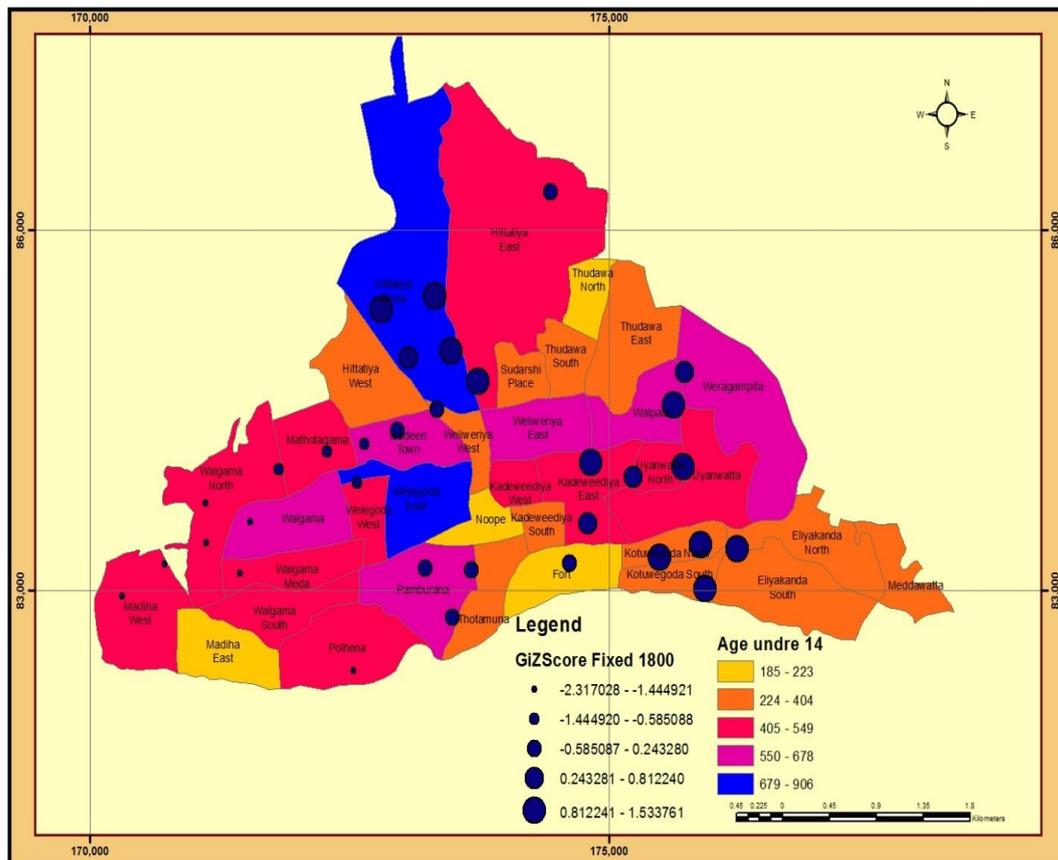
Gender wise differences in the temporal pattern clearly identified showing that more males than females being affected. Analyse of the collected data pertaining all the MOH exhibits that males are more susceptible to than female. As revealed in total 1,055 cases were reported, including 572 or 55% males and 470 or 45% female cases. During the highest dengue cases occurrence in year 2012, 187 males and 157 females cases were reported dengue patients. There were slightly more male patients (55%) than 45% female patients. Out of total number of dengue in 2014, 122, or 59% are males and 50 or 41% are females in the area. The reasons of the male population is victimized than that of females may be due to out-door working, moving during the day time.

### Age wise occurrences dengue

Dengue diseases temporal distribution based on age of the patients was also determined. The age distribution of dengue case observed was different from the general population age distribution in the area. The highest incidence was in the 11-30 years age group with a percentage 52% while incidence in the over the 61 years group was 2.7%. Most of the patients are youngsters within the age group 10-30 especially employees and students who expose themselves to the environment during the day time are vulnerable. Those over 60 years of age and those below age were very less amount reported cases in the area. As summarized in fig 2 the number of dengue cases in 2014.

