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CS-174 Estimation of Flooded Area by Land Cover Classification Using Satellite Remote Sensing Data－Case Study of Dhaka City, Bangladesh－

MD. MONIRUL ISLAM Student Member Kitami Institute of Technology
KIMITERU SADO Member Kitami Institute of Technology

1. INTRODUCTION

Bangladesh suffered damage on account of the most catastrophic flood during the year of 1988. It was devastating and historical flood set 100 years new record. Flood commenced in the beginning of July and peak flow (190800 m^3/s) of three major rivers, Ganges, Meghna, and Brahmaputra were reached within a period of 72 hours between 30 August and 2 September (Rashid and Paramanik, 1990). An estimated area 82000 km^2 (57% of total area) was inundated which superseded the previous record of the extent of 1987 flooding 40% of total area. Flood caused untold suffering to the people, crops were lost, lives were lost, infrastructure were damaged, and so on. Consequently, the flood problem is great indeed.

2. USING MOS－1, MESSR DATA

For the estimation of flooded area of Dhaka city three images data of 17th October 1988, 27th January 1989, and 9th May 1989 were considered for different dates, during the flood (one month after the peak flow of three major rivers), dry season, and the beginning of monsoon, respectively.

3. LAND COVER CLASSIFICATION

Geometric correction were carried out by using Affine transformation. Seven ground control points were selected from points easily identified on the satellite image and on topographic maps of Dhaka city generalized land use map (1:25000) produced by Bangladesh Space Research and Remote Sensing Organization (SPARRSO). The absolute difference between the calculated values and the measured values of image coordinate were within 3 pixels, and were satisfactory. After geomatric correction each image has 400 × 320 pixels which covered 20km × 16km on the ground surface. In the new image, the CCT count of each pixel was resampled from the old image by the nearest neighbour interpolation. For land cover classification, parallel piped classifier was used. The image data of 17th Oct.,'88, 27th Jan.,'89, and 9th May,'89 were classified into twelve, eight and seven categories, respectively. Classification have been done by using the software "Remote－10" (The Remote Sensing Society of Japan, 1989) on the basis of false color composition of satellite image compared with Dhaka city land use map (1:25000).

4. ESTIMATION OF FLOODED AREA

Table 1 is the matrix which shows the estimation method of flooded area in collaboration with land cover classified results of flood and dry season. The percentage **a**, **b**, **c** and **d** can be obtained from land cover classified results. The percentage **c** and **d** correspond to originally water area and non water area during the dry season, on the other hand **a－c** and **b** are flooded and non flooded area during the flood season. In order to estimate the flooded area land cover classified results were finally divided into two categories, water and non water area. Water and non water area percentage during flood (October), dry season (January), and beginning of monsoon (May) are shown in Table 2(a) and 2(b). What kind of change should take place and how much percentage of area remained unchanged and changed their condition during the flood and the beginning of monsoon compared with dry season can be understood. Comparing between the matrix shown in Table 1 with Table 2(a) and 2(b), it is assumed that actual water area is around 4.42% or 3.91% during dry

Table 1. Matrix for estimation of flooded area

		Dry season		
		Water area	Non water area	Total
Flood season	Water area	c	a－c	a
	Non water area	0	b	b
	Total	c	d	100%

Table 2. Water and non−water areas (a) during the flood and (b) the beginning of monsoon

(a)

OCTOBER \ JANUARY	Water area (%)	Non water area (%)	Unclassified (%)	Total (%)
Water area (%)	4.16	41.09	5.20	50.45
Non water area (%)	1.77	38.20	4.94	44.91
Unclassified (%)	0.26	3.24	1.14	4.64
Total(%)	6.19	82.53	11.28	100.00

(b)

MAY \ JANUARY	Water area (%)	Non water area (%)	Unclassified (%)	Total (%)
Water area (%)	3.04	17.14	1.72	21.90
Non water area (%)	2.28	56.04	6.88	65.20
Unclassified (%)	0.87	9.35	2.68	12.90
Total(%)	6.19	82.53	11.28	100.00

season, adding 0.26% and 0.87% which belongs to unclassified with 4.16 and 3.04%, and ignored 1.77% and 2.28% considered as error which belongs to non water area in the flood season and the beginning of monsoon, respectively. At least 41.09% area were remaining under flooding condition up to the mid−October 1988 and cosidered as flooded area. From similar assumption 17.14% area can be considered as temporary deposit water in the begnning of monsoon.

5. RESULTS AND DISCUSSION

Flooded area 41.09% which was estimated by using the data of one month after the peak flood. Although estimated flooded area is less than actual flooded area at the time of peak flood, this technique have been adopted to estimate the inundated area in collaboration with land cover classification.

Figure 1(a) and 1(b) shows the mean value and standard deviation of NDVI for highland with scattered settlements, cultivated land with scattered settlements and housing area, commercial with housing area, respectively. Positive mean value of NDVI indicates high dense vegetation. and negative indicates low dense vegetation. NDVI values were influenced by deciduous trees, with leaves in spring and summer and without leaves in winter, and also depends on crop growing seasons. During the flood inundated water and moisture content of the submerged soil which caused low albedo and led to the increase of standard deviation.

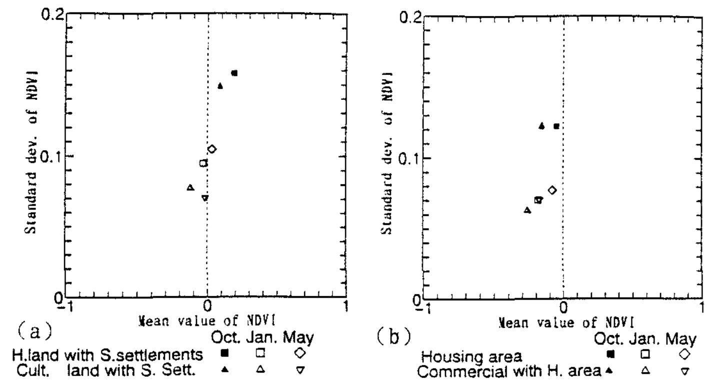

Figure 1. Mean value and standard deviation of NDVI

CCT count for each band of different water categories are shown in Figure 2 during the flood. The different spectral characteristics for river, lake and deposit water and usefulness of band 1 to 4 are understood. CCT count for river water is higher than that of lake and deposit water. Because river water contained more turbidity during the flood which led to the increased reflection of solar radiation.

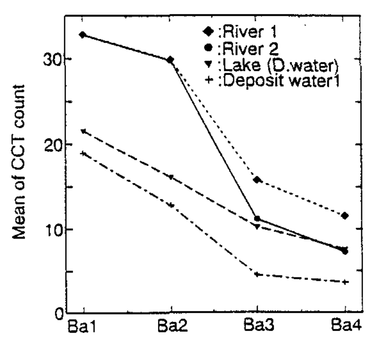

Figure 2. CCT count of different water categories for each band

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