# GIS Based

# Landslide Forecasting Model:

# A Case Study in Kaluthara District

By

R.M.S.A.K Rathnayake

M.Sc. 2014

## DECLARATION OF THE CANDIDATE

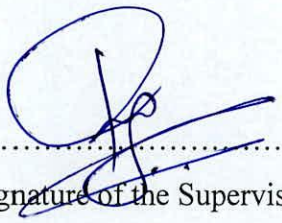
The work described in this thesis was carried out by me under the supervision of Dr. H. M. Ranjith Premesiri and a report on this has not been submitted in whole or in part to any university or any other institution for another Degree / Diploma.

.....Rathyake..... .....15.06.2014.....

Signature of the Candidate Date

## DECLARATION OF SUPERVISOR

I certify that the above statement made by the candidate is true and that this thesis is suitable for submission to the University for the purpose of evaluation.



.....

Signature of the Supervisor

15-06-2014

.....

Date

# GIS Based

# Landslide Forecasting Model:

# A Case Study in Kaluthara District

By

R.M.S.A.K. Rathnayake

MSC/GR/2012005

Thesis Submitted to the University of Sri Jayewardenepura for the award of the Degree of Master of Science in Geographic Information System and Remote Sensing on

15th June 2014

## TABLE OF CONTENTS

Page

## LIST OF TABLES

**Page**

## LIST OF FIGURES

Page

## LIST OF ABBREVIATIONS

| | |
|---|---|
| NBRO | - National Building Research Organization |
| DSD | - Divisional Secretariat Division |
| GND | - Grama Niladari Division |
| GIS | - Geographic Information System |
| LRRMD | - Landslide Research & Risk Management Division |
| SQL | - Structured Query Language |

## ACKNOWLEDGEMENTS

I would like to express my especial thanks and sincere gratitude to my supervisor, Dr.H.M. Ranjith Premasiri for his invaluable guidance, encouragements, patience and precious time that he offered to me. And, I was guided step by step from the beginning and I am deeply impressed with his wealth of knowledge and dedication to academic research.

Also, I thank Prof. Krishan Deheragoda who motivated me towards this endeavour by valuable guidance during reviews from the inception. Further, I thank Rev. Dr. Pinnawala Sangasumana (Head/Geography/Coordinator-M.Sc. in GIS & RS) and accedemic staff of M.Sc. in GIS & RS specially Mr.Prabath Malavige and Mr. M.I.D.H. Wijewicrama for their invaluable guidance and encouragements provided during this research.

**GIS Based Landslide Forecasting Model:**

**A Case Study in Kaluthra District**

**Rathnayake Mudhiyanselage Suminda Aruna Kumara Rathnayake**

# ABSTRACT

Among the natural hazards, landslides draw and more attention due to its increasing impact on economic and human losses. Hazard zonation mapping plays a vital role in identifying the vulnerable zones for future land-use planning activities, designing of early warning systems and applying adequate mitigation measures in landslide-prone areas, very often lack of real time early warnings significantly increases the damages Worldwide.

Landslides associated with intense rain during monsoon and inter-monsoon seasons are the most pressing natural disaster in the Central Highland of Sri Lanka. About 20% area of the country within ten administrative districts are considered to be prone to landslides and almost 42% of the total population of the country is living in these districts. According to the available records, major landslides occurred during past three decades have caused a loss of more than 775 human lives making over 90,000 people homeless. Most significantly, Galle, Matara, Hambantota and, Kaluthara districts. The catastrophic event occurred on 17th May 2003 killing more than 150 people in a single day. 855 houses were completely destroyed and another 2858 were damaged rendering almost 20,000 people homeless. Every year huge economic and human losses are recorded and damages causes throughout the island. This is because people live everywhere at their own risk and use even the marginal lands for housing, farming, infrastructure and development activities without an adequate attention to the problem as a result of higher demand of lands with rising population. Thus, as a measure to save lives and property it is incumbent upon to develop real time prediction models for such regions to manage future events successfully. Under the present study, a contribution is made to evaluate the capabilities of available static and dynamic modelling approaches to cope with the real time forecasting of rain induced landslides within Kaluthara district of Sri Lanka.