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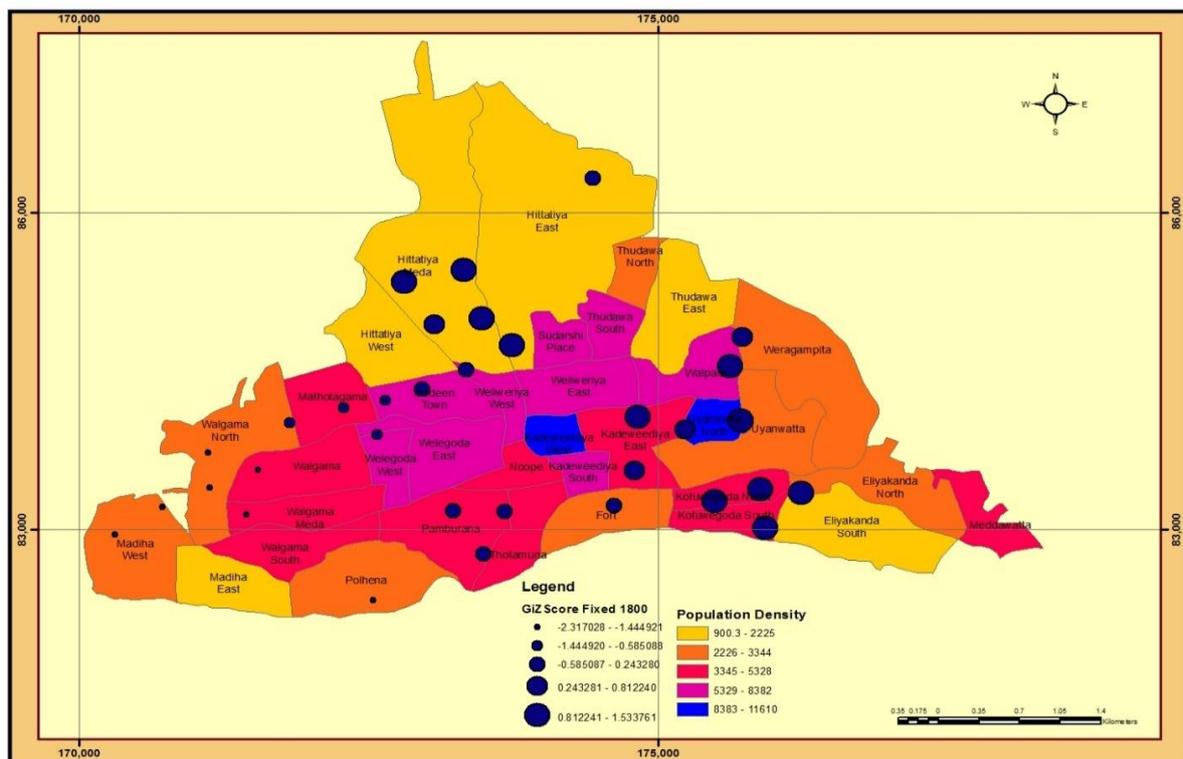


**Figure 2: Age wise dengue incidence in 2014.**

### Population density and dengue

The study revealed that there was a high trend spreading the dengue vectors especially during the rainy season. It was evidenced that the distribution of the disease was mainly caused by the environmental factors. Matara city which is administrated by MMC has a high population density, lack of a properly maintained drainage system has been identified as a major physical factor in the transmission of the disease rapidly. These areas are full of mosquitoes sites. Garbage dumping is a usual sight of these areas. Drainage systems are not properly maintained. Study revealed that the urban areas of the district have been suffered severely by the dengue epidemic due to the above factors (see Figure3).

Areas with settlement are at high risk for the dengue fever occurrences due to the probabilities of crowded town area. Therefore, higher population density and interconnection of houses could lead to more effective transmission of the virus and thus increased exposure to infection. The transmission of the disease is normally limited by the flying distance of *Aedes aegypti* during its lifetime. The flight distance of *Aedes aegypti* ranges from a few meters to more than 50 meters in a closed urban environment (Reiter P et al., 1995). Whereas in urban environment where interconnections are not very common, the independent nature of houses limits the flight range of *Aedes aegypti* and reduces the transmission of the disease.



