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ASSESSMENT OF WATER QUALITY USING REMOTE SENSING TECHNIQUES -A CASE STUDY ON SYLHET METROPOLITAN AREA

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ABSTRACT
Supportable administration of water assets includes save maintaining, capable use, and distinction administration. However, exercises identifying with amount examination and administration as far as waterway release and water assets arranging are given consideration, water quality appraisal are as yet being done at particular areas of real concern. Utilizing otherworldly and spatial goals sensors and geospatial displaying strategies, water quality parameters, for example, chlorophyll-a, green growth sprout, turbidity and mineral substance in water bodies are being observed requiring little to no effort. Coordination of these advances with field checking have effectively helped in distinguishing proof of pollution zones and sources and for creating techniques for remediation. SYLHET" is one of the major urbanized territory in the Bangladesh which bowl zone encounters a fast change because of increment of the urbanized zone. There is incredible Impact of land utilize change because of quick populace and spontaneous urbanization. Unlawful lodging, superfluous enterprises and motorways are experiencing childhood with the water hold territory. These foundations going through the insurance zones of catchments territory which hampering water quality enormously. The examination is centred around the evaluation of urbanization in connection to arrive utilize and water quality utilizing RS and GIS strategies. To evaluate the water quality turbidity and Chlorophyll is estimated and results shows due to increase of heat island decrease of chlorophyll within 10 years is 15.37%.

Keywords: GIS; Water Quality; Land Use Change; Water Basin

INTRODUCTION

Bangladesh is a place where there are wetlands. In excess of 66% of the nation might be delegated wetlands as indicated by the definition articulated in the Ramsar Convention. Based on sorts, the wetlands of Bangladesh can be comprehensively characterized into the inland freshwater and tidal saline water wetlands. Floodplains, beels, haors and baors are the parts of the inland freshwater wetland's classification. The wetlands of Bangladesh bolster a wide assortment of flower and faunal decent variety, some of which are all inclusive and in addition privately imperilled. Be that as it may, these amphibian assets have been subjected to quick debasement because of the expanding populace weight, territory pulverization and other anthropogenic and regular causes (Choudhury, 2005). In the course of recent decades' biodiversity has turned into the issue of worldwide worry for its fast decrease around the world. Bangladesh is no exemption. Wetlands are considered as the world's most gainful environments as they give an extensive variety of monetary, societal and natural advantages. Wetlands and floodplains assume an imperative job in the lives of a large number of needy individuals worldwide by giving subsistence jobs (Nishat, 2002) despite the fact that wetlands have many known attributes that are vital to the vocations of nearby occupants, they are corrupted and lost because of a great deal of activating elements. Wetland preservation and relief can be an inescapable technique for the eventual fate of the Bangladesh. Bangladesh is an incredible agent of tropical districts rich with gigantic organic

decent variety. The wetlands of north-eastern locale of Bangladesh have incredible environmental, business and financial significance. The dynamic connection of earthbound and oceanic frameworks makes these wetlands very profitable naturally. The wetlands are perceived as containing extremely rich segments of biodiversity of nearby, provincial and national hugeness (Nishat, 2002). The assets in the hoar region have no appropriate preservation and administration strategy, for which those are declining steadily. Regardless of a developing familiarity with the requirement for ensuring nature, debasement has happened quickly amid the most recent three decades. Subsequently, nation's nature has been harmed, backwoods exhausted, wetlands decimated.

The aim of the study is to evaluate the quality of the changing of wetland during the period of 2005 to 2016 in Sylhet Metropolitan Area (SMA). To achieve the aim of the study, following objectives are adopted (1) To find out the changes of wetland area in SMA during the period of 2005 to 2016 using supervised classification (2) To measure the quality of wetland according to remote sensing techniques of chlorophyll, turbidity and temperature in SMA.

METHODOLOGY

Sylhet, is a noteworthy city in north-eastern Bangladesh. It is the capital of Sylhet Division and Sylhet Region, and was conceded metropolitan city status in Walk 2009 (Choudhury, 2014 It is one of the biggest urban areas in Bangladesh. The Sylhet locale is outstanding for its tea gardens and tropical timberlands, the city anyway is right now known for its business blast — being one of the most extravagant urban communities in Bangladesh, with new ventures of inns, shopping centers and extravagance lodging bequests, and so forth. For carrying study, a consecutive methodology has been adopted. For the study TM of Landsat imagery is collected for three different years 2005, 2010, 2013 and 2016 and the cloud cover of the data is less than 4%. After data collection data is processed in several steps for further analysis. Image order alludes to gathering picture pixels into classifications or classes to create a topical portrayal. For surveying the land cover change at first regulated characterization used to decide the land utilize example of the examination zone and exactness appraisal is done to evaluate the precision of the order. The overall accuracy of the classification is about 79%.

