

Development of Warning system for Mitigation of Urban Flood
hazard

A Case Study – Panadura Urban Council

By

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DECLARATION OF THE CANDIDATE

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

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LIST OF ABBREVIATIONS

DEM	Digital Elevation Model
DMC	Disaster Management Center
GIS	Geographical Information System
GPS	Global Positioning System
IT	Information Technology
LiDAR	Light Detection and Ranging
OCHA	Office for the Coordination of Humanitarian Affairs
RS	Remote Sensing
TS	Total Station
UNDP	United Nations Development Program
UTM	Universal Transverse Mercator
WGS 84	World Geodetic System 1984
ESRI	Environmental Systems Research Institute

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ABSTRACT

Urban flooding has become one of severe problems faced in Sri Lanka leading for various social and environmental interruptions. With the increasing of the occurrence of floods, it has become a necessity to find a proper solution to overcome the problem. This study mainly focuses to developed a warning system for mitigation the urban flood hazard and a case study was carried out in Panadura urban council area. The system was Developed using GPS, Remote Sensing (RS), Geographical Information System (GIS) techniques, PIC Control circuit, Google API, Arc Server, PHP, Java Script and Google My maps .

Digital Elevation Model (DEM) was used to delineate requisite mini water catchments using GIS Analysis Model. DEM processing and accuracy assessment was performed based on the ground truth elevation data measured by GPS surveys. Current drainage system in the area was assessed as alignment, as capacity for large water volumes in heavy rainfalls along and delineated natural drainage system. Highly flood vulnerable locations in the current drainage system were identified. A wireless circuit with water level sensing was developed it locater where flood level need to detect. All these sensors are networked to controlling station. The controlling station process the received information and produces water level with the location. The system automatically updates the SQL database with attributes, and water level values in using PHP files. When java script runs it displays flooding area in the web system. Finally adjustments to the current drainage network and new drainage paths were proposed to minimize the flood hazard.

Keywords: Digital Elevation Model (DEM), Disaster, Heavy Rainfall, Arc Hydro Model

CHAPTER ONE

INTRODUCTION

1.1 Introduction

Urban Flood Hazard

A flood is an excess of water (or mud) on land that's normally dry and is a

SITUATION where the inundation is caused by high flow, or overflow of water in an established watercourse, such as a river, stream, or drainage ditch; or ponding of water at or near the point where the rain fell. This is a duration type event. A flood can strike anywhere without warning, occurs when a large volume of rain falls within a short time.

Type of Flooding

- According to Duration

Slow-Onset Flooding, Rapid-Onset Flooding, Flash Flooding.

- According to Location

Coastal Flooding, Arroyos Flooding, River Flooding and Urban Flooding. The urban area is paved with roads etc and the discharge of heavy rain can't be absorbed into the ground due to drainage constraints leads to flooding of streets, underpasses, low lying areas and storm drains.

1.2 Causes of Urban Flood

Natural Causes

Heavy Rainfall / Flash floods

Water of Heavy rainfall concentrates and flows quickly through urban paved area and is impounded in to low lying area raising the water level. It creates more havoc when a main drain or a river passing through the area over-flows.

Lack of Lakes

Lakes can store the excess water and regulate the flow of water. When lakes become smaller, their ability to regulate the flow become less and hence flooding.

Silting

The drains carry large amounts of sediments and deposited in the lower courses making beds shallower thus channel capacity is reduced. When there is heavy rain, these silted drains can't carry full discharge and result in flooding

Human Causes

Population pressure

Because of large amount of people, more materials are needed, like wood, land, food, etc. This aggravates overgrazing, over cultivation and soil erosion which increases the risk of flooding.

Urbanization

Leads to paving of surfaces which decreases ground absorption and increases the speed and amount of surface flow. The water rushes down suddenly into the streams from their catchment areas leading to a sudden rise in water level and flash floods. Unplanned urbanization is the key cause of urban flooding. Various kinds of depression and low lying areas near or around the cities which were act as cushions and flood absorbers are gradually filled up and built upon due to urbanization pressure. This results in inadequate channel capacity causing urban flooding.

Un authorized colonies

Have been developed by the local colonizers on the agriculture land, earlier being used for crop has been purchased at lucrative prices from farmers, without consideration to

the city plans ,drainage, sewerage etc. and thus subjected to flooding during heavy rain falls

1.3 Impact Urban Flood hazard

Urban flooding has become a severe problem in Colombo, Kalutara, Gampaha, Kegalle, Matara districts within the country for few years. During last two years the problem has gone up to a more vulnerable level due to frequent flash floods causing several social interruptions such as traffic congestions, delays of trains, closure of schools, electricity interruptions, disruption of several services and temporary loss of income (DMC Report, 2010). Considering these facts of urban flooding, it is required to propose a long term solution for the problem through detail studies.

According to the literature, a number of physical studies based on topographic surveying have been conducted to propose a solution for this severe problem. But most of them were failed during the implementing phase although they utilized both high cost and time. Therefore as a highly applicable approach, this study was carried out to propose an appropriate solution to minimize urban flooding in Panadura area. The major difference comparing to previous studies is the decision making according to the GIS analysis. As Remote Sensing data, processed Digital Elevation Model (DEM) created by LiDAR images was used. Processed warning System and Geo database.

1.4 Study Problem

Many studies have been carried out on this problem but has not found a propose solution. Most of them are physical studies instead spatial methods are used in this research.

The main causes of urban flooding

- Seasonal heavy rainfall

- Improper drainage system
- Improper land use planning and constructions.

SriLanka does not have any Flood Warning System or Risk management plan preparedness plan and awareness about the disaster.

Significance of the Study

1.5 Economic effects

- Damage to Public buildings, Public utility works, housing and house –hold assets.
- Loss of earning in industry & trade
- Loss of earning to petty shopkeepers and workers
- Loss of employment to daily earners
- Loss of revenue due to Road, Railway Transportation Interruption
- High prices for essential commodities.

1.5.1 Environmental effects

Damage to surroundings, forests, ridges, wild-life, zoo, urban community-trees, water bodies, shrubs, grass, fruits/vegetables in go downs etc result imbalance of eco-system of the city.

1.5.2 Effect on Traffic

Flooding results in the damages of roads, collapse of bridges causing traffic congestion which affect day-to-day life and other transportation system.

1.5.3 Effect on Human Beings

- ❖ Human lives
- ❖ Psychological impact

Very Import minimizes these Effects for people and Government.