Trend of dengue cases in Sri Lanka: An empirical investigation in Doluwa MOH area in Kandy district.

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Introduction:

Dengue fever is an infectious tropical disease caused by the dengue virus. It is transmitted by several species of mosquitoes that breed under different climatic situations (Subsequent infection with a different type increases the risk of severe complications). As there is no commercially available vaccine, prevention is sought by reducing the habitat thus resulting a decrease in the number of mosquitoes and limiting exposure to bites. According to the WHO report (2012) approximately 2.5 billion people, two fifths of the world's population is now at risk of dengue and estimates that there may be 50 million cases of dengue infection worldwide every year. The disease is now endemic in more than 100 countries.

The cases of dengue related diseases have dramatically increased in Sri Lanka over the last few decades, and also there was an explosive increase in geographic distribution of dengue after 1950s in the country. Reasons such as uncontrolled urbanization, rapid population movement, inadequate water, bad waste management as well as unsustainable vector control programs have already been identified. However, it is believed that climatic change affects the transmission of dengue as mosquitoes reproduce more quickly and bite more frequently at higher temperatures. Sri Lanka has geographic and climatic features that are conducive for the propagation of vectors of dengue fever and its epidemics. Limited researches have been done to estimate the cost in prevention and treatment for dengue in Sri Lanka and there is no research done to estimate the cost in prevention and treatment dengue in Kandy district. Estimation of the costs of dengue has many dimensions which include information on the economic benefits of dengue control, prevention intervention and information on cost-effectiveness and budget impact analysis.

Research objectives

Sri Lanka is classified as a "Category A" country by W.H.O. which means dengue fever is a leading cause of hospitalization and death among children. The year 2002 recorded the largest outbreak with 8931 cases and 64 deaths where government was forced to pay full attention to the issue. The following year, 2003 was one of the relatively low endemic with only 4,749 suspected cases and 32 deaths reported. However, in year, 2004 there were 15463 suspected cases and 88 deaths reported to the Epidemiological Unit of the Ministry of Health. In the second half of the year, 2009 Sri Lanka experienced the most alarming situation ever by having 349 deaths, while having around 22 000 infected patients. This trend has increased drastically and by 2012 around 45000 cases were reported in the country. Approximately 49.30% of dengue cases were reported from the Western province. This situation warrants regular removal of possible mosquito breeding sites from the environment. When Sri Lanka is compared with the regional situation it is now similar to the situation of Indonesia, Bhutan and India. Prevailing climatic condition, environmental pollution, rapid urbanization, overcrowding of cities and careless human practices provide for the rapid breeding of mosquitoes and spreading of the disease. The overall goal of this study is to investigate the trend of dengue cases in Sri Lanka and measure the cost of prevention of dengue fever in Doluwa MOH area.

Accordingly, the objectives of this study are:

(1).To analyse the trend of dengue cases in Sri Lanka

(2).To measure the cost of dengue control activation implemented by Doluwa M.O.H team

(3).To measure the cost of treatment for dengue in Doluwa M.O.H area

This study will investigate these issues by using secondary data covering all GS divisions in Doluwa M.O.H. area in Kandy district.

Literature Review

A number of studies have been already undertaken to investigate various aspects of the link between climatic change, the spread of dengue fever and cost of prevention and treat dengue in different countries Climate is an important determinant for temporal and

spatial distribution of dengue fever vector and its pathogen (Kovats et al. 2001; Lafferty, 2009).

The structure and functions of dengue control and curative programs were thoroughly revived and various cost elements were enumerated. Then cost elements were examined to identify variables and fixed costs pertaining to each activity within each element. Health cost of dengue prevention activities in Colombo district reached a total of LKR 127 million. Of them 79% were spent on staff remunerations, 15% were spent on fuel and insecticides used in fumigations. Per capita cost of dengue control was around LKR 55.10 (Thalagala 2012).

