# Flood Volume Estimation in the Kurigram Region, Bangladesh Using Remote Sensing

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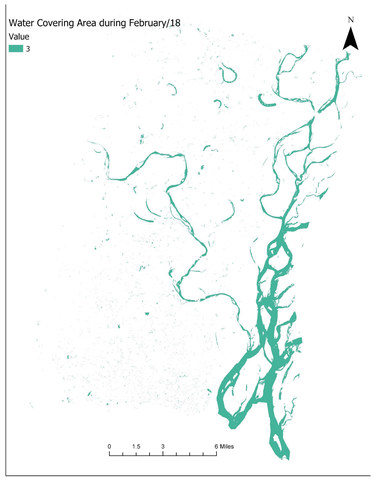
## Introduction

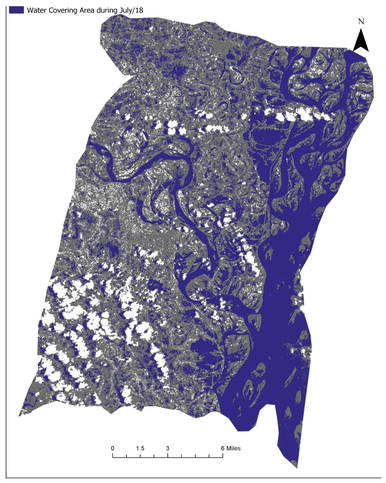
Bangladesh is a flood prone country and flood is a common natural calamity in the northern part of Bangladesh due to heavy rainfall and water flow from the upstream hills in India. Moreover, the sudden release of water from Teesta barrage makes the flood condition worse.

## Area of Study

My study area is Kurigram region, Bangladesh. Kurigram region is situated 25°23'N to 26°14'N latitude and 89°28'E to 89°54'E longitude. I selected this region for some important reasons related to flood risk. Four major rivers (e.g. Brahmaputra, Dharla, Teesta, Torsa) are flows on the Kurigram, and this area is close to Teesta barrage which may have severe influence on flooding when water released suddenly from barrage. Flood and river bank erosion are main disasters in the Kurigram region (Roy 2016).




Water covering surface area in Kurigram region during February 2018

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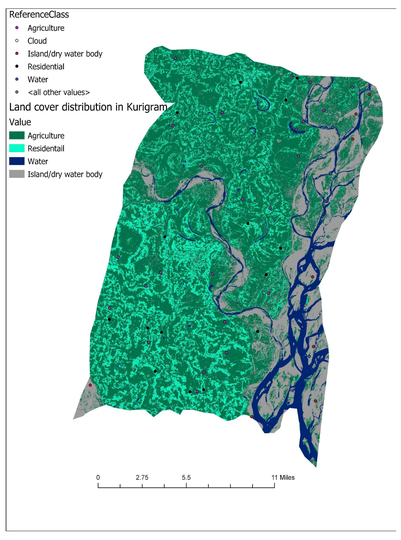
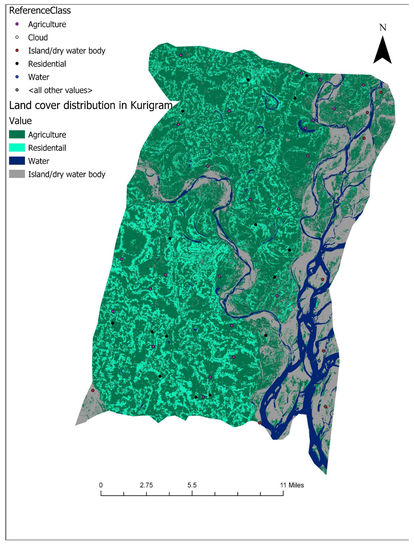
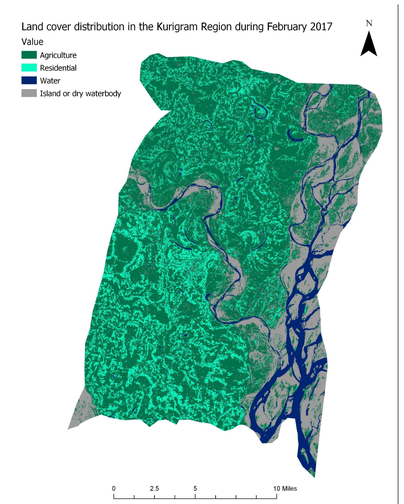
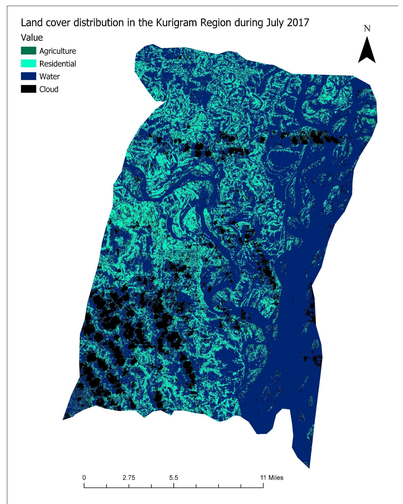


