

GIS-Based Flood Damage Analysis in Bulathsinhala and Kalawana Divisional Secretarial Divisions.

By Disanayaka Krishanthi Namali

Index No. Msc/GR/2012034

Registration No. 5998MD2012036

Thesis Submitted to the University of Sri Jayewardenpura for

the Degree of Master of Science in Geography Information

System and Remote Sensing on 2014/06/15

(A) The second leaf of the thesis should have a signed declaration by the candidate stating that The work described in this thesis was carried out by me under the supervision of, Dr. H.H Leelananda and Mrs. H. M. B. S. Herath, and a report on this has not been submitted in whole or in part to any university or any other institution for another Degree.

.....*Kishanth*.....

Signature of the Candidate

.....*14/08/2014*.....

Date

(B) The third leaf should have a signed declaration with the date by the Supervisor certifying the work of the candidate stating
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.

.....*H.M.B.S. Herath*.....

Signature of the Supervisor

.....*14/08/2014*.....

Date

.....*[Signature]*.....

Signature of the Supervisor

.....*14/08/2014*.....

Date

ACKNOWLEDGEMENT

Special thanks goes to my supervisors, Mr. H. H. Leelananda and Mrs. H. M. B. S. Herath, Senior Lecturer, Faculty of Humanities and Social Sciences, University of Sri Jayewardenepura; for their encouragement given to my research.

I would like to thanks Ven. Dr. Pinnawala Sangasumana, Head, Department of Geography, Faculty of Humanities & Social Sciences, and University of Sri Jayewardenepura for the guidance given to me.

Finally I like to thanks my loving parents, brothers and sisters, friends who helped me to complete this study successfully.

Table of Contents

Chapter 1

1.0 Introduction

1. 1 what is Flood?

1.1.1 What is disaster management?	1
1.1.2 Disaster prevention	2
1.1.3 Disaster preparedness	3
1.1.4 Disaster relief	4
1.1.5 Disaster recovery	4
1.1.6 Resources on disaster recovery	4
1.1.7 Disaster relief resources	6
1.1.8 What is flood?	7
1.1.9 Etymology	8
1.1.10 Areal (rainfall related)	8
1.1.11 River line	9
1.1.12 Estuarine and coastal	9
1.1.13 Urban flooding	9
1.1.14 Catastrophic	10
1.1.15 Effects	
1.1.15.1 Primary effects	10
1.1.15.2 Secondary and long-term effects	11
1.1.16 Flood forecasting	11
1.1.17. Flood control	12
1.1.18 Benefits	13
1.1.19 Deadliest floods	
1.1.19.1 List of deadliest floods	14
1.1.19.2 In myth and religion	15

1.2 Research problem	15
1.3 Significance of the study	16
1.4 Research Objectives	17
1.5 Study area	17
Chapter 02	
2.0 Literature review	
2.1 Introduction	19
2.2 What is Flood?	19
2.3 Global Flood damage	21
2.4 Sri Lanka Flood damage	22
2.5 Sri Lanka Flood Hydro power station	24
Chapter 03	
3.0 Methodology	
3.1 Collection of data and information	26
3.1.2 Secondary data	26
3.2 Analysis of data	27
3.3 Material and Software used	27
Chapter 04	
4.0 Flood damage analysis and discussion	
4.1 Vulnerability analysis	
4.1.1. Social Vulnerability	
4.1.1.1. Houses situation	28
4.1.2 Economic Vulnerability	
4.1.2 .1 Land Use	30
4.1.3. Environmental Vulnerability	35
4.1 Hazard Analysis	36
4.2. Drainage Pattern	36
4.2.1 High Hazard analysis	

4.2.1.1. Flood damaged Educational	
Institutions and other Buildings in Bulathsinhala (50m)	38
4.2.1.1. Flood damaged Educational	
Institutions and other Buildings in Kalawana(50m)	40
4.2.2. Moderate Hazard analysis	
4.2.2.1 Flood damaged Educational	
Institutions and other Buildings in Kalawana (100m)	40
4.2.2.2 Flood damaged Educational	
Institutions and other Buildings in Bulathsinhala (100m)	41
4.2.2.3 Cultural Places	42
4.2.3 Low Hazard analysis	44
Chapter 05	
5.0 Summary and conclusion	
5.1 Conclusions	46
5.2 Suggestion	47
6.0 References	46

