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GIS based analysis on environmental sensitive areas and identification of the potential disaster hazardous locations in Matara District

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Abstract
This study mainly focuses to carry out the physical dimension and characteristics of environmental sensitive areas in Matara District and build a system to identify the spatial distribution of environmentally sensitive locations in the events of Disasters such as Landslide, Flooding. By generating the 3D model for entire Matara District, It has to be demarcated high lands and low lying areas classification. For that, it is necessary to set up a comprehensive contour network for entire study area. By georeferncing 1: 50000 topographic sheets. Contour information has been digitized into the Geographic Information System. Feeding of height information, adjustment of contours between the topographic sheets have been done using quality control tools of GIS. After, setting up a very reliable and sophisticated contour based GIS system. Slope classification method were applied to obtain the slope angle values and slope aspects. Classification of slope angle and aspect gave the elevation picture of entire area of high lands in Matara District. The areas with more than 60% slope angle were considered as risky areas. Distribution networks of rivers, streams and tributaries have been mapped to measure the sensitive buffering of law lying areas which frequently affected from flooding. In addition to the elevation and water related sensitive identification, some Landuse/Landcover areas such as marshy, swampy and forestry lands have been overlaid to make final identification of the Potential Disaster Risk Areas (PDRA). Result of this study shows that vulnerable risk locations and its spatial pressure to spread the Disasters within Matara District.

Keywords: GIS Analysis , Environmental Sensitive Areas, Disaster Mitigation

Introduction

In this study, two research objectives have been performed to find potential Hazardous areas in Matara District. One was to find the Slope classification of highland areas. Slope failures either initiated by natural processes or by human activities are a major cause of natural disasters. It is especially the high number of slope failure which makes that the some environmental loss due to slope failures (eg. Direct damage to agricultural land) and infrastructure and indirect damage to economic activity). Since slope failure is considered as a fairly well predictable environmental hazard, the slope and aspect/exposure maps are useful for determining sensitive acreage in hilly or mountainous terrain.

Geographic Information system is the most reliable and sophisticated way to measure slope classes. The slope is measured and presented in colorized slope classes (i.e. 0-30%, 30-60%, 60%-90%.). Slope limit criteria can be set by the client (i.e. county slope regulations) and the area of land in each slope class and/or the slope within a series of slope classes (i.e. 0-30%) can be calculated. More than 60% slope areas can be defined as environmentally risky areas.

Secondly, Flood plain areas within Matara District have been measured. 25 meters and 60 meters buffering areas have been identified as flood risky areas. Using GIS buffering techniques, It can be demarcated the most flood risk buffers as frequent flood occurring areas. Merging of Two objectives, Slope classifications and Flood buffering, it can be obtained the most disaster prone areas in Matara District.

Materials and Methods

1:50000 Topographic sheets have been scanned and digitized in to GIS ArcView shape file format. A0 scanner has used for scanning. The maps were geo-referenced to the National Grid Co-Ordinate with 0.00 RMS errors. After Geo-referencing, the maps were cropped in order to remove unnecessary components and clipped together to create a seamless image. These seamless images of separate sheets were cropped to create a single image representing entire Matara District as study area.

Accordingly multiple features shown on topographic sheets were extracted by heads up digitization after zooming the source file 1: 10000 scale. This vector spatial data is represented by Contours, Rivers , Tributaries and Landuse.

Following Methods have been applied for obtained results:

Methods

Objective One

- Contour Map have been given relevant Contour Value
- Using 3D analysis , 3D surface has been created
- Slope angle has been classified using 3D surface
- Reclassification and Converted to Arc View shape format
- Three Slope Classes have been identified

Objective Two

- Create Rivers, Tributaries Layers
- Buffering has been given , 60 m for Rivers and 25m for Tributaries
- Flood Zoning in Matara District has been Identified

Final Result

- Intersect Slope Classification with Flood Zoning
- Estimate the total Risk area and Risk Distribution

Results and Discussion

As shown in Figure 1: Result of Slope classification indicates significant areas come under slope class between 60%-90% which are vulnerable to Landslides. Total areas of risky slope land are 6269 Hectors. It is 5.34 % of total land of Matara District.

Secondly, Figure 2 shows that flood affecting areas according to flood buffering. Total Flood affecting area is 4756 hector for River buffering and 4885 hectors for tributary buffering. Both values are 9641 in Hectors. Combination of both Slope Angle Risk locations and Flood buffering risk locations consist of 15910 hectares. It is 12.23 % of total land of Matara District. Further, annex one details show the spatial distribution and their size of risk locations in the level of Divisional Secretariat Divisions of Matara District. As main Government agent of Local Planning, DSD office can allocate annual fund based on above findings. In Table 4 of Annex one indicates the risk parentages of each DSD levels. Kotapola DS Division is most risky DS Division in Matara District that are 27 % of total landcover followed by Pasgoda 16 %, Akuressa 14 % , Petabeddara 13 %. Based on this study Dickwella has been classified as less risky DS Division followed by Kirinda – Puhulwella. (This study is not focuses about Tsunami Risk).