Arbolela et al. 2009 did the study at Colombia. DF is endemic in Medellin city and surrounding municipalities. They used DF cases and satellited environmental data to investigate conditions associated with suitable areas for DF occurrence in 2008 in three municipalities (Bello, Medellin and Itagui). They conducted that Bello and Medellin present ecological conditions somewhat different from and more suitable for DF than those of Itagui. They suggest that areas predicted by their modelling can be suitable for DF that could be considered as at-risk and could be used as guide campaigns for DF prevention in these municipalities.

Dunombe et al. 2012 did a review which provides details on the role of Geographical Information Systems (GIS) in current dengue surveillance systems and focuses on the application of open asses GIS technology to emphasize its importance in developing countries where the Dengue burden is in the greatest.

The above review of the previous studies shows that most studies have considered the different aspects on spreading of dengue in different countries, making GIS maps and estimates the cost for dengue. However, these studies have only provided limited information on these links. Accordingly, it is obvious that more conceptual and theoretical work is needed to develop a better understanding of this relationship. This study will fill this void in the literature.

Methodology

Theoretical ideas underlying the study

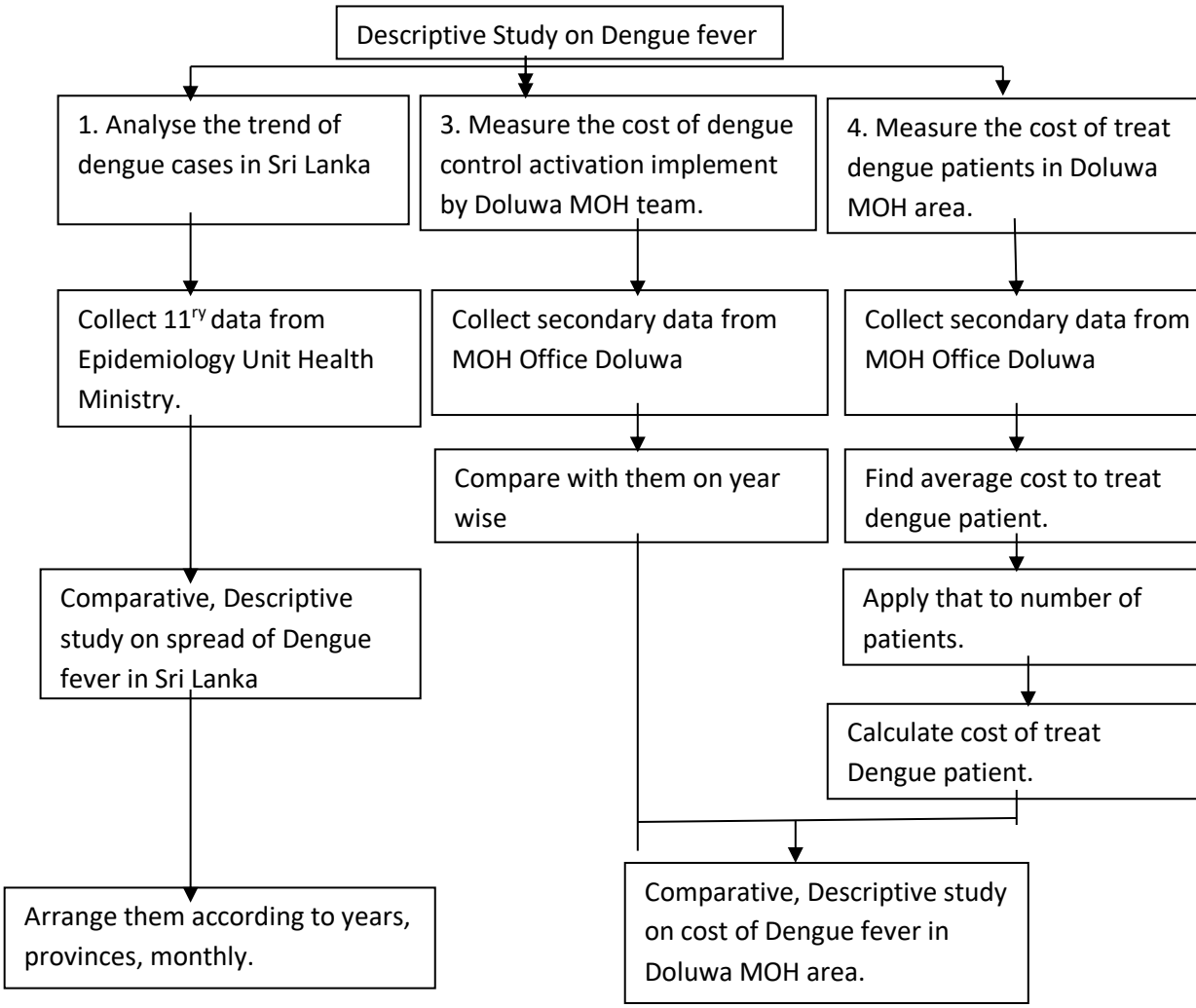
Health economics is a branch of economics concerned with issues related to efficiency, effectiveness, value and behavior in the production and consumption of health and health care. Arrow (1963) was the first who drew conceptual distinctions between health and other goods. Factors that distinguish health economics from other areas include extensive government intervention, intractable uncertainty in several dimensions, asymmetric information, barriers to entry, externalities and the presence of a third-party agent. In healthcare, the third-party agent is the physician, who makes purchasing decisions (e.g., whether to order a lab test, prescribe a medication, perform a surgery, etc.) while being insulated from the price of the product or service. Health economists evaluate multiple types of financial information: costs, charges and expenditures. Uncertainty is intrinsic to health, both in patient outcomes and financial concerns. The knowledge gap that exists between a physician and a patient creates a situation of distinct advantage for the physician, which is called *asymmetric information*. Externalities arise frequently when considering health and health care, notably in the context of infectious disease. For example, making an effort to avoid catching the common cold or diseases such as dengue that affect people other than the decision maker.