List of Figure

1.1 Bulathsinhala and Kalawana DSD	18
2.1 Natural Disaster Risk Hotspots	23
2.2 Natural Disaster Risk Hotspots (Weighted by Mortality)	23
4.1 Housing situation in Kalawana	28
4. 2 Housing situation in Bulathsinhala	29
4. 3 Flood Damaged Houses	30
4.4 Land Use map in Kalawana	32
4.5 Land Use map in Bulathsinhala	33
4.6 Forest map around the Reservoir	35
4.7. Drainage Pattern in Study Area	36
4.8 Flood Damage Building (50m) in Bulathsinhala	38
4.9. Flood Damage Building (50m) in Kalawana	39
4.10 Flood Damaged building in Study area (100m)	41
4.11 Flood Damaged building in Bulathsinhala (100m)	43
4.12 Flood Damage building in Bulathsinhala - 150 m	44
4.13 Flood Damage building in Kalawana - 150 m	45

List of Pictures

4.1 A Flood damage houses in Bulathsinhala	29
4.2 A Paddy field damaged due to the flood in Kalawana	31
4.3 A Tea plantation damaged due to the flood in Bulathsinhala	34
4.4 Molkawa Maha Vidyalaya	42
4.5 Molkawa Maha Vidyalaya	42

List of Diagram

1.1 Disaster management cycle	2
3.1 Data analysis	27

List of Table

1.1 List of deadliest floods	14
4.1 Temples and Kovil which have been damaged in 150m	45

Chapter 1

INTRODUCTION

1. 1 What is Flood?

1.1.1 What is disaster management?

The United Nations defines “a disaster as a serious disruption of the functioning of a community or a society. Disasters involve widespread human, material, economic or environmental impacts, which exceed the ability of the affected community or society to cope using its own resources”.

The Red Cross and Red Crescent societies define disaster management

“as the organization and management of resources and responsibilities for dealing with all humanitarian aspects of emergencies, in particular preparedness, response and recovery in order to lessen the impact of disasters”. ([http://www.wcpt.org/disaster management](http://www.wcpt.org/disaster-management) 2011/05/05)

Types of disasters are no country that is immune from disaster, though vulnerability to disaster varies. There are four main types of disaster.

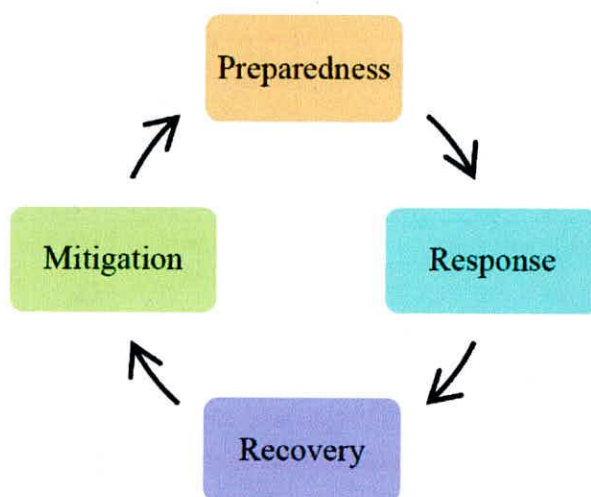
- Natural disasters: including floods, hurricanes, earthquakes and volcano eruptions that have immediate impacts on human health and secondary impacts causing further death and suffering from (for example) floods, landslides, fires, tsunamis.
- Environmental emergencies: including technological or industrial accidents, usually involving the production, use or transportation of hazardous material, and occur where these materials are produced, used or transported, and forest fires caused by humans.
- Complex emergencies: involving a break-down of authority, looting and attacks on strategic installations, including conflict situations and war.
- Pandemic emergencies: involving a sudden onset of contagious disease that affects health, disrupts services and businesses, and brings economic and social costs.

