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STUDY ON THE RELATIONSHIP BETWEEN RAINFALL AND LANDSLIDES IN CHATTOGRAM HILL AREA OF BANGLADESH USING REMOTE SENSING TECHNOLOGY

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ABSTRACT

This investigation intends to analyze the affiliation between the amount of rainfall and landslide occurrences in the Chattogram hill area of Bangladesh. A Landslide can induce human injury, death toll, financial pulverization, devastate development works, cultural and natural heritage. A landslide happens when some portion of a slope abruptly implodes due to quick changes in nature, for example, heavy precipitation, a tropical cyclone, or a seismic tremor (Lee 2016). Every year in the hilly region of the country faces casualties due to landslides. The situation is getting worse because of poorly planned urbanization in those areas. This work used JAXA Global Rainfall Watch (GSMaP) data to assess the amount of rainfall three days before the landslides. We used rainfall data of GSMaP of the month June of the year 2007 and 2017 respectively to watch the rainfall amount of that point to seek out a correlation between total amount rainfall and landslide occurred at that point. Although the variation of rainfall level differs too much it can be said that rainfall amount of any more than 200mm/day can be considered as a dangerous and potential cause for a landslide.

Key words: Landslides, remote sensing, urban expansion, environment

INTRODUCTION

Landslide is one of the principal remarkable catastrophic events in hilly conditions. The high-altitude territories of Bangladesh are obligated to landslide in contrast to other hilly regions of the world. The term "landslide" circumfuses several modes of slope movement such as falls, topples, slides, spreads, and flows. These are subdivided further by the type of geologic material (bedrock, debris, or earth). Debris flows (commonly referred to as mudflows or mudslides) and rockfalls are examples of common landslide types in Bangladesh. Landslide happens often inside the hilly regions of Chittagong, a south-eastern part of Bangladesh (Ahmed *et al.* 2014). The hills are normally composed of incoherent sedimentary rocks like sandstone, siltstone, shale and combination. Landslides commonly used to portray the descending movement of soil, rock and natural materials under the impacts of gravity and the landform that outcomes from such movement (Highland and Bobrowsky 2008). Snappy urbanization and human advancement

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exercises like housing and commercial construction through deforestation and unearthing of slope inclines have expanded landslides in intensely populated urban communities situated in hilly regions (Galli and Guzetti 2007).

In Bangladesh rainy monsoon season generally lasts from June through October. Reference (Temesgen *et al.* 2001) considered the recurrence of landslides in Ethiopia by examining the connection between precipitation and geography, including topography and forest formation. According to the reference, precipitation is the most typical explanation for landslides (Polemio 2000). The goal of this study is to investigate the affiliation between the quantity of rainfall and landslide in Bangladesh. For doing this we observe the rainfall data prior to the landslide incidents of both 2007 and 2017. We investigate those landslides prone spot for understanding the correlation between probable landslide and rainfall.

METHODOLOGY

Chattogram Sadar and Sitakund Upazila have been investigated for the study area. All of those places, especially Chattogram Sadar have been known to have suffered landslide events frequently. The research team studied the study area from google image to seek out potential landslide zones. The group tried to determine the quantity of rainfall on those places and also to find out the exact place of the landslide. JAXA (The Japan Aerospace Exploration Agency) has developed the Global Satellite Mapping of Precipitation (GSMaP) within the Global Precipitation Measurement (GPM) mission. It delivers near real-time rainfall products. During this work, we used rainfall data from GSMaP of the month June of the year 2007 and 2017 respectively to watch the rainfall amount of that point to seek out a correlation between total amount rainfall and landslide occurred at that point.

Figure 1. Red squares are shown past landslide spots of Chattogram.