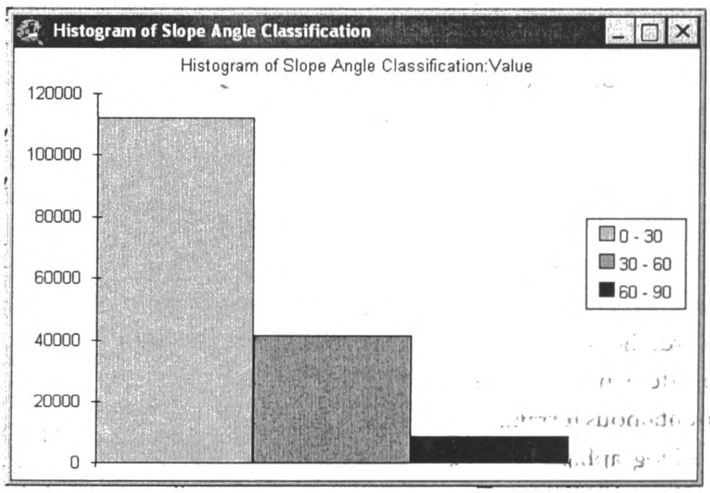

Figure 1: Result of the first objective

Name	BufferDis	Hectares
River Flooding	60.0000	4756.489
Tributeries Flooding	25.0000	4885.378

Figure 2. Result of the second objective

Conclusion

According to main objective, This study focuses to carry out the physical dimension and characteristics of environmental sensitive areas in Matara District and build a system to identify the spatial distribution of environmentally sensitive locations in the events of Disasters such as Landslide, based on slope and flooding buffers, It is highlights that hectares 15910 (12.34 %) is sensitive areas. In additional to that spatial distribution through out the district has been estimated.

Total works of this study has been done by using Geographic Information System. Three Dimension Model and Flood Buffer were essential to find the final Results. Results of This study will be very productive for the Local Planning. Especially, Divisional Secretariat Division offices and Local Authorities can be developed this system further for their distribution of funds and aid for prevent to disaster.

References

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Annex I. Spatial Distribution of Risk

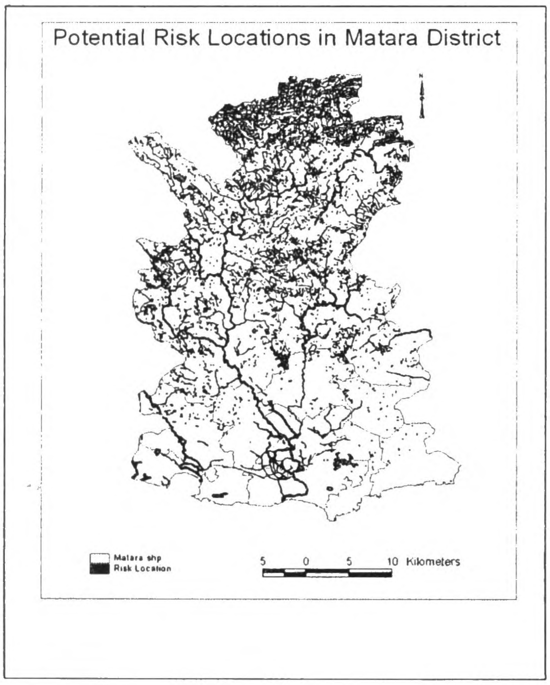
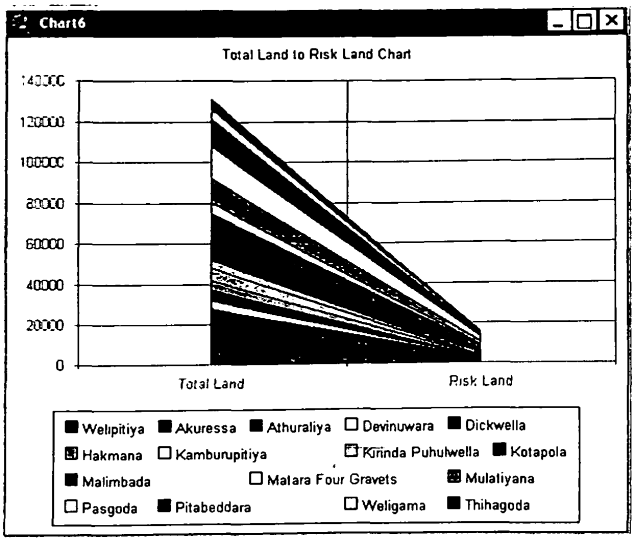


Chart 1: Risk Locations



Dsd_n	No_of_lands	TotalLand	Risk Land	% of Risk
Welipitiya	38	6696.51	461.768	7
Akuressa	46	14861.67	2009.564	14
Athuraliya	28	6593.40	602.098	9
Devinuwara	41	3761.76	95.148	3
Dickwella	48	5175.76	15.239	0
Hakmana	34	4962.18	322.703	7
Kamburupitiya	39	5971.89	258.892	4
Kirinda Puhulwella	25	4178.95	66.354	2
Kotapola	37	17932.86	4828.587	27
Malimbada	29	4797.80	224.704	5
Matara Four Gravets	66	5615.04	410.511	7
Mulatiyana	48	11941.39	1423.728	12
Pasgoda	43	15394.41	2536.247	16
Pitabeddara	40	13656.09	1737.769	13
Weligama	48	4337.62	306.163	7
Thihagoda	40	5094.39	609.466	12

Chart 2: Spatial distribution detail of Risk