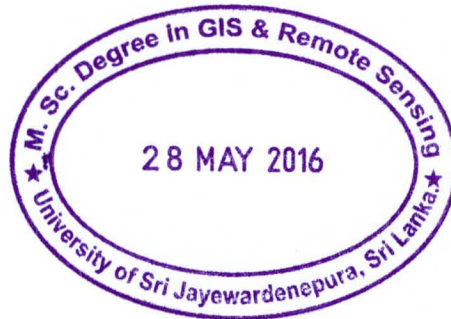


**Geographical Patterns of Road Safety in
Northern Provinces of Sri Lanka
with Special Reference to
Jaffna, Kilinochchi, Mannar and
Mullaitivu Administrative Districts**

J.A. Wijayanayaka Hewavitharana

5998MD2014054



M.Sc.

2016

**Geographical Patterns of Road Safety in
Northern Provinces of Sri Lanka
with Special Reference to
Jaffna, Kilinochchi, Mannar and
Mullaitivu Administrative Districts**

By

J.A. Wijayanayaka Hewavitharana

**Thesis submitted to the Faculty of Graduate Studies
University of Sri Jayewardenepura for the Partial
Fulfillment of Master's of Science Degree in
GIS and Remote Sensing on 20th March 2016**

DECLARATION OF THE CANDIDATE

I do hereby declare that work described in this thesis was carried out by me under the supervision of Dr. Shirantha Heenkenda and Dr. Ranjith Premasiri, report on this thesis has not been submitted in whole or in part to any University or any other institution for another Degree/Diploma.

Date 30/03/2016



J.A. Wijayanayaka Hewavitharana,
No 3/2,
Police Officer's Quarters,
Sir Baron Jayathilaka Place,
Maligawatta,
Colombo - 10.

ACKNOWLEDGEMENTS

My sincere and profound gratitude go to Prof.C.K.M.Deheragoda who initiated the M.Sc. in Geographic Information System and Remote Sensing, University of Sri Jayewardenepura and Dean of the Graduate Faculty, Chairmen and members of the multi-disciplinary board, the Head of the Department Prof. Sunethra Thennakoon and the Coordinator Prof. R.M.K Ratnayake who remain in my memories for their contribution to make my endeavor a success.

I wish to express my deep appreciation and gratitude to Dr. Shirantha Heenkenda and Dr. Ranjith Premasiri as supervisors, for their guidance, constant encouragement and support to complete the thesis. Without the help of these two scholars, this output would not have emerged in this present form.

I am also grateful to Sri Lanka Police Department gave this valuable opportunity to develop my higher education qualification and also to Inspector General of Police Mr. Pujith Jayasundara (former In charge of Northern Province), DIG Police Welfare Range Mr. V. Indran and all other officers in the relevant institutions who gave me a support for the study in different aspects.

Last, but not least, I would mention that my studies involved great inconveniences to my wife Priyangika Chandani, Three children Ahaswin, Vinul and Budvin. I thank them all for their help since without their support this study could not have been completed.

J.A. Wijayanayaka Hewavithrana

20th March 2016

Chapter Structure

Declaration of Candidate	i
Acknowledgements	ii
Chapter Structure	iii - iv
List of Tables	v
List of Figures	vi - vii
Abstract	viii
Chapter One – Introduction	1 - 11
1.1 Introduction	1 - 4
1.2 Problem of the Study	5 - 7
1.3 Significance of the Study	8 - 10
1.4 Objectives of the Study	11
Chapter Two - Geographic Information System Analysis of Road Ethnic and Road Safety	12 - 23
2.1 Road Ethnic and Road Safety	12 - 18
2.2 The Uses of Geographic Information System to Enhance Road Safety	18 - 20
2.3 A GIS and Spatial Technology Application of Road Safety in Developing Countries	21 - 23
Chapter Three – Methodology	24 - 35
3.1 Background of the Study Area	24 - 32
3.2 Data Source and Collection	33 - 34