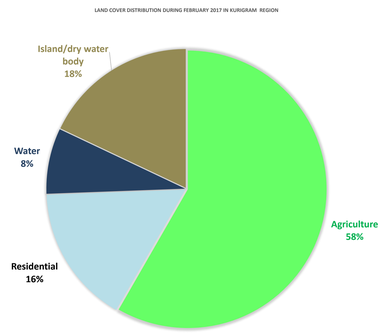



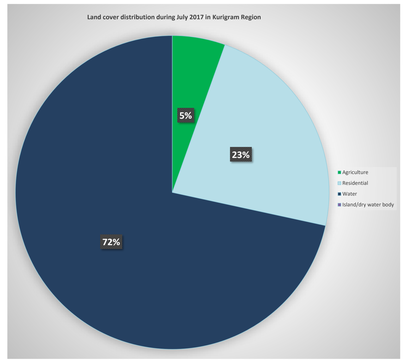

## Data

I used two image from planet satellite having spatial resolution 3x3 meter. One image captured during dry season, February 5, 2017 and another image captured during flood, July 18, 2017 are used to compare water volume to get the total volume of flood. I also used ALOS digital surface model (DSM) data to get the 3D inundation of the study area.



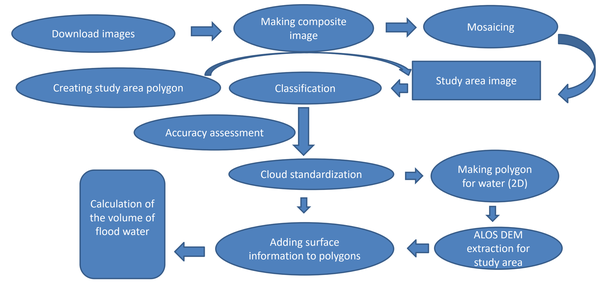

## Results and Discussion

The area (2-D) covered by water in the Kurigram region during February, 2017 is 792.1 square kilometer and 3-D area is 794.1 Sq.km. At the same time, the volume of this water is 51.9 cubic kilometer. While area (2-D) during June is 793sq.km, and 3-D area is 795 sq.km. But, there is a huge amount of water during June, 171.06 cubic kilometer. This huge amount of water on such a small area indicates severe flood. Almost 4 times (171.06 cubic kilometer) time more water accumulated during June than the February.

This flood had a severe effect not only on the Kurigram region but also other part of the Bangladesh as water flowed all the way to Bay of Bengal. Two major factors make flood condition worse in this region. Firstly, Teesta barrage harms both way. During dry season, it restricts the natural flow of the water as a result river basin became shallow accumulating sediment in the river bad. Suddenly, tremendous amount of water discharge through barrage during summer time which causes flood.

Secondly, rainfall distribution is uneven due to climate change. Sometimes, Kurigram region experience 250 mm rainfall within few days. Flood and river bank erosion happen coincidently in this zone and make thousand of people homeless. The number of climate refugees are increasing every year in Bangladesh.

## Methodology




## Accuracy Assessment

I followed Fitzpatrick-Lins suggestion to determine the sample size of reference point N which is based on the binominal probability theory (Jensen 1996).

$$N = Z^2(p)(q)/E^2$$

Where my expected percent of accuracy of map p is 85 and q=100-p. Allowable error, E, is 10 while Z =2 from the standard deviation of 1.96 for the 95% two-sided confidence level.

| Error Matrix (February/17) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Agriculture | Residential | Water | Island | Raw total | Producer accuracy | User Accuracy |
| Agriculture | 20 | 3 | 0 | 1 | 24 | 90.91% | 83.33% |
| Residential | 2 | 12 | 0 | 1 | 15 | 80.00% | 80.00% |
| Water | 0 | 0 | 6 | 0 | 6 | 100.00% | 100.00% |
| Island | 0 | 0 | 0 | 6 | 6 | 75.00% | 100.00% |
| Column total | 22 | 15 | 6 | 8 | 51 | Total Accuracy | 86.27% |

| Error Matrix (July/17) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Agriculture | Residential | Water | Cloud | Raw total | Producer accuracy | User Accuracy |
| Agriculture | 7 | 1 | 0 | 0 | 8 | 77.78% | 87.50% |
| Residential | 2 | 10 | 0 | 1 | 13 | 90.91% | 76.92% |
| Water | 0 | 0 | 16 | 2 | 18 | 94.12% | 88.89% |
| Cloud | 0 | 0 | 1 | 11 | 12 | 78.57% | 91.67% |
| Column total | 9 | 11 | 17 | 14 | 51 | Total Accuracy | 86.27% |

Assessment of the land cover classification accuracy was carried out. Error matrices were used to assess the accuracy of classification. Accuracy of the classes range from 70% to 100%.

## Conclusions

Remote sensing technology helps to understand what are going on the large land within very short period of time without doing arduous effort. Flood monitoring requires quick initiatives and remote sensing technology facilitate to monitor quickly and continuously.

This study will help decision makes to manage flood in a better way. It also provide an idea whether drainage basin is sufficient or not in the Kurigram Region. Barrage is needed to save land from river-bank erosion and this study may help to know what kind of barrage is needed for some part of Kurigram area.

Finally, this study will help to conduct further research on flood in Kurigram.

## Reference

Jensen, John R. 1996. *Introductory digital image processing: a remote sensing perspective*. Upper Saddle River, NJ: Prentice-Hall.

Roy, S.K. and Sarker, S.C. (2016) *Integration of Remote Sensing Data and GIS Tools for Accurate Mapping of Flooded Area of Kurigram, Bangladesh*. Journal of Geographic Information System, 8, 184-192. http://dx.doi.org/10.4236/igis. 2016.82017

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