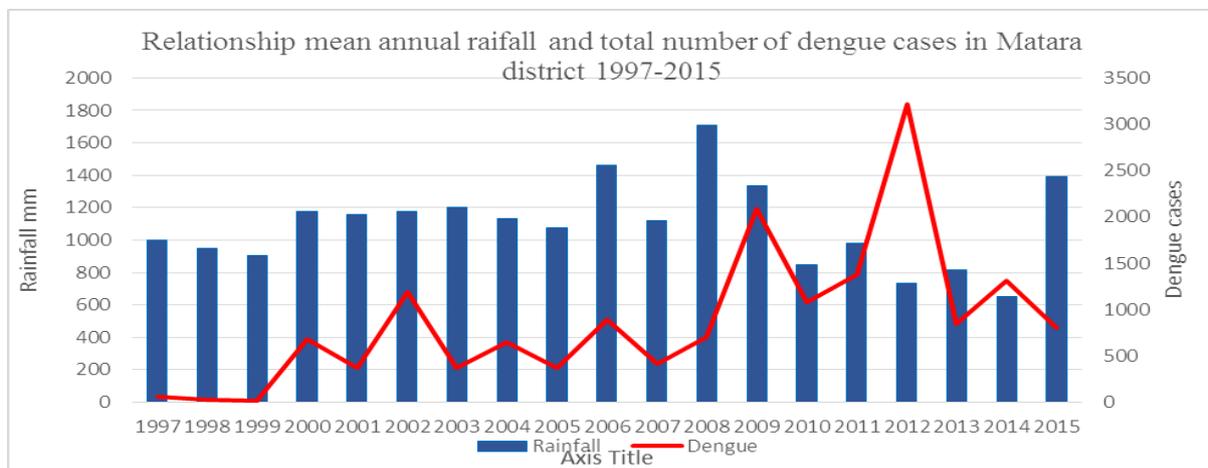
**Figure 3: Relationship between dengue and population density.**

### **Relationships mean annual rainfall and dengue**

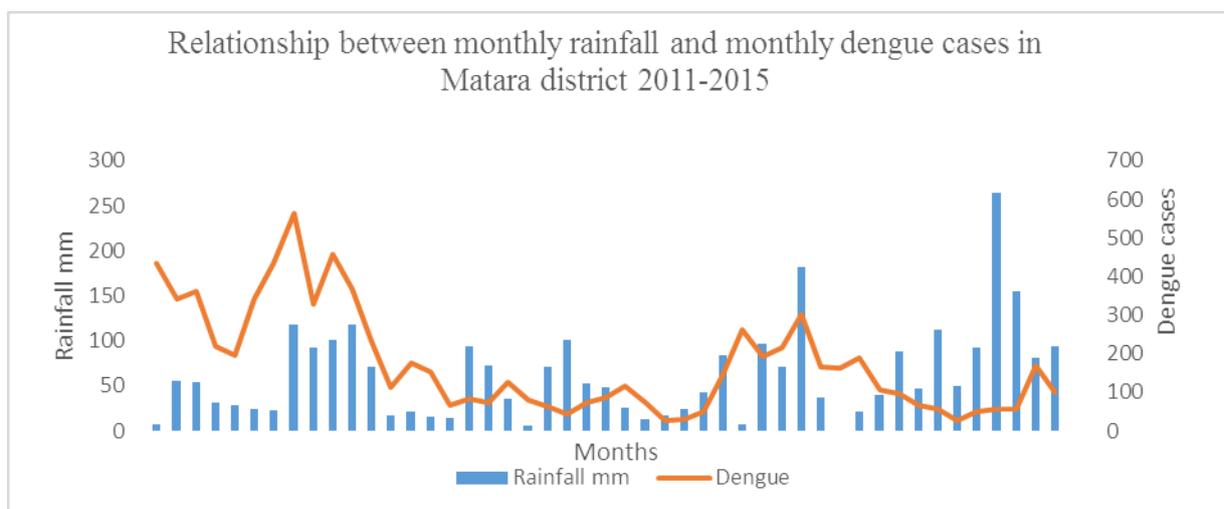
Temporal analysis to study relationship between annual rainfall and the occurrence of dengue both variables were further statistical correlated. Figure shows during the period 1989-2015 the result and accordingly the annual mean rainfall and the incidence of dengue are correlated slightly in negative relationship. The reason this is the annual rainfall behind the favor that spread of dengue.