3.3	Analytical Methods	34 - 35
Chapter Four - Geographical Pattern in Road Safety		36 - 84
4.1	Distribution patterns of Road Accident	36 - 82
4.2	Traffic Accidents in Junctions	83 - 83
4.3	Collision Type	84 - 84
Chapter Five - Conclusions and Recommendations		85 - 89
5.1	Conclusions	85 - 86
5.2	Recommendations	86 - 87
References		88- 89
Appendixes		i - x

List of Tables

2.1	Main Hazard Factors which Contribute to Accidents	17 - 18
3.1	Statistical Information of the Study Area	24 - 25
3.2	Distribution Pattern of Road Network in Jaffna, Kilinochchi, Mannar and Mullaitivu Administrative Districts	28
3.3	Distribution Pattern of Road Network in Jaffna District	29
3.4	Distribution Pattern of Road Network in Kilinochchi District	30
3.5	Distribution Patterns of Road Network in Mannar District	31
3.6	Distribution Patterns of Road Network in Mullaitivu District	32
4.1	Total Values for injuries and deaths recorded in the years under review	36
4.2	Details of Near Distance between Hospitals & Accidents Places by using "Near-by" Tool in Arc.GIS 10.2 in Jaffna District	46 - 47
4.3	Details of Near Distance between Hospitals & Accidents Places by using "Near-by" Tool in Arc.GIS 10.2 in Kilinochchi District	58 - 59
4.4	Details of Near Distance between Hospitals & Accidents Places by using "Near-by" Tool in Arc.GIS 10.2 in Mannar District	70 - 71
4.5	Details of Near Distance between Hospitals & Accidents Places by using "Near-by" Tool in Arc.GIS 10.2 in Mullaitivu District	81 - 82

List of Figures

1.1	Motor Traffic Accidents Reported in Sri Lanka since 2005 to 2014	3
1.2	No. of Accidents Reported in Sri Lanka since 2005 to 2014	3
1.3	Motor Traffic Accidents reported in Jaffna, Kilinochchi, Mannar & Trincomalee Police Divisions since 2005 to 2014	6
1.4	Motor Traffic Accidents reported in Jaffna, Kilinochchi, Mannar & Trincomalee Police Divisions since 2005 to 2014	7
3.1	Study Area	27
3.2	Analytical Method	35
4.1	Road Accident Distribution Map in Jaffna District 2005 - 2015	37
4.2	Number of Accidents in Jaffna District 2005	38
4.3	Number of Accidents in Jaffna District 2015	39
4.4	Number of Deaths in Jaffna Year 2005	41
4.5	Number of Deaths in Jaffna Year 2015	42
4.6	Road Accidents Distribution Pattern with Buffer Zone in Jaffna 2005 - 2015	43
4.7	Hotspot Analysis of Accidents in Jaffna 2015	44
4.8	Density Analysis of Accidents in Jaffna 2005 - 2015	45
4.9	Road Accident Map in Kilinochchi District 2005 - 2015	48
4.10	Number of Accidents in Kilinochchi District 2005	50
4.11	Number of Accidents in Kilinochchi District 2015	51
4.12	Number of Deaths in Kilinochchi in Year 2005	53

4.13	Number of Deaths in Kilinochchi inYear 2015	54
4.14	Road Accident Pattern with Buffer Zone in Kilinochchi 2005-2015	55
4.15	Hotspot Analysis of Accidents in Kilinochchi in Year 2015	56
4.16	Density Analysis of Accidents in Kilinochchi 2005 - 2015	57
4.17	Road Accident Distribution Map in Mannar District 2005 - 2015	60
4.18	Number of Accidents in Mannar District in Year 2005	62
4.19	Number of Accidents in Mannar District in Year 2015	63
4.20	Number of Deaths in Mannar District in Year 2005	65
4.21	Number of Deaths in Mannar District inYear 2015	66
4.22	Road Accident Pattern with Buffer Zone in Mannar 2005 - 2015	67
4.23	Hotspot Analysis of Accidents in Mannar in Year 2015	68
4.24	Density Analysis of Accidents in Mannar 2005 - 2015	69
4.25	Road Accident Distribution Map in Mullaitivu District 2010 - 2015	72
4.26	Number of Accidents in Mullaitivu District in Year 2010	73
4.27	Number of Accidents in Mullaitivu District in Year 2015	74
4.28	Number of Deaths in Mullaitivu District in Year 2010	76
4.29	Number of Deaths in Mullaitivu District inYear 2015	77
4.30	Road Accident Pattern with Buffer Zone in Mullaitivu 2005 - 2015	78
4.31	Hotspot Analysis of Accidents in Mullaitivu in Year 2015	79
4.32	Density Analysis of Accidents in Mullaitivu 2010 - 2015	80
4.33	Traffic Accidents in Junctions 2005 to 2015	83
4.34	Collision Type 2005 to 2015	84