Grossman (1972) was concerned with how individuals allocate their resources to produce health. The model goes beyond traditional demand analysis and has been extremely influential in health economics. It utilizes the idea of the individual as a producer of health (not simply a consumer) by removing the artificial separation of consumption and production. It also introduces the idea of investing in human capital (health and education) to improve outcomes in both the market (work) and non-market (household) sectors. The demand for 6

health care is a derived demand from the demand for health. Health care is demanded as a means for consumers to achieve a larger stock of "health capital." The demand for health is unlike most other goods because individuals allocate resources in order to both consume and produce health.

Following Becker (1965), Grossman (1972), Becker and Lewis (1973), Willis (1973), Becker (1981), Lleras-Muney (2002), this study is based on the theoretical framework on a model of family decision-making in which the utility function of the household depends on their own consumption (standard of living) and the well-being of each member of the household. In turn, well-being depends on health and cognitive development outcomes. These outcomes are produced with inputs of goods and services purchased in the market (for example, medical care services in the case of health and books and other types of educational material in the case of cognitive development) and with the their own time. There also may be production functions for items that determine the households' living standard. Maximization of the utility function subject to production and resource constraints yields demand functions for health and cognitive development outcomes. These demand functions depend on income or wealth, input prices, efficiency in production, tastes including time preference, and heritable endowments of health and cognitive development.

Basic framework that is used to collect and analyse the data is summarised from the following chart.



Secondary data as well as primary data will be used for the analysis. It was used secondary data covering all GN divisions in Doluwa M.O.H. area of dengue related diseases in Sri Lanka.

This study will use secondary data for the analysis. The basic techniques that were to be used for analyzing data is summarized in the following table.