The inter-annual variability of rainfall and the total number of dengue cases district 1997-2015 were also investigated for studying impact of rainfall on the occurrence of dengue. It

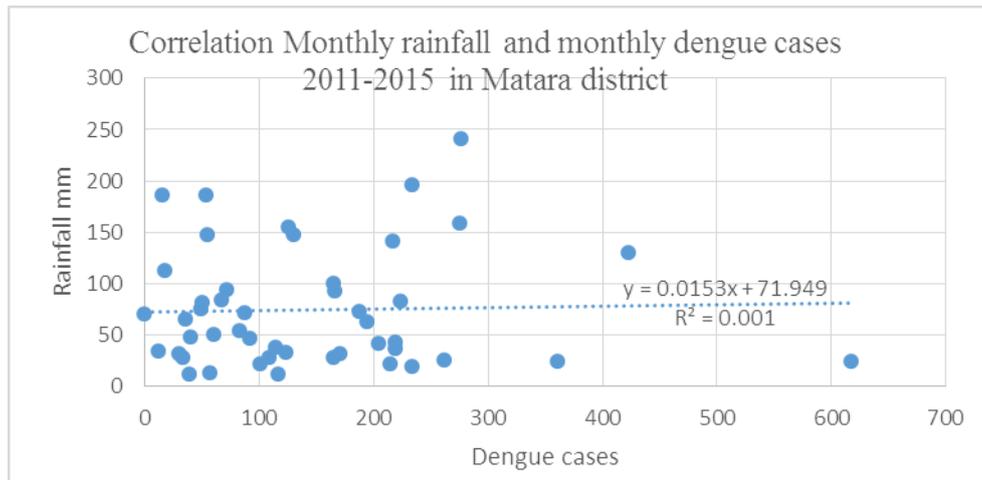
can be seen that annual rainfall totals vary to a great extent, without showing a corresponding variability of the number of dengue cases (see figure 4, 5, and 6). Annual rainfall in most of the study years in Matara district is between 1,280 and 2890 mm (20 years under study), but the number of cases also considerably vary for the respective years. Within the given range of rainfall occurs the most seriously dengue affected year (2009) and also the least affected year (1999). Therefore, annual rainfall totals does not show a direct relationship to the occurrence of dengue. Spatial analyses and statistics, such as spatial autocorrelation analysis, cluster analysis, temporal analysis, are commonly used to highlight spatial patterns of diseases and to test whether there is a pattern of disease incidence in a particular area (Brownstein et.al,2002). High Humidity during the rainy season enables the growth and existence of density mosquitoes (Barbizon, et al, 2010).



**Figure 4: Relationship mean annual rainfall and total number of dengue case in Matara district.**



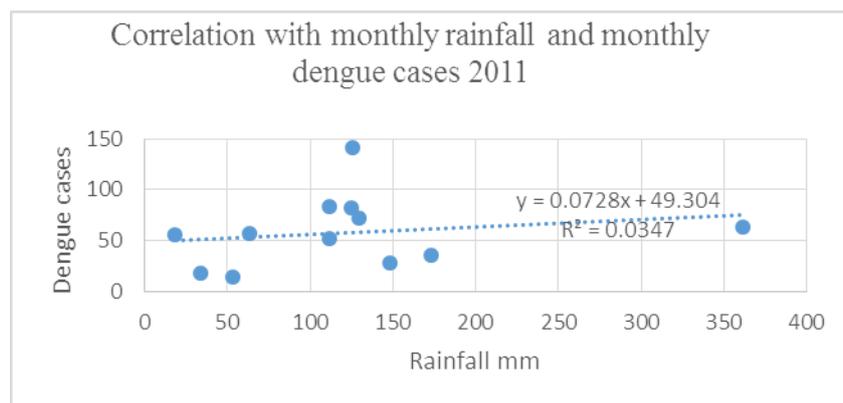
**Figure 5: Relationship between monthly rainfall and the occurrence of dengue.**