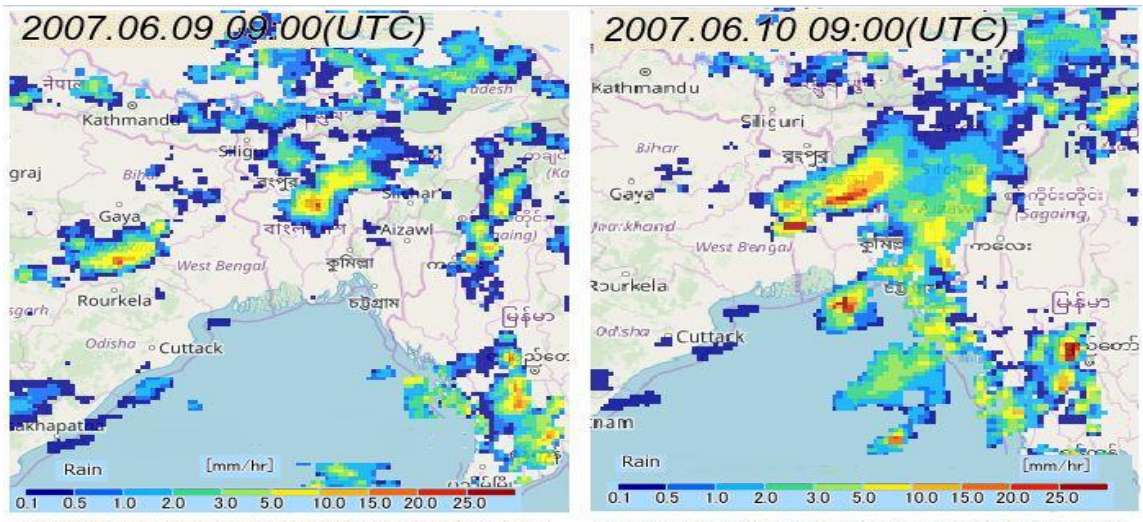
Figure 1 and 2 shows the past landslide spots of Chattogram. Two events that took place in 2007 and 2017 have the highest impact in the near past. Both of the events were in June. This work used JAXA Global Rainfall Watch (GSMaP) data to assess the amount of rainfall three days before the landslides. Figure-3 showing precipitation over the study area from 9/06/2007 to 12/06/2007 at local time 15:00. And Figure-4 showing precipitation over the study area from 9/06/2017 to 12/06/2017 at local time 15:00. The portal provides hourly rainfall data from satellite measurements. The rainfall amount is calculated during the four days before the landslide by randomly selecting hourly rainfall each day.

Figure 2. Showing spot [1], [2] and [3], respectively as landslide spot could be seen in the mid-section of the image above the establishment.

Landslide of 12 June 2007

The rainfall condition of the period 9-12 June 2007 is acquired from JAXA Global Rainfall Watch. The average rainfall of this period is estimated to determine total rainfall before the landslide.