Research objectives	Techniques
Analyse the trend of dengue cases in Sri Lanka.	Descriptive method
Measure the cost of dengue control activation implemented by Doluwa M.O.H team	Descriptive method
Measure the cost of treat patients on dengue in Doluwa M.O.H area	Descriptive method

Results and Discussion

In the analysis first, the trend of dengue cases in the country was investigated and it is reported in Table 1. It is clear that in the years from 2011 to 2012 the cases have increased up to 56.15%. However, in the years from 2012 to 2013 it has decreased to 27.88%. In years 2013 to 2014 the figures shows that it has increased up to 48.15% again and in years 2014 to 2015 it has decreased to 37.31%. In the last two years, 2015 to August 2016, it shows an incensement of 26.28 %.But in 2017 up to July highest cases reported in Sri Lanka. In general, when considering the total percentages it's shown that the dengue cases have increased throughout the years.

Table 2 shows the number of provincial wise dengue cases. We can study the cases further based on the provinces. Here the highest average number in period between 2011 and 2017 is from the Western province which is 25400, while the lowest is from the North Central province which is 1201 for the same period. North western and Sabaragamuwa have the next highest average as 4304 and 5151. Among them Sabaragamuwa is higher. Central and Southern provinces (4113 and 4021) show a rise of dengue cases relatively lower than North western and Sabaragamuwa but higher than of North Central, Northern (2369), Eastern (3383) and Uva (1459),.

According to the Table 3, the highest average of dengue cases reports in July 9527 of average precisely. The lowest average is shown in the month of September which is 2430. The months: January, May, June, and December shows high number of average relatively to February, March, April, August, October and November. Among them June has the highest average of 7129 while October has the lowest 2582. Other months average number of Dengue cases as follows: January: 5134, December: 4605, May: 4484,

March: 3797, August: 3526, April: 3461, November: 3220 and February: 2765.

Table 4 shows the cost for dengue prevention in Doluwa MOH area. In year 2011 Doluwa MOH office spent 5000 LKR for dengue prevention activities. It is the lowest amount reported in these years. The highest expense was in the year of 2014 which amounted up to 122,000 LKR. On the following year of 2015 the cost has reduced drastically down to only 20,000 LKR. However in 2016, it has again increased up to 100000 LKR. In 2017 spend 40,000 LKR (January to July).

Table 5 gives the information of the main costing elements in treatment of dengue patients. Further it was estimated the cost of dengue treatment for the patients who suffered from dengue in Doluwa MOH area which shows in Table 6. In year 2012 the cost for treat dengue patients in Doluwa MOH area was 259,584 LKR. This remains the lowest cost reported between, 2011-2016. The number of total dengue cases reported in that year was only 20. It is also the lowest number of cases in this time period. The highest cost for dengue treatment was in 2017 up to July which cost up to1707295 LKR. It also has the highest number of reported cases with the number of 115.

Conclusion and Policy recommendation:

The results of this analysis show that during the last few years, suspected dengue cases have been increasing in Sri Lanka. Interestingly more than 50% of dengue cases were reported from the Western province. Simultaneously, the cost of treatment and prevention is also increasing. This situation shows the important of regular removal of possible mosquito breeding sites from the environment. It is also important to seek medical attention in the event of fever by day three of the illness and make awareness program in high risk areas in the country. Prevention programmes will continue with the assistance of public health officers, police and military personnel. Not only residences but also the offices both public and private will be thoroughly inspected and legal actions would be taken against offenders. This type of policy measures can reduce the reported dengue cases in Sri Lanka in the future.

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Annexes:

Table 1: Spread of dengue in Sri Lanka

Year	Number of dengue cases
2011	28473
2012	44461
2013	32063
2014	47502
2015	29777
2016	55150
2017(Jan. To July)	122384

Source: Epidemiology unit Ministry of Health

Table 2: Number of dengue cases in provincial wise

Province	Cases of dengue						
	2011	2012	2013	2014	2015	2016	2017(Jan. to July)
Western	15913	20814	16540	26153	15582	27442	55354
Central	2252	3455	2530	3299	1906	5632	9715
Southern	2090	3952	1771	2637	1887	5370	10443
Northern	666	1319	1161	2564	2552	3236	5087
Eastern	2154	1442	1509	2306	2666	2355	11252
North-western	1611	5337	3696	3380	1992	3602	10513
North Central	603	782	1077	1190	651	1210	2892
Sabaragamuwa	2240	6643	2966	4547	1752	4645	13260
Uva	944	717	813	1426	789	1660	3865