**Figure 6: Correlation between total monthly rainfall and dengue cases 2011-2015.**

### Relationship between monthly rainfall and dengue cases

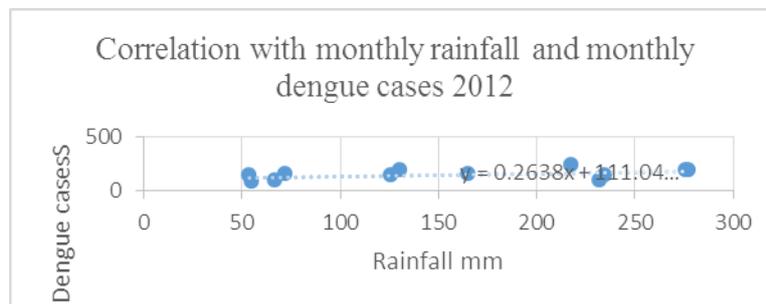
In 2011, the highest monthly rainfall was 362 mm in November and the lowest being 19 mm in June. The highest number of dengue cases recorded was in November 141 and the lowest as 14 in January. The range of rainfall was 19-362 mm and dengue cases range from 14-141. During the months from October to December and rainfall was in its maximum and the highest number of dengue cases has been recorded there. In the months from May to September rainfall was minimum and the number of recorded dengue cases also is minimum. The statistical treatment carried out to find the correlation between rainfall and number of dengue cases shows a positive relationship for the year 2011. (see figure 7).



**Figure 7: Correlation with monthly rainfall and dengue cases 2011.**

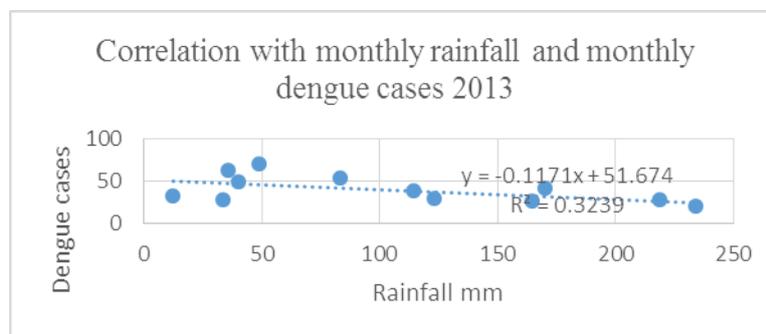
In 2012, the rainfall fluctuated from 15 to 276 mm and the number of cases ranged from 84-241. It is interesting to note here that many differences occurred in relation to monthly rainfall and the monthly number of dengue cases. The highest number of dengue cases was

276 recorded in August and the lowest was 84 in May. Accordingly, these two variables show a somewhat positive relationship.



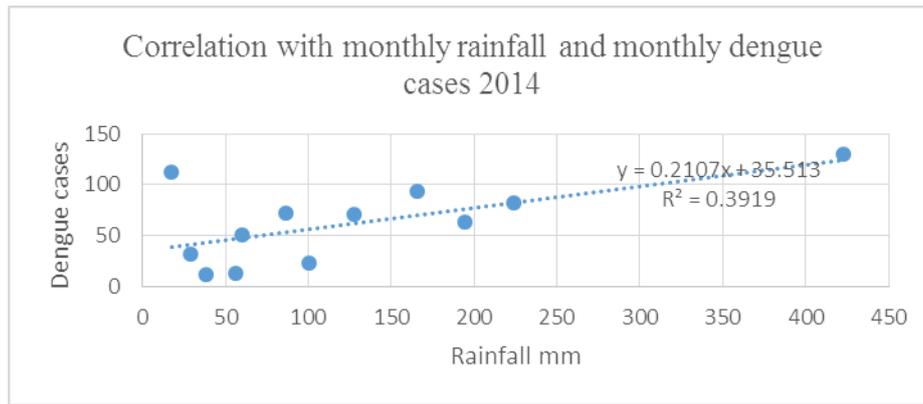
**Figure 8: Correlation with monthly rainfall and dengue cases 2012.**

However, a somewhat different conclusion can be made for 2013. According to the figure 9, when the highest monthly recorded rainfall was 234 and the lowest rainfall being 34 mm in April, the highest number of dengue cases amounting to 75 were recorded in February and the lowest 19 in October. These two variables show a very strong negative relationship. Monthly rainfall increases meaning dengue cases also have to decrease. In a similar pattern when monthly rainfall decreases number of dengue cases also decreases.