Any disaster can interrupt essential services, such as health care, electricity, water, sewage/garbage removal, transportation and communications. The interruption can seriously affect the health, social and economic networks of local communities and countries. Disasters have a major and long-lasting impact on people long after the immediate effect has been mitigated. Poorly planned relief activities can have a significant negative impact not only on the disaster victims but also on donors and relief agencies. So it is important that physical therapists join established programmes rather than attempting individual efforts.

- Local, regional, national and international organisations are all involved in mounting a humanitarian response to disasters. Each will have a prepared disaster management plan. These plans cover prevention, preparedness, relief and recovery.

To respond natural disasters, disaster management is used. The disaster management Cycle is as of diagram 1.

Diagram 1: Disaster management cycle



Source: Virtual University for Small States of the Commonwealth (VUSSC)

1.1.2 Disaster prevention

These are activities designed to provide permanent protection from disasters. Not all disasters, particularly natural disasters, can be prevented, but the risk of loss of life and injury can be mitigated with good evacuation plans, environmental planning and design

standards. In January 2005, 168 Governments adopted a 10-year global plan for natural disaster risk reduction called the Hyogo Framework. It offers guiding principles, priorities for action, and practical means for achieving disaster resilience for vulnerable communities.

1.1.3 Disaster preparedness

These activities are designed to minimise loss of life and damage – for example by removing people and property from a threatened location and by facilitating timely and effective rescue, relief and rehabilitation. Preparedness is the main way of reducing the impact of disasters. Community-based preparedness and management should be a high priority in physical therapy practice management.

Disaster preparedness resources

- The American Physical Therapy Association has published A Physical Therapist's Guide to Community Emergency Preparedness for People with Disabilities and Special Needs which includes a list of online resources.
- A Resource Guide for Public Health Preparedness has been produced by the New York Academy of Medicine in partnership with National Library of Medicine.
- The Health Library for Disasters is an electronic information resource on public health for emergency preparedness and response and complex emergencies.
- The WHO Health Action in Crises web pages contain technical information for crises and crises management, useful templates, training information and tools to facilitate work in the field. Included is a Global assessment of the national health sector emergency preparedness and response (2008) and WHO Humanitarian Action Biennial Work Plan.
- The International Federation of Red Cross and Red Crescent Societies Early warning Early action (2008) outlines the actions to take years, months, weeks, days and hours before disasters, giving a range of examples.
- UNHCR Handbook for Emergencies, Third Edition is a comprehensive manual.
- The Mailman School of Public Health of the University of Columbia National Centre for Emergency Preparedness 2007 publishes Emergency preparedness: Addressing the needs of persons with disabilities. Executive Summary and Final Report.

- The Sphere Project brought together people from over 400 organisations, including national and international NGOs, UN agencies and academic institutions, representing 80 countries. The Humanitarian Charter and the draft Core Minimum Standards aim to improve ‘the effectiveness and accountability of disaster response’ and ‘sets out what people affected by disasters have a right to expect from humanitarian assistance’.

1.1.4 Disaster relief

This is a coordinated multi-agency response to reduce the impact of a disaster and its long-term results. Relief activities include rescue, relocation, providing food and water, preventing disease and disability, repairing vital services such as telecommunications and transport, providing temporary shelter and emergency health care.

1.1.5 Disaster recovery

Once emergency needs have been met and the initial crisis is over, the people affected and the communities that support them are still vulnerable. Recovery activities include rebuilding infrastructure, health care and rehabilitation. These should blend with development activities, such as building human resources for health and developing policies and practices to avoid similar situations in future.

Disaster management is linked with sustainable development, particularly in relation to vulnerable people such as those with disabilities, elderly people, children and other marginalised groups. Health Volunteers Overseas publications address some of the common misunderstandings about disaster management.

1.1.6 Resources on disaster recovery

The following resources are aimed at recovery planning:

- The UN development group together with the World Bank has published a range of documents on post conflict needs assessment. The purpose of the Guidance is to inform strategic decision-makers (national and international) of the purpose, scope and benefits of a common platform for recovery planning.

The following resources are aimed at community development:

- Making it work (March 2009) is an international multi-stakeholder initiative aimed towards effective implementation of the United Nations Convention on the Rights of Persons with Disabilities (CRPD). The manual is available in English, French and Spanish.
- The UN Development Group Toolkit is a repository of guidance, lessons learned and tools to support development.