Source: Epidemiology unit Ministry of Health

Table 3: Cases of dengue in months in Sri Lanka

Month	Cases of dengue						
	2011	2012	2013	2014	2015	2016	2017
January	933	3986	3462	3610	6345	6674	10927
February	1052	3145	3258	2011	3731	4439	8722
March	1118	2628	2996	1648	1962	2696	13539
April	1771	2028	2109	1682	1293	2830	12512
May	1967	2550	2614	4292	1625	2412	15927
June	3471	5955	2427	6736	1477	4730	25106
July	4817	5193	2924	5721	2125	10259	35651
August	2106	5266	3282	4022	1604	4873	
September	2445	2857	1912	2640	1099	3629	
October	2127	3181	1636	4297	2066	2185	
November	2203	4034	2611	5452	2762	2257	
December	4463	3638	2832	5391	3688	7677	

Source: Epidemiology unit Ministry of Health

Table4: Cost for dengue prevention in Doluwa MOH area.

Year	Expenses LKR
2011	5000.00
2012	21375.00
2013	61250.00
2014	122000.00
2015	20000.00
2016	100000.00
2017(Jan. to July)	40000.00

Source: MOH office Doluwa

Table5: The main costing elements in treatment of dengue patients are:

Patient type	Diagnosis	Place of treat	Average cost LKR
Paediatric	Dengue fever	Ward	6717
Paediatric	Dengue Hemorregic fever	Ward	16985
Paediatric	Dengue fever	ICU	10378
Paediatric	Dengue Hemorregic fever	ICU	58179
Adult	Dengue fever	Ward	4210
Adult	Dengue Hemorregic fever	Ward	11965
Adult	Dengue fever	ICU	43256
Adult	Dengue Hemorregic fever	ICU	91902

Source: Thalagala,N. 2013. Dengue tool Surveillance Project, Epidemiology unit Ministry of Health

Table 6: Cost for treat dengue in Doluwa MOH area.

Year	Total cases	Adult patient				Paediatric patient				Cost for treatment LKR
		Dengue fever		Dengue Hemorregic fever		Dengue fever		Dengue Hemorregic fever		
		Ward	ICU	Ward	ICU	Ward	ICU	Ward	ICU	
2011	46	40	00	00	05	01	00	00	00	634627
2012	20	18	00	00	02	00	00	00	00	259584
2013	25	22	00	00	03	00	00	00	00	368326
2014	30	27	00	00	02	01	00	00	00	304191
2015	31	28	00	00	03	00	00	00	00	393586
2016	50	42	00	00	05	03	00	00	00	656481
2017 (Jan. to July)	115	80	00	05	10	15	00	00	05	1707295

