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Data Descriptor

Landslide Inventory (2001-2017) of Chittagong Hilly Areas, Bangladesh

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Abstract: Landslide is a frequent natural hazard in Chittagong Hilly Areas (CHA), Bangladesh, which causes the loss of lives and damage to the economy. Despite that, an official landslide inventory is still lacking in this area. In this paper, we present a landslide inventory of this area prepared using the visual interpretation of Google Earth images (Google Earth Mapping), field mapping, and literature search. We mapped 730 landslides that occurred from 2001 to 2017. Different landslide attributes, including type, size, distribution, state, water content, future risk, and causes, are presented in the dataset. In this area, slide and flow were the two dominant types of landslides. Among five districts (Bandarban, Chittagong, Cox's Bazar, Khagrachari and Rangamati), most (54.93%) of the landslides occurred in Chittagong and Rangamati districts. About 45.09% of the landslides were small (<100 m^2) in size while the maximum size of the detected landslides was 85201.6 m^2. This dataset will help to understand the characteristics of landslides in CHA and provide useful guidance for policy implementation.

Dataset: Dataset is submitted as a supplement material

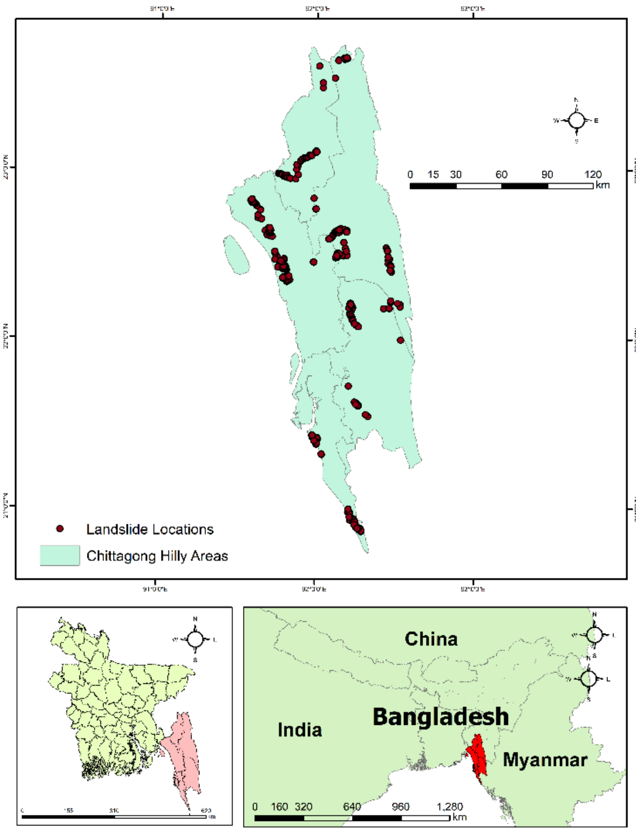
Keywords: Landslide, Landslide Inventory, Chittagong Hilly Areas, Attributes of Landslides

1. Introduction

Landslide is the movement of rock, soil, and debris downslope under the influence of gravity [1]. It is a natural phenomenon and depends on various factors, including local geology, topography, climate, and land use/land cover type [2]. Prolonged rainfall and earthquakes are the primary triggers of landslides. Road construction on the slopes, hill cutting, and deforestation are the major anthropogenic activities that create a conducive condition for landslides [3].

Landslide susceptibility mapping is essential to mitigate landslide disaster, and landslide inventory is the first step towards the susceptibility assessment [1]. Since landslides generally occur in existing slide areas, it is vital to know the locations of occurred landslides, size of landslides, and their-related geomorphological factors [4]. Landslide inventory is a dataset of various information associated with landslides, including the absolute and relative location, date, type, size, distribution, casualties, and causes of landslides [1]. Several methods have been used for landslide inventory mapping, including field mapping and visual interpretation of aerial and satellite images [5]. The first step of landslide inventory is to map the exact location of landslides and then to construct the dataset of landslides [6]. A good landslide inventory is shareable with broad scientific community and stakeholders [1].

In Bangladesh, landslides occur mainly in the Chittagong Hilly Areas (CHA) (Fig 1). More than 350 people died in CHA in the last three decades [7]. Landslide susceptibility mapping in some parts of this area have already been prepared [8-10]. In these works, researchers have generated landslide inventories using field mapping, visual interpretation, and automatic recognition of landslides from satellite images [10,11]. [11,12] published the landslide inventories in three cities of this area: Cox's Bazar, Teknaf municipalities, and Chittagong Metropolitan Area (CMA). Our recent work [5] mapped landslides of the whole area. This inventory can be used for landslide susceptibility mapping of the entire area, which is very important for land use planning and policymaking. It is of importance to publish and make the data available so that the broader scientific community and policymakers can utilize this dataset for scientific purposes as well as decision making.



2. Data Description

This article describes the landslide inventory dataset of CHA in Bangladesh (Fig 1). This inventory is prepared based on Google Earth mapping, field mapping, and literature search. It contains various attributes of landslides (Table 2) that occurred from 2001 to 2017.