Theoretically, slope instability hazard zonation is defined as the mapping of areas with an equal probability of occurrence of landslides in a given area within a specific period of time. However, calculation of landslide probability is extremely difficult, since there is no simple relationship between magnitudes of landslide events, return periods and as well as due to lack of reliable historical records of landslide dates and triggering events. Thus, susceptibility assessment to identify the critical locations and establishment of triggering thresholds to predict the timing of the events can be considered as a realistic approach in landslide hazard zonation.

The research presents uses three district secretariat divisions of Kaluthara district to identify the rainfall threshold value for trigger landslides. Rainfall is commonly known as one of the principal landslide triggers. Thus the concept of hydrological triggering thresholds can be utilized for the prediction of timing of rain induced landslides. Hydrological triggering thresholds can be established in a statistical or in a deterministic way. In present study obtained a rainfall thresholds value and also prepare a risk map according to past landslide records and GND population.

This research developed model can be use for the purpose of performance and accuracy improvements of landslide forecasting.

# CHAPTER 1

## 1 Introduction

### 1.1 General background

World's natural hazards are many folds such as earthquakes, volcanic eruptions, tsunamis, hurricanes or tropical cyclones, droughts, hot and cold weathers, lightening and thundering, wildfires, floods, and landslides. They can be considered as a sort of consequences of exogenic and endogenic processes of the earth and extra-terrestrial processes of the solar system. These events are in fact natural agents that maintain the stability of the dynamic Earth and transform vulnerable human conditions into disasters. In very general term, disasters can be expressed as,

Disaster = Hazard * Vulnerability

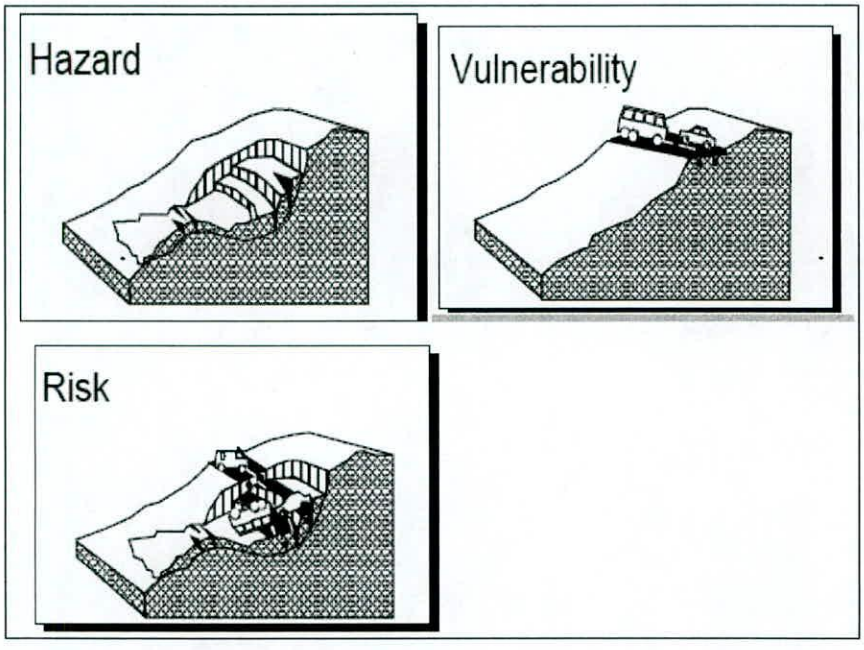



**Figure 1.1: Schematic indication of hazard, vulnerability, and risk**

The natural hazard means the probability of occurrence within a specified period of time and within a given area of a potentially damaging phenomenon. Vulnerability means the degree of loss to a given element or set of elements at risk, resulting from the