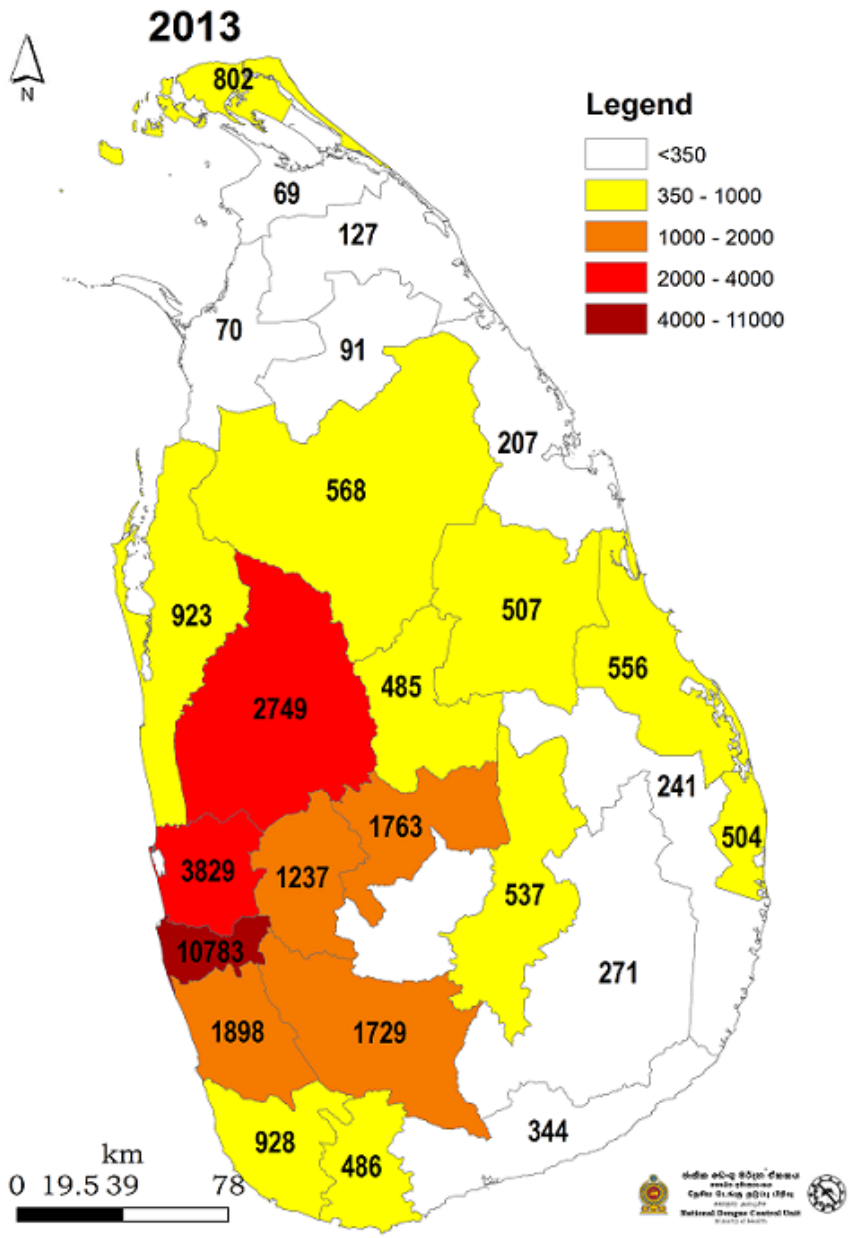