**Geographical Patterns of Road Safety in Northern Province of
Sri Lanka with Special Reference to
Jaffna, Kilinochchi, Mannar and Mullaitivu Administrative Districts**

ABSTRACT

J.A. Wijayanayaka Hewavitharana

Terrible losses of lives and injuries with consequent property damages resulting from road traffic accidents have now emerged as serious issues in Sri Lanka. Affecting the community personally, socially and economically. Presently, providing safer roads through reducing accidents is now a priority issue for policy makers at the national level in developing and developed countries. Therefore this research the main objective was to ensure road safety with Support of Arc GIS techniques to address the issues in Northern Province in the country. In additionally to examine the distribution patterns of accidents in the selected roads, to develop and implement community based road safety programs and to prevent road accident use of suitable technique where if necessary.

The methodology of this study was consisted of study are, data and data collection techniques and analytical methods. The study area were Jaffna, Kilinochchi, Mannar, and Mullaitivu Administrative Districts to selected to study the problem using deferent techniques and secondary data from selected Police station records, primary data were obtained at location black spots using GPS (Global Positioning System) device. The data obtained was entered and use to develop accident information system. Analysis and capability of the developed system was illustrated with numerical examples.

Head on the findings of this study, some recommendations related to Engineering, Enforcement, Educational and Emergency Response aspects are made. This kind of research will help generating new ideas to find out the parameters for reducing road traffic accidents in greater Sri Lanka.

Key Words: GIS, GPS, Road Safety, Geographical Patterns, Northern Province

Chapter One

INTRODUCTION

1.1 Introduction

"Road safety has come to the top of the international agenda" Addressing the safety problems emerges a serious challenge in the absence of requisite transport safety professionals and resources.

Globally, road accidents and their economic and social impacts are so huge and alarming that the issue has been identified as major concern. The global context may be summarized as about Three thousand people, including 500 children, are killed every day on the world's roads. More than eight out of ten deaths occur in low and middle-income countries. This amounts to 1.2 million deaths a year. In addition, more than 50 million people are seriously injured; many are disabled for life. It is also worth noting that these figures, as shocking as they are, are an underestimate of the real scale of the problem. Due to underreporting and insufficient data collection, many low- and middle-income countries do not know exactly how many of their citizens die or are injured in road crashes annually.

The rapid economic growth, increasing disposable income and urbanization are raising the demands for transportation in developing countries. As a result, the numbers of vehicles on roads of developing countries are also increasing gradually. Developing countries are experiencing an annual growth rate of about 16% to 17%, which is doubling the vehicle fleet in five years. This factor along with the high proportion of two-and three-wheeled motor vehicles in the region and the relatively young age of the majority of the population are contributing to the serious road accident casualties.

During recent years, road safety has become a major concern throughout the world specially in Sri Lanka. Road Traffic Accidents and Traffic Congestion are a pressing problem leading to fatalities and severely impacting the society.

Road traffic accidents cause monetary and general community losses. Although the general trend of frequency and severity on traffic accidents is stable with some variations in recent years, there are potential to minimize the number of accidents further though comprehensive research and effective countermeasures development.