Table 1: Details of the Landsat Satellite Images

Satellite	Sensor	Date	Resolution	P/R
Landsat 5	TM	06 September, 2005	30m	136/43
Landsat 5	TM	25 August, 2010	30 m	136/43
Landsat 8	OLI-TIRS	12 September, 2013	30m	136/43
Landsat 8	OLI_TIRS	03 July, 2016	30 m	136/43

Table 2: Accuracy Assessment Matrix

Classification	Waterbody	Vegetation	Others	Row total	Error of commission	User accuracy
Waterbody	2155	35	50	2240	12.12	87.89
Vegetation	3	3278	14	3279	18.39	81.60
Others	318	289	199	806	22.57	77.43
Total column	2436	3849	263			
Error of omission	13.18	14.84	24.33			
Procedure accuracy	86.82	85.16	75.67			
Overall accuracy 79.85%						

The one of the most important stage of the study to estimate the temperature from the prepared satellite image. Then the radiance is converted into temperature in Kelvin unit. Then temperature is again converted Kelvin to Degree Celsius. For Landsat TM image digital numbers DNs of thermal band (band 6) of were converted into radiance using the following Eq. (1)

$$R_{TM6}=V/255\ (R_{max}- R_{min}) + R_{min}$$

Where V represents the DN of band 6 and

$R_{Max} = 1.898(\mathrm{mW} * cm^{-2} * \mathrm{sr}^{-1}), \mathrm{R_{MIN}} = 0.1534(\mathrm{mW} * cm^{-2} * \mathrm{sr}^{-1})$

And the second step, conversion of radiance into temperature in Kelvin T(K) was done by the following Eq. (2)

$$T = \frac{K1}{\ln(K2/(R_{TM6}/b) + 1)}$$

Where, K_1=1260.56K and K_2= $607.66(\mathrm{mW} * \mathrm{cm}^{-2} * \mathrm{sr}^{-1} * \mu\mathrm{m}^{-1})$, b represents the effective spectral range and b=1.239(μm)

For Landsat OLI_TRS, at first, OLI and TRS band data can be converted to TOA using the following Eq. (3)

$$L_\lambda = M_L W Q_{cal} + A_L$$

Where; L= TOA spectral radiance $(\mathrm{Watts/m}^2 * \mathrm{srad} * \mu\mathrm{m})$, M_L= Band specific multiplicative rescaling factor from the metadata, A_L= Band specific z rescaling factor from the metadata. Q_{cal}= Quantized and calibrated standard product pixel values (DN)

For converting spectral radiance to temperature following Eq. (3) is used

$$T = \frac{K2}{\ln(K1/L_\lambda + 1)}$$

Where ;T= At satellite brightness temperature (K), L_λ= TOA spectral radiance $(\mathrm{Watts/m}^2 * \mathrm{srad} * \mu\mathrm{m})$, K_1= Band-specific thermal conversion constant from the metadata (K_1_CONSTANT_BAND_x, where x is the band number, 10 or 11) , K_2= Band-specific thermal conversion constant from the metadata (K_1_CONSTANT_BAND_x, where x is the band number, 10 or 11); Temperature are derived in 'Kelvin (A)' which were converted into 'Degree Celsius (B)' using the following equation

B= A-273.15

For assessing turbidity and total suspended matters are considered as important variables in many studies due to their linkage with incoming sunlight that in turn affects photosynthesis for growth of algae and plankton. These parameters are also directly associated with Secchi disk depth.

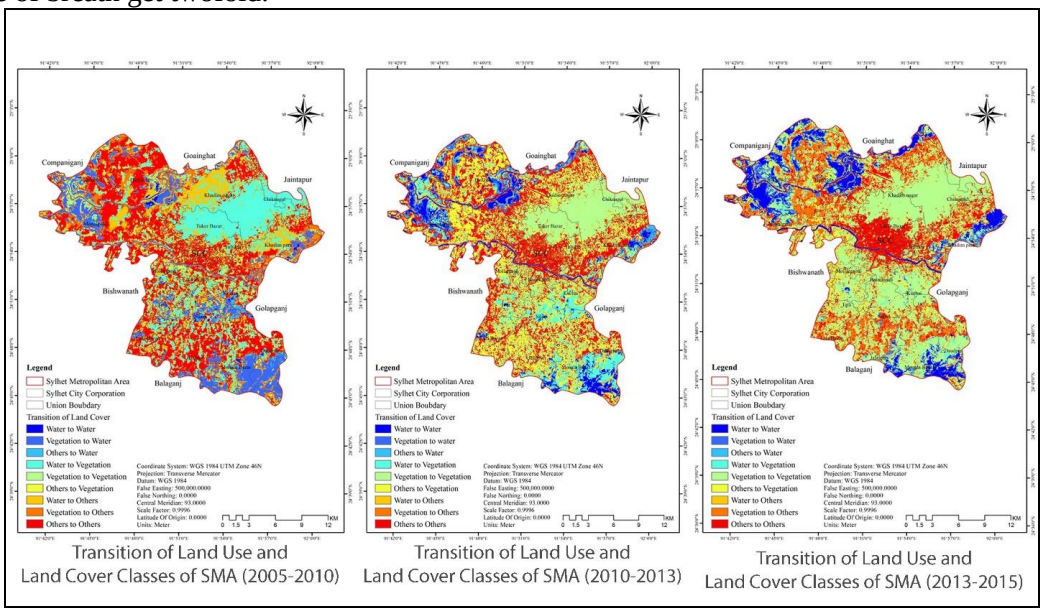
$$T = 6.7 + \left(0.62 \times \frac{RED}{NIR}\right) - \left(0.882 \times \frac{NIR}{BLUE}\right) - \left(3.22 \times \frac{GREEN}{BLUE}\right)$$