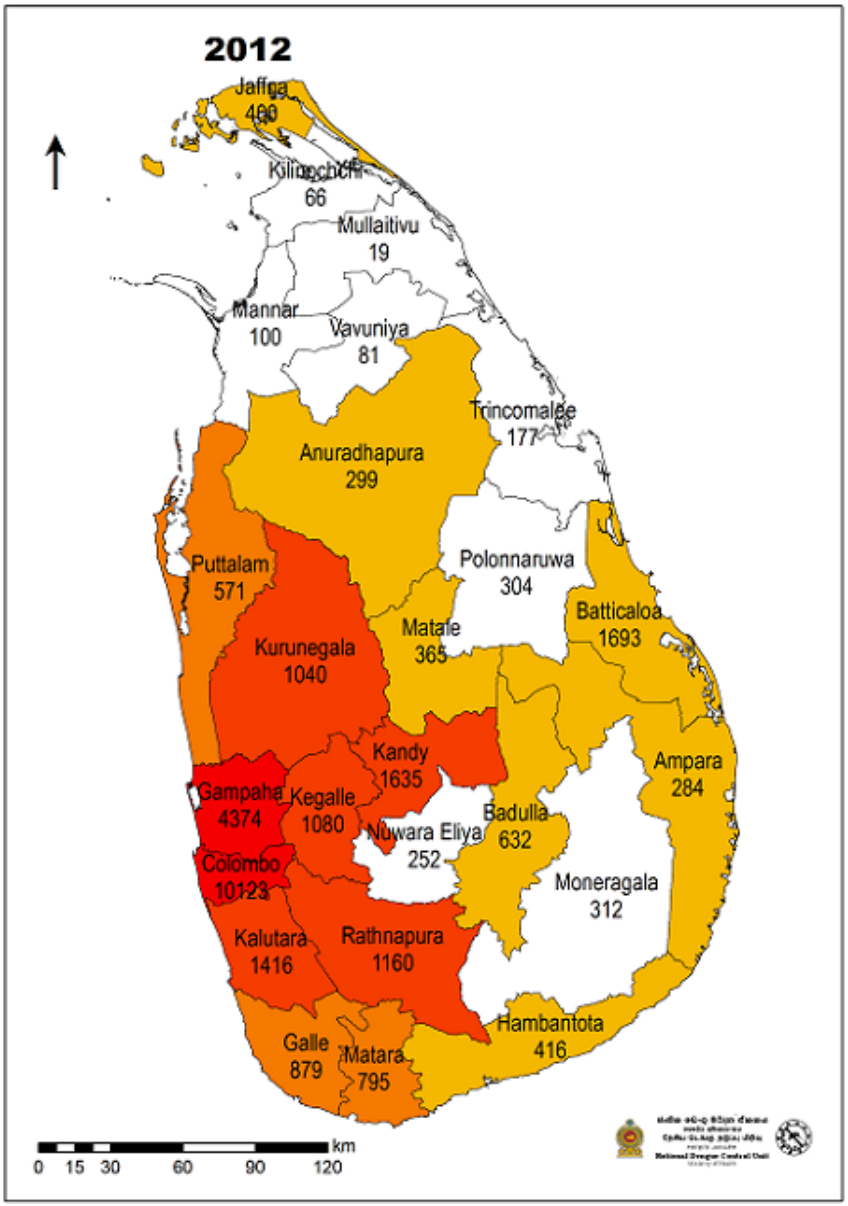