The following resources are aimed at mainstreaming disability:

- A guidance paper for an inclusive local development policy by Charlotte Axelsson (2009) is available in English and French. This guidance paper aims to provide concrete directions for mainstreaming disability in local development.

The following resources are aimed at recruiting rehabilitation volunteers:

- Voluntary Service Overseas is a UK based non-governmental organization that recruits volunteer physical therapists to take part in recovery and development programmes in low-income countries.

The following resources are aimed at pandemic disasters and communicable disease control:

- The WHO programmed on communicable disease control in humanitarian emergencies produces a range of publications including A field manual - Communicable disease control in emergencies and Early warning surveillance and response in emergencies. They also hold regular five-day intensive short courses on communicable diseases in emergencies in different countries around the world.
- The Chartered Society of Physiotherapy has available guidance on prevention and control of health care infection associated infections.
- Leadership During a Pandemic: What Your Municipality Can Do is a resource kit produced by the Pan American Health Organization. Elements of this resource may be useful for physical therapists.
- Where there is no Doctor could be a useful adjunct to professional literature for physical therapists in the aftermath of the disaster where health infrastructures may not yet be in place. In such situations all personnel need to be aware of general health conditions and treatments. This book is prepared in simple language for

people with little formal education. It is available in more than one hundred languages.

1.1.7 Disaster relief resources

The following volunteer databases are important in disaster relief:

- The Center for International Disaster Information maintains a database for volunteers.
- The USAID medical volunteer database also includes volunteers other than physicians.
- Voluntary Service Overseas International regularly recruits physical therapists to serve in a variety of development situations. This organisation partners with several governmental agencies responsible for emergency relief.
- Health Volunteers Overseas has a page dedicated to volunteer positions for physical therapists and a volunteer toolkit with the information and tools to help prepare volunteers for their assignment.
- The International Federation of Cross and Red Crescent Societies recruits volunteers for local community development projects. Red Cross or Red Crescent Societies are in many countries of the world. Contact your local office to volunteer.

The following are involved in helping children in emergency situations:

- A new edition of 'Facts for Life' has been published jointly by UNICEF and WHO in collaboration with other UN agencies and the World Bank. This delivers essential information on how to prevent child and maternal deaths, diseases, injuries and violence and is designed to educate those who have influence over the safety and wellbeing of children.
- The International Foster Care Organization has produced guiding principles on the care and protection of unaccompanied and separated children in emergency-affected countries. First developed in response to the tsunami in Asia in 2004, they have been updated in 2010 for the situation in Haiti following the earthquake. The document represents the views of the following agencies: the International Committee of the Red Cross (ICRC), the International Rescue Committee (IRC), Save the Children UK (SCUK), the United Nations Children's Emergency Fund (UNICEF), the United

Nations High Commissioner for Refugees (UNHCR), and World Vision International (WVI).

The WHO has published Guidelines for health care equipment donations. These guidelines are not specifically for use in disaster response situations and indeed note that 'The general rule of thumb is that capital equipment should not be donated in emergency situations, unless it is established that the emergency will be continued over a long period.' The donation process, flowcharts and checklists may be applicable across many settings and situations, but involvement of the recipient in decision making is paramount. The guidelines emphasizes:

- There should be no double standard on quality. If the quality of an item is unacceptable in the donor country it is also unacceptable as a donation.
- All donations should be made according to a plan formulated jointly by both donor and recipient.
- The recipient should derive the maximum possible benefit from the equipment.
- Equipment should be given in accordance with the recipient's wishes.
- Equipment should be given in conformity with government policies and administrative arrangements of the recipient's country.

1.1.8 What is flood?

A flood is an overflow of water that submerges land which is usually dry. The European Union (EU) Floods Directive defines a flood as a covering by water of land not normally covered by water. In the sense of "flowing water", the word may also be applied to the inflow of the tide. Flooding may occur as an overflow of water from water bodies, such as a river or lake, in which the water overtops or breaks levees, resulting in some of that water escaping its usual boundaries, or it may occur due to an accumulation of rainwater on saturated ground in an area flood. While the size of a lake or other body of water will vary with seasonal changes in precipitation and snow melt, these changes in size are unlikely to be considered significant unless they