A Traffic Collision also known as a Motor Vehicle Collision, Traffic Accident, Motor Vehicle Accident, Car Accident, Automobile Accident, Road Traffic Collision, Road Traffic accident, Car Crash, or Car Smash occurs when a vehicle collides with another Vehicle, Pedestrian, Animal, Road Debris or other Stationary Obstruction, such as a Tree or Utility Pole. Traffic collisions may result in Injury, Death and Property Damage.

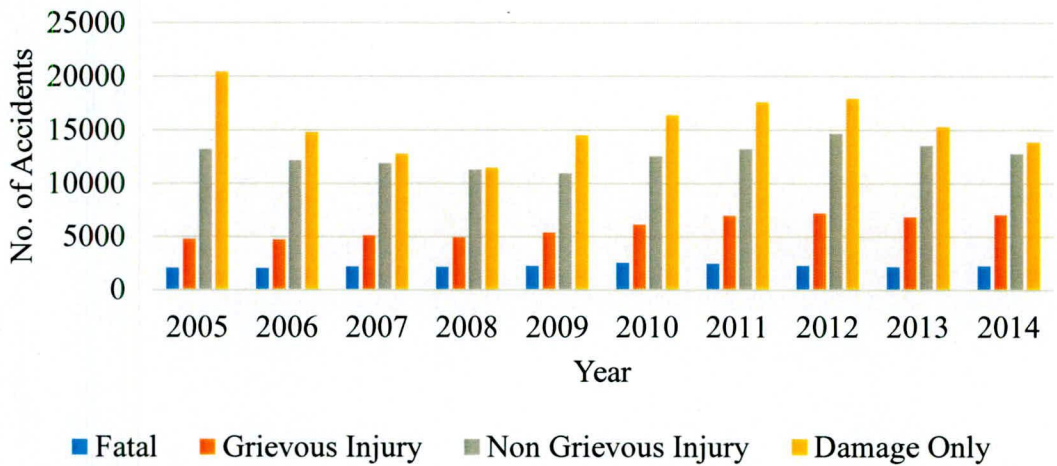
Traffic Congestion is a condition on road networks that occurs as use increases, and is characterized by slower speeds, longer trip times, and increased vehicular queuing. The most common example is the physical use of roads by vehicles. When traffic demand is great enough that the interaction between vehicles slows the speed of the traffic stream, this results in some congestion.

The Some of main causes of Road Traffic Accidents are Over Speeding and Unhealthy Competition of Vehicles, Poor Surface Conditions, Under Construction of Roads, Lack of Pedestrian Crossing facilities and unwanted Pedestrian Crossings, Uncontrolled Access Streets and Unmanned Junctions, Bad Driving Habits and Lack of Discipline & Poor Knowledge about Road Safety by Road Users including Pedestrians (Not obey traffic rules, Not wearing seat belts, Avoid drugs and alcohol while driving), Improper Parking on Road Side, Extra people in addition to rider & pillion specially in motorbikes, Aggressive Driving etc.

Road Safety is a collective effort of the government and people. While the government administration must leave no stone unturned in ensuring proper condition of the roads and enforcing strict adherence to traffic rules, responsible driving and the right attitude people with respect to traffic rules.

Following bar chart can be shown how the accidents reported in Sri Lanka during the period of last ten years since 2005 to 2014.