2.1. Design of the Dataset

The dataset was prepared in ArcGIS 10.6.1, and the file type is ESRI shapefile. The main advantage of using the shapefile format is that the dataset is readily available for working in the ArcGIS platform. All necessary statistical and spatial analyses can be conducted with the dataset, and it can also be converted into other formats, such as the CSV file. Using this format, we do not have to provide coordinates of the landslides as these locations are geocoded in the shapefile.

2.2. Inventory Statistics

Most landslides in the dataset occurred in the Chittagong district (208) followed by Rangamati district (193) (Fig 2). The mean size of the landslides was 1205.49 m^2, with a standard deviation of 5167.71 m^2. The maximum size of the landslide was 85201.6 m^2, while the minimum size was 11.02 m^2. CDMP II (2012) did not provide landslide areas for 77 landslide locations; thus, the distribution for the size of landslides is based on 653 landslide locations. Slide (285) is the most dominant type of landslides, followed by flow (230), fall (87), complex (34), and topple (17). We

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failed to recognize the type of 77 landslides, and 62 of them were mapped in Google Earth. For 77 landslides from CDMP II (2012) in Cox's Bazar municipality, we did not have the size of landslides. From the rest of the 652 landslides, 45.09% (Table 1) are small (<100 m), while 13.96% of the landslides are within 1000 to 10000 m.

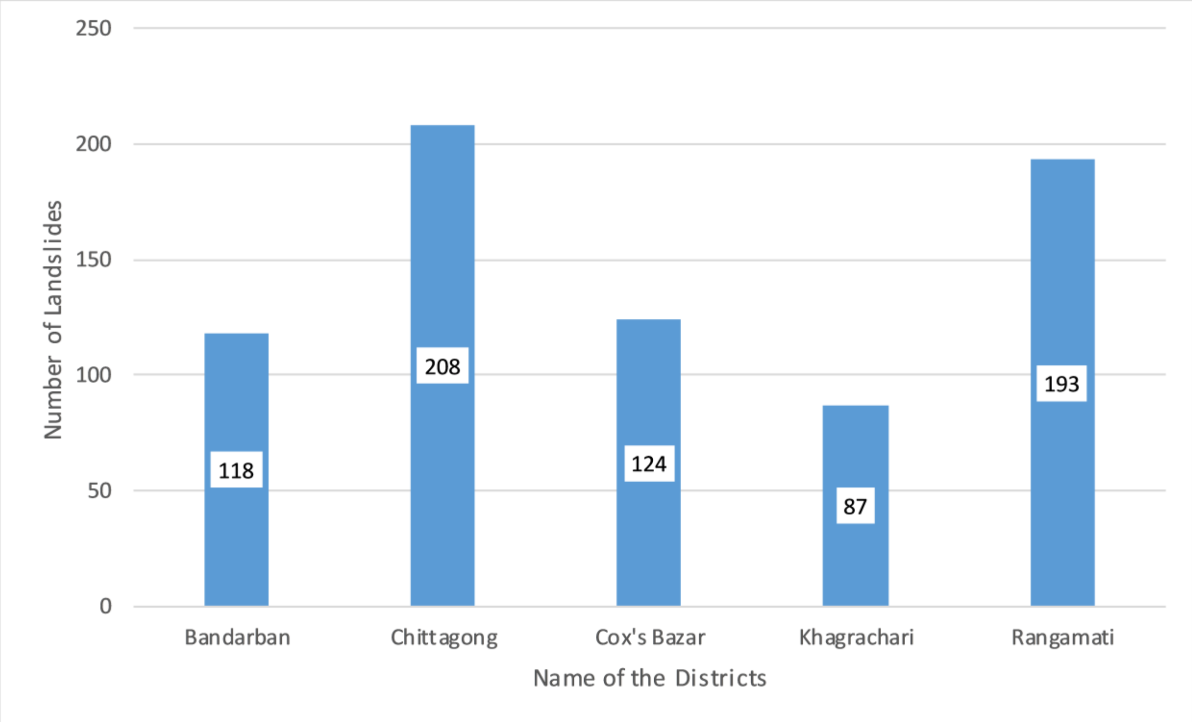

Fig 2: Number of Landslides in Different Districts of CHA

Table 1: Area of Landslides of CHA, Bangladesh

Area of Landslides (m^2)	Number of Landslides	Percentage of Landslides
0-50	185	28.37
50-100	109	16.72
100-200	68	10.43
200-500	102	15.64%
500-1000	74	11.34
1000-10000	91	13.96
10000-1000000	23	3.52

3. Methodology

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There is no standard method to create a landslide inventory dataset. Landslide inventory preparation aims to gather as much data as possible. A dataset includes various attributes, but some attributes may not be available for all landslides [13]. Most landslides are compiled from different sources for different purposes. We adopted three methods in our study: visual interpretation of Google Earth images, literature search, and field mapping. Each method has its advantages and disadvantages. For example, we can detect landslide location, type, dimension, and date in Google Earth mapping, while only the data that were recorded in the literature can be acquired. In contrast, most attributes related to landslide inventory can be gathered in the field mapping. The combination of these three methods helps to generate a landslide inventory that occurred in recent days, in the past, inaccessible areas and remote areas.