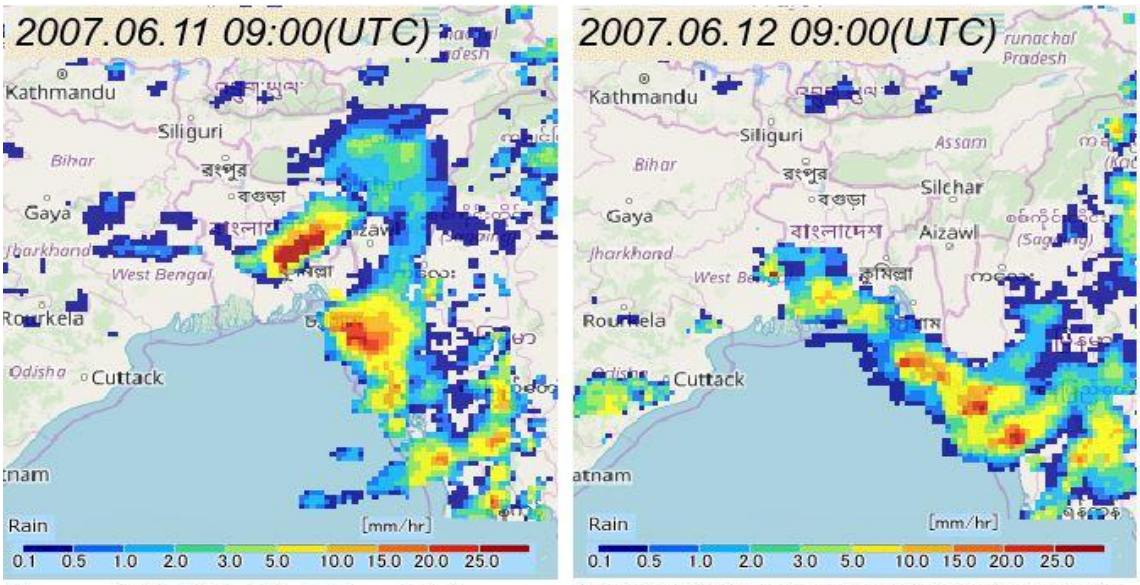
(a) **(b)**



As seen on 09/06/2007, local time 15:00, precipitation over the study area is zero.

As seen on 10/06/2007, local time 15:00, precipitation over the study area is no more than 10.00 mm/hr.

(c) **(d)**



As seen on 11/06/2007, local time 15:00, precipitation over the study area is over 25.0mm/hr.

As seen on 12/06/2007, local time 15:00, precipitation over the study area is no more than 10.0mm/hr.

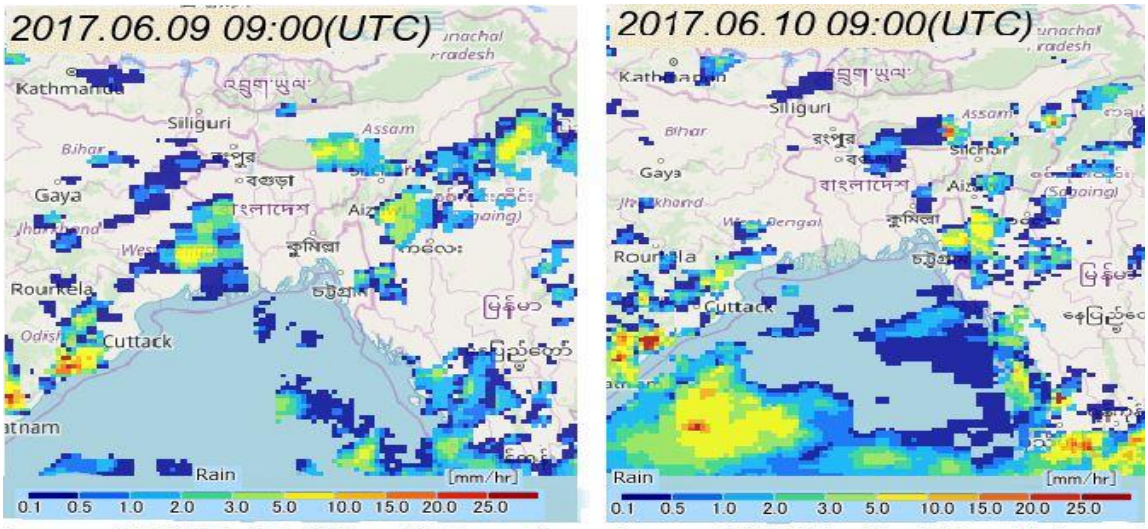
Figure 3 (a, b, c, d). Showing precipitation over the study area on 9/06/2007 - 12/06/2007, local time 15:00.

From the rainfall data, it is found that the average amount of rainfall was approximately 60mm, 297mm, 400mm and 200mm on days 9, 10, 11 and 12 June 2007, respectively.

Landslide of 12 June 2017

The rainfall condition of the period 9-12 June 2017 is gathered from JAXA Global Rainfall Watch. The average rainfall of this period is estimated to determine total rainfall before the landslide.

(a) **(b)**



As seen on 09/06/2017, local time 15:00, precipitation over the study area is 0.0 mm/hr.

As seen on 10/06/2017, local time 15:00, precipitation over t study area is more than 5.0mm/hr.