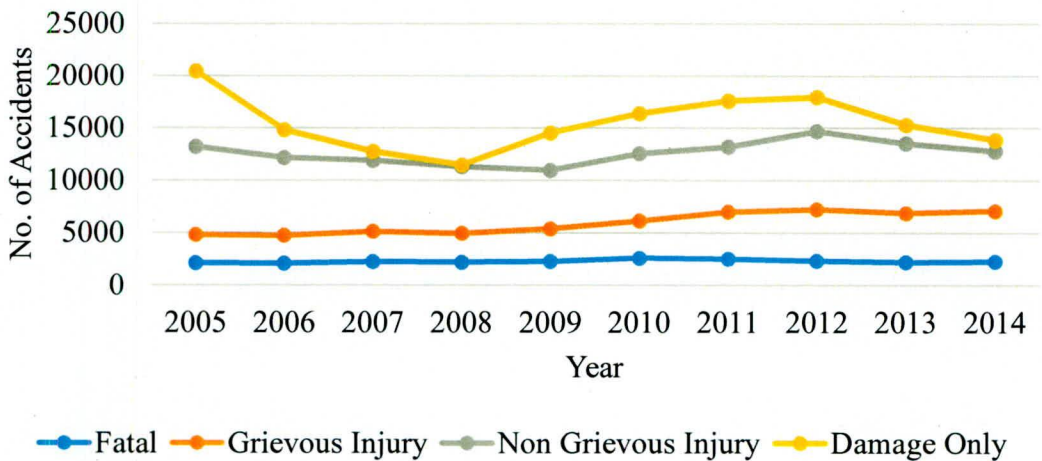
Figure 1.1: Motor Traffic Accidents Reported in Sri Lanka since 2005 to 2014



Source: Compiled by Author, 2015

Above mentioned statistics can easily analyze by using line chart as follows.

Figure 1.2: Motor Traffic Accidents Reported in Sri Lanka since 2005 to 2014



Source: Compiled by Author, 2015

Everyone complains about being jammed in traffic, but like weather, no one seems to do anything about it and everyone hates traffic congestion. But despite all attempted remedies, it keeps worse. Why don't they do them something about it? Because rising traffic congestion is an unpreventable situation in all large and growing metropolitan areas across the world.

The advantage of using GIS in Black Spot studies is that it can present both the geographical positions of the accidents and information about the accident details. Traffic accident data with coordinates can be easily analyzed and presented on a computer screen and various queries about the accidents can be followed. Arc View GIS provides an excellent opportunity to develop engineering tools in accident studies.

Road Safety is considered as a significant topic worldwide, both at national and international level. Simultaneously, due to the evolution of Geometrics in recent years, considerable number of studies has been carried out, focusing on the development and implementation of geographic information based tools, in the field of Road Safety. GIS allow today the concurrent management of large amount of spatial and attribute data, and provide variety of processing capabilities and spatial data analysis tools, while offering prospect for standardization and automation of various processes. According to the above mentioned, GIS can contribute accident reporting, data analysis, and especially to the investigation of factors affecting the level of road safety. Particularly, the use of GIS contributes to the identification of factors that would not be noticeable using other conventional methods of statistical analysis.

1.2 Problem of the Study

The global forecast has indicated that over the next 10 years developing countries will experience an alarming increase in road accidents and casualties. Addressing the safety problems thus emerges a serious challenge in the absence of requisite transport safety professionals and resources.

Vehicles on roads of developing countries are also increasing gradually. Developing countries are experiencing an annual growth rate of about 16% to 17%, which is doubling the vehicle fleet in five years. This factor along with the high proportion of two-and three-wheeled motor vehicles in the region and the relatively young age of the majority of the population are contributing to the serious road accident casualties.

Main causes of road accidents in Asia Countries are over speeding, overloading, and overtaking by motor vehicles. Unregulated movement of non-motorized vehicles along with motorized vehicles on the same route is also one of the major causes for road accidents. Lack of awareness and reckless driving habits also result in frequent accidents claiming lives and causing anguish and grief to the affected families.

In urban areas, the traffic roadway system is more complex where a mixed road user environment prevails and greater perceptual demands are placed on the road users. Of particular concern are the urban intersections, particularly the signalized ones that are problematically located. These have been identified as among the most hazardous locations on the roads, which account for a substantial portion of traffic accidents.

In Sri Lanka The principal contributing factors of accidents are adverse road and roadside environment, poor design of junctions and road sections, excessive speeding, overloading, dangerous overtaking, reckless driving, carelessness of road users, failure to obey mandatory traffic regulations, variety of vehicle characteristics and defects in vehicles and conflicting use of roads. Others include a low level of awareness of the safety problems, inadequate and unsatisfactory education, safety rules and regulations and traffic law enforcement and sanctions.