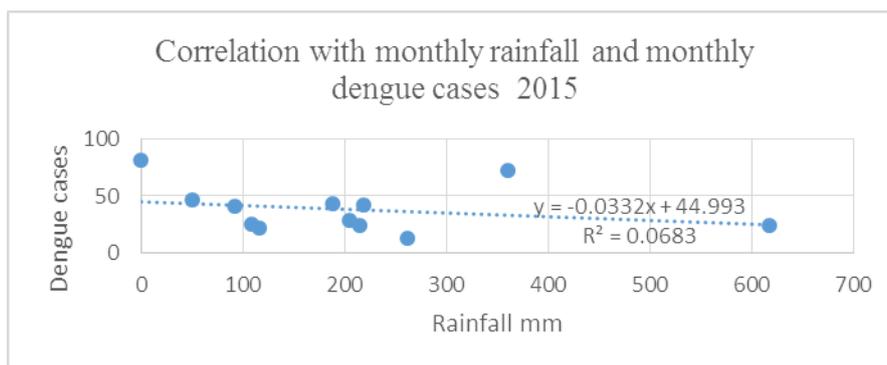
**Figure 9: Correlation with monthly rainfall and dengue cases 2013.**

In 2014, rainfall ranged from 39-423 mm and the number of cases varied from 11-130. The highest recorded dengue cases were 130 in November and the lowest 11 in March. The data exhibits that there is no negative but a strongly positive relationship between two variables. (See figure10).



**Figure 10: Correlation with monthly rainfall and dengue cases 2014.**

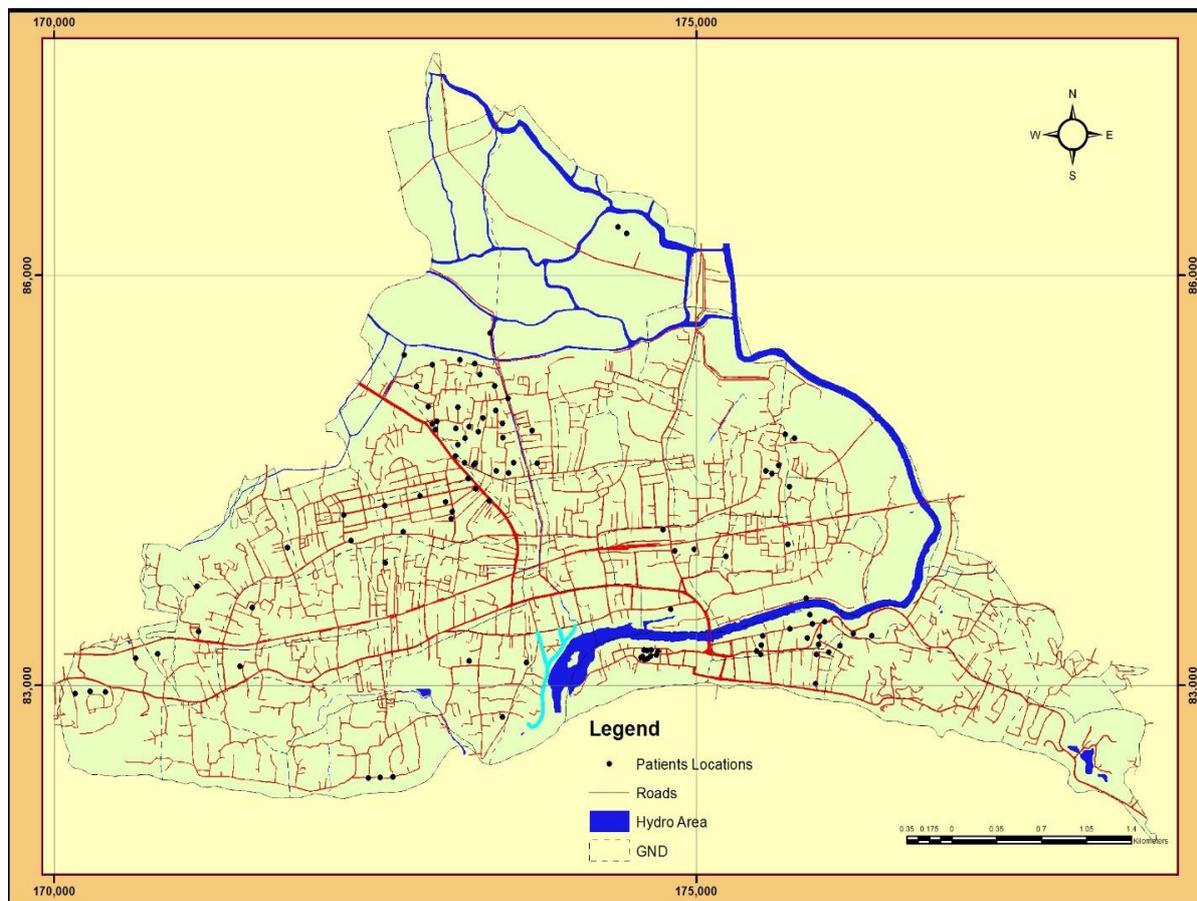
The highest recorded monthly rainfall of 617 mm were attributed to November and the lowest of 0 mm to January. The highest number of dengue cases was recorded in February 81 and the lowest number of cases, 12 in July. It can be identified (see figure11) that a strong negative relationship with monthly rainfall and number of dengue cases are there.