Figure 1:Number of Dengue cases reported in Sri Lanka- 2013

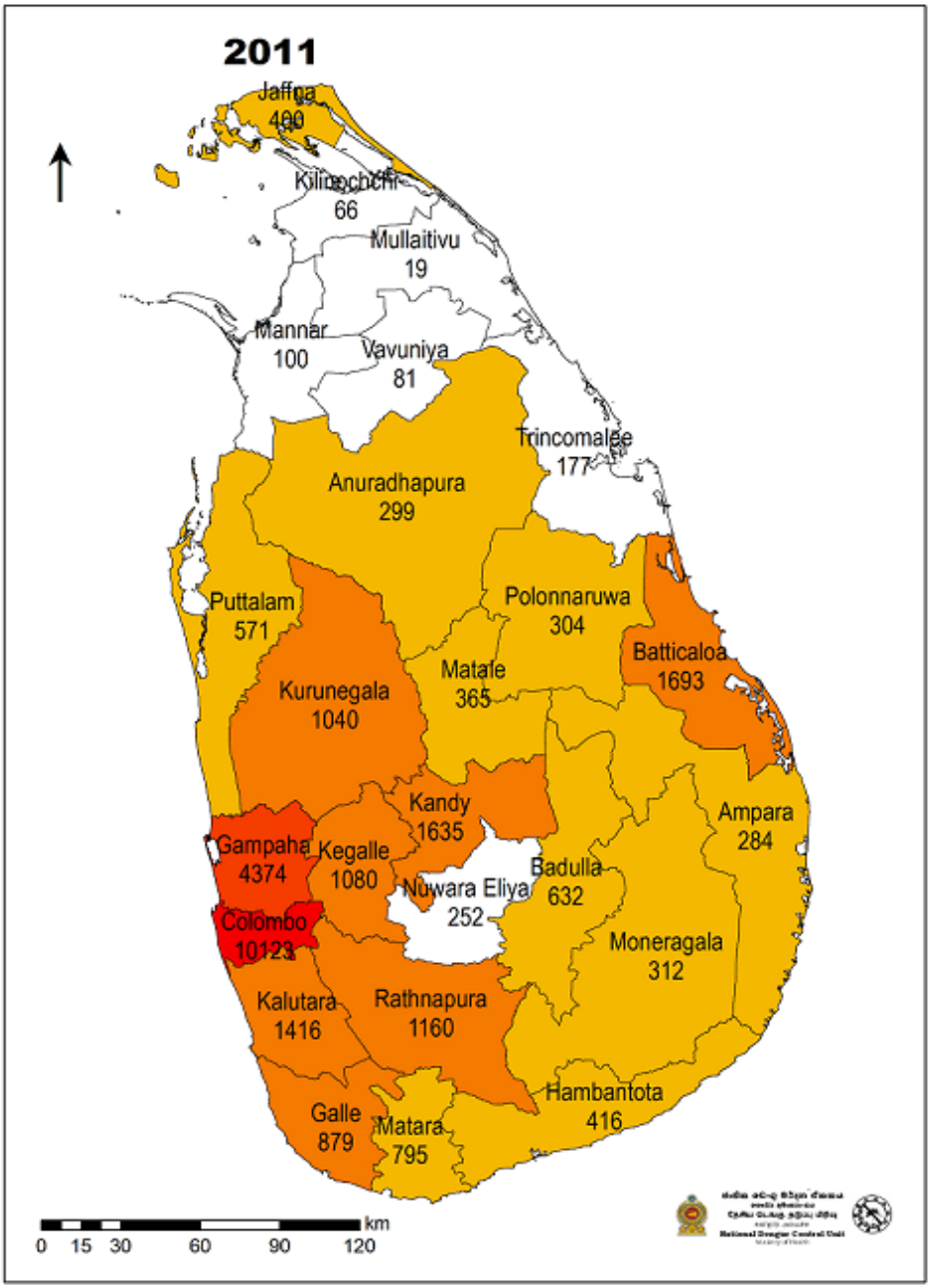
Source: National Dengue Control Unit

Figure 2:Number of Dengue cases reported in Sri Lanka- 2012



Source: National Dengue Control Unit

Figure 3:Number of Dengue cases reported in Sri Lanka- 2011



Source: National Dengue Control Unit

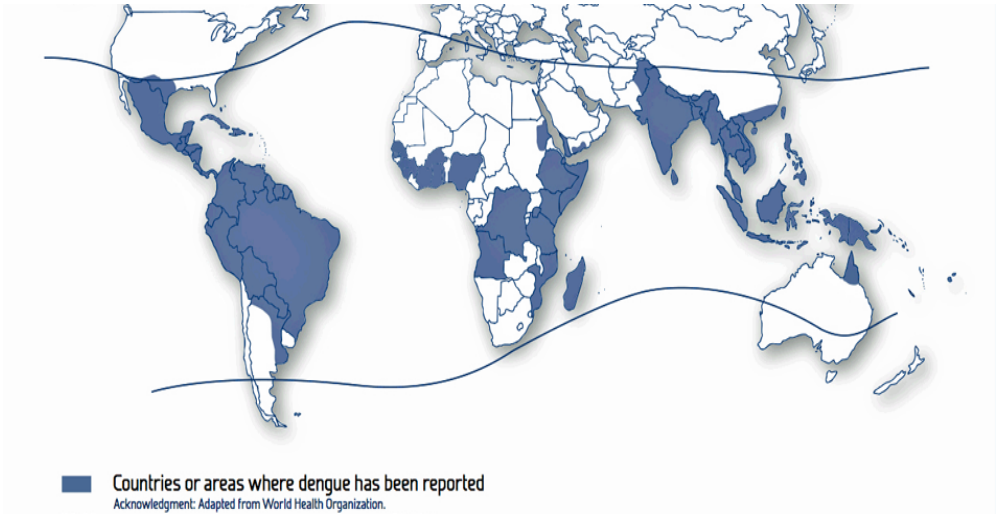


Figure 4: Dengue Reported Countries

Source: National Dengue Control Unit