(c) **(d)**

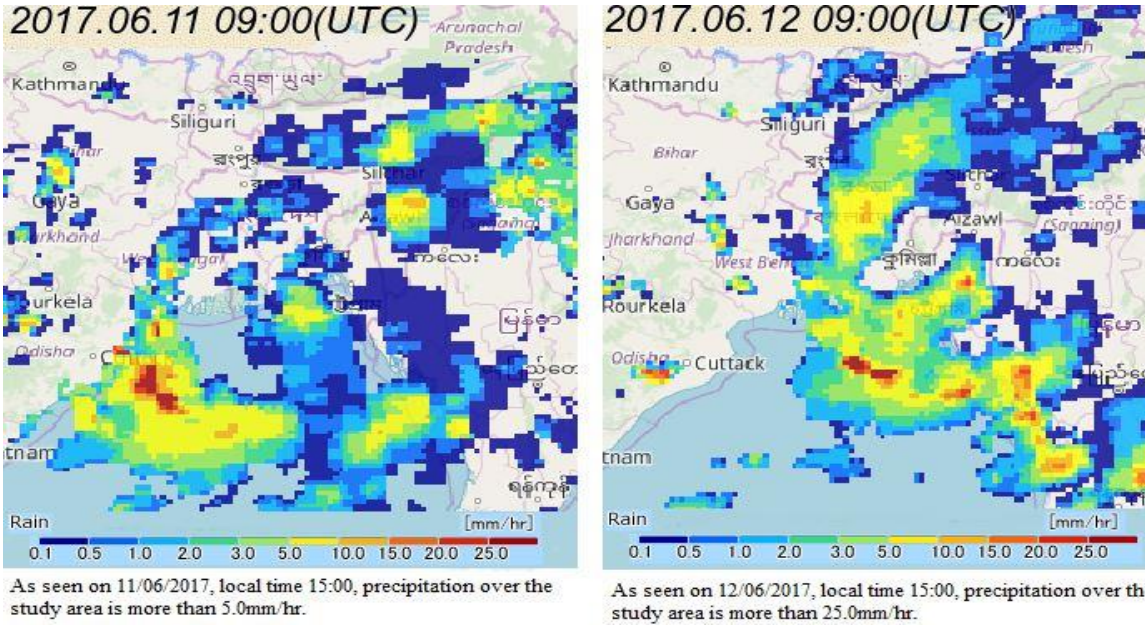


Figure 4 (a, b, c, d). Showing precipitation over the study area on 9/06/2017 - 12/06/2017, local time 15:00.

From the rainfall data it is found that the average amount of rainfall was approximately 50mm, 84mm, 67mm and 201mm on day 9, 10, 11 and 12 June 2017, respectively

RESULTS AND DISCUSSION

The landslide which occurred on 11/06/2007 and 12/06/2007 was responsible for the death of nearly 127 people and 125 people were also injured because of that landslide incident. We have seen an average of more than 200mm/day amount of rainfall occurred prior to the landslide incident of that time. Approximately 164 people had died and 187 people got injured due to the landslide incident of 12 June 2017 (Sultana 2020). On that day the total amount of rainfall was also more than 200mm. So, it is obvious that a daylong heavy rainfall of amount 200mm/day or more prior to the landslide incident was the main reason for occurring those landslides. It is necessary to predict landslide occurrences brought about by future changes in precipitation through the agreement of the relationship between past and future precipitation and landslides and to create strategies to quantitatively anticipate changes in precipitation on account of worldwide environmental change (Daly *et al.* 2003). For the determination of rainfall triggering level, it is extremely important sufficient number of events for an accurate threshold level of rainfall. Due to the lack of any centralized database accounting landslide events, the current work suffers uncertainty of measurement. The pixel size of used rainfall data is 12 km while the sites are much smaller in some instances making it difficult to assess the amount of rainfall at that particular place. It was also noted that a considerable amount of construction activity was going on at some of the sites which eventually led to such events.

CONCLUSION

In the calculated data it's seen that the variation of rainfall level differs too much but it can be said that rainfall amount of any more than 200mm/day can be considered as a dangerous and potential cause for the landslide. It should also be noted that in the Chattogram region any two-three days of rainfall span requires special monitoring for probable landslide incidents.

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