In Google Earth, we adopted four criteria to detect landslides: change of vegetation in historical images, the slope, and elevation of the area, morphological changes in the images, and presence of debris [5]. We mapped landslide from 2001 to March 2017 and recorded the location, date, type, and dimension of landslides. The detail of the landslide mapping in Google Earth is given in [5]. We searched for existing literature and newspaper reports before the field mapping. [11,12] provided the landslide locations, date, type, causalities, and causes of landslides for Chittagong Metropolitan Area (CMP), Cox's Bazar, and Teknaf municipalities. [12] did not provide the size of landslides, while [11] presented. Newspaper reports (1980-2017), records of the Disaster Management Department of the People’s Republic of Bangladesh, and Roads and Highways Department provided the landslide data that caused casualties and damages to roads. Based on these reports, we selected Rangamati, Bandarban, Khagrachari, and part of Chittagong districts for field mapping. We adopted participatory field mapping to record landslide locations and various attributes of landslides (Table 1), including causalities, damages, economic losses, and future risk of landslides [5,16]. The causes of landslides and financial losses were detected by interviewing local people, government officials, and local political leaders. The future risk was identified based on the qualitative judgment of the field investigators (classified four categories for future risk: Nil, Low, Medium, High). We used measuring tap and GPS to measure the area of each landslide. Four well trained filed investigators were hired to collect the type, distribution, state, and water content of landslides through visual investigation using classification schemes of [14,15].

The final dataset is the compilation of the data gathered from field mapping, Google Earth mapping, and literature search. We also combined the same landslide locations mapped by Google Earth and field mapping.

3.1. Accuracy Assessment

We assume that the accuracy of the field mapping is better than the other two methods because we visited the field sites and collected GPS locations of the landslides. The accuracy of the field mapping depends on the accuracy of the GPS unit. In this study, we used Gramin Trex 20x with an accuracy of 3-10 m. The dimensions of the landslides were measured using GPS and measuring tapes. The quality depends on the expertise of the field investigators (in our study, the field investigators were highly trained). The assessment of future risk was qualitative relying on the capability of field investigators.

We used the field mapping to validate the landslides mapped by using remote sensing techniques. The overall accuracy was 88% based on the validation at a test site in Bandarban district in CMA. We used Google Earth to map landslides and record the data in remote areas, especially in the forests. Due to the remoteness, we did not conduct the fieldwork there; thus, it is not possible to check and validate every location. The accuracy of the [11] and [12] are not known, but we can anticipate a very high accuracy as they used field mapping techniques.

Table 2: Landslide Attributes and Data Types

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Type of Attribute	Data Type	Full Explanation	Comment
ID	Number	Identification Number	
District	Text		The district is the Second Administrative Boundary of Bangladesh. Five Districts: Bandarban, Chittagong, Cox's Bazar, Khagrachari and Rangamati.
Location	Text		Detail Address of the Landslide Location.
Fail_Type	Text	Type of Failure	Five Types (Slide, Flow, Fall, Topple and Complex) of Landslides Have Been Identified Based on [14]. Type of 77 Landslides Was Not Identified And Kept As Unrecognized.
Date	Text		Generally, Exact Date Has Been Recorded. For Google Earth Mapping Date of the Image was Recorded.
State	Text	Sate of the Landslides	Six types of states: Active, Dormant, Inactive, Reactivated,

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			Stabilized and Suspended. State of 231 Landslide Was Not Determined.
Distri_	Text	Distribution of Landslides	Five types of distribution: Advancing, Diminishing, Moving, Retrogressive and Widening. Distribution of 286 Landslides Was Not Determined.
Water_Cont	Text	Water Content in the Scarp	Two types of Water Content: Wet and Dry. Water Content of 350 Landslides Was Not Determined.
Material	Text	The material of the Mass Moved	Materials Include Soil, Debris, Weather Rock and Soil, Rock and Soil, and a Mixture of These Materials. For 272 Landslides Material Was Not Determined.
Death_	Text	Number of Death	
Settlemet_	Text	Number of Settlement Damaged	
Dam_Int1	Text	Settlement Damage Intensity	Qualitative Judgement (High, Medium and

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			Low) of Field Investigators. Damage Intensity of 271 Landslides Was Not Determined.
Damae_Int2	Text	Road Damage Intensity	Qualitative Judgement (High, Medium and Low) of Field Investigators. Damage Intensity of 271 Landslides Was Not Determined.
Economic	Text	Economic Loss Caused by the Landslides	Qualitative Judgement (High, Medium and Low) of Field Investigators. Economic Loss of 271 Landslides Was Not Determined.
Future_Ris	Text		Qualitative Judgement (High, Medium and Low) of Field Investigators. Future Risk of 271 Landslides Was Not Determined.
Area	Number	Area of Landslides	Number of Decimal Places= 0.
Causes_	Text	Causes of Landslides	

We usedArea4 variable in the dataset to compline all landslides locations mapped in Google Earth and field mapping. For the convenience of joining the attributes of different.shp files, we kept the format of Area4 as text

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