**Figure 11: Correlation with monthly rainfall and dengue cases 2015.**

This study found at providing useful information on dengue incidences and mapping their patterns and dynamics of diffusion. Spatial hotspot analysis proved to be a valued tool to analyses the spatial patterns change over period. Though this study used a good number of variables to investigate their influence on dengue transmission or incidence rate, there is still a greater need for more variables to be included to be able to make a comprehensive description of dengue fever outbreak. A dengue Transmission risk map therefore will also necessitate a multi-level approach of analysis in which different variables will be tested. It was not possible to acquire data for climatic factors and other valuable variables like incidence composition by age, sex, occupation, mobility and so on.

The field survey and the secondary data collected from MOH office revealed that both physical environmental factors and socio-economic factors have been impacted on spreading of dengue epidemic in the area. It was identified preventive measures and strategies to be adopted within the MMC limit through GIS analysis and the maps already prepared. This will help to control and mitigate the risk in the respective areas. This will facilitate the work of decision makers in health sector to plan the strategy for a preparedness plan to combat the emergence of the dengue disease and ensure safer living conditions to people without the fear of diseases.



**Figure 12: Water logging areas with dengue epidemic.**

Dengue fever incidence is mapped by depending on some of the environmental factors which contribute for the survival of *Aedes aegypti* mosquitoes. For the purpose of identifying areas of dengue fever susceptible to areas, this study focused on slope, land use, land cover pattern, rainfall distribution, drainage pattern and locations of the dengue (see figure12) fever occurrences as the factors of incidence in this study area. The occurrences and transmission of dengue fever requires the environment with lower elevation (higher temperature),

abundance of wet lands, occurrence of gentle slopes, availability of still waters around rivers, and areas of lower drainage density (Edirisinghe 2016).

GIS analyses reveals many factors are caused in spreading dengue epidemic both physical environmental and human involvements are identified. The average height of the land within Matara MC limit in below 100m mean sea level. It is clear that the water flowing pattern in such area is usually slow, due to the low level of the area. Even rain water remains in the area for a long time. This creates breeding places for mosquitoes. That means physical location of the area creates well atmosphere for mosquitoes.

## CONCLUSION

The study revealed that there was a high trend spreading the dengue vectors especially during the South West Monsoon season. It was evidenced that the distribution of the disease was mainly caused by the environmental factors. Matara city which is administrated by MMC has a high population density, lack of a properly maintained drainage system has been identified as a major physical factor in the transmission of the disease rapidly. The main natural drainage system which flows via Hittatiya releases its water to the Nilwala River. But due to the different circumstances water remains in certain areas. A proper flowing process could not be seen there because of garbage collection. Therefore, the researchers was compelled to name, Hittatiya West, Fort, Isadeen Town and Kotuwegoda GNDs such as dengue hotspot through GIS analysis. A healthy atmosphere has been created for the vector mosquitos by the rainfall pattern of the area. Dengue occurrence is mapped depending on following factors such land cover drainage pattern and rainfall distribution. They are the factors which contribute for the creation of ideal habitats for dengue mosquitoes. There were many habitats for vector mosquitoes within the city limit. There were large buildings houses shops and garages. These areas were identified as hotspots. Business premises of the areas usually release waste items such as polythien products plastic container and yogurt cups into the atmosphere. The study reveal a significant clustering pattern. Spatial relationship between the occurrences of dengue with the environmental factors that were associated with A the breeding of mosquitos. They can be classified into three risky areas. It is essential to pay the attention towards hotspots area and the interference of the respective parties such as government and relevant authorities.

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