For retrieval of Chlorophyll band ratios is used to select two spectral bands that are representative of absorption/scattering features of chlorophyll-a (Gin et al. 2002). The past examinations have additionally demonstrated that the wavelength run for portraying chlorophyll-an is somewhere in the range of 400nm and 900nm. Along these lines, the four groups which are generally connected with chlorophyll-an are the blue, green, red and NIR groups. The last phase of the investigation is the estimation of connection between the surveyed parameters to decide the water quality.

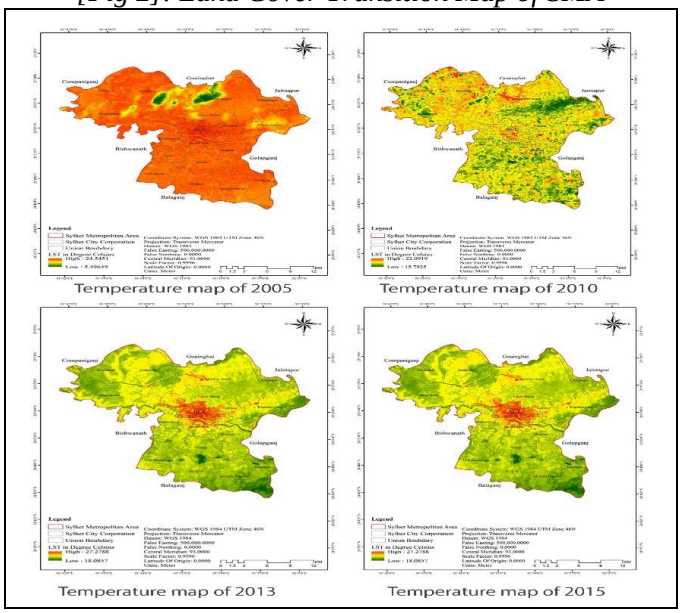
RESULTS AND DISCUSSIONS

Figure 2 demonstrates the change of land cover in the Sylhet Metropolitan Territory (SMA) for the four eras considered in this exploration. Two patterns are unmistakably discernable from the figure: (a) vegetation expanded steadily over the periods; and (b) water body declined step by step over the periods. All the more particularly vegetation expanded by 33.14% and water body diminished by 20.54% in the previous 11 years, from 2005 to 2016. Be that as it may, two things are not reasonable from Figure 6. To start with, it is misty whether the developed territories were just the beneficiary of grounds from different kinds or contributors too to different sorts (e.g., changed over from developed to water body). Second, the examples of transformations like the degree of change from one class to the others). With the end goal to comprehend these connections, additionally examinations were led. In this examination band no 6 from Landsat TM satellite picture was utilized to assess surface temperature and NDVI. Remote detecting is a compelling apparatus for order of land cover and NDVI. The LST circulation of 2005, 2010, 2013 and 2016 present in figure 3. High temperatures are mostly found in urban focuses, that is the warmth island impact. The base, greatest and normal temperature were 14.50°C, 24.55°C and 19.52°C of every 2005 and 15.79°C, 22.09°C and 18.94°C out of 2010 and

19.84°C, 25.73°C and 22.78°C of every 2013 and in conclusion, 18.09°C, 27.28°C and 22.68°C out of 2016. Over the eleven years (2005 to 2016) the normal temperature expanded 3.16°C and the greatest and least temperature expanded separately 2.73° C and 5.34°C. The outcome shows that the warmth island impact is expanding step by step. Since, the temperature is rising step by step, rate of breath in the plants is affected by temperature and inside certain breaking point of 10°C increment in temperature, the rate of breath get twofold.



[Fig 2]: Land Cover Transition Map of SMA



[Fig 3]: Temperature Map of SMA

Table 3**:** LST (°C) values for 2005, 2010, 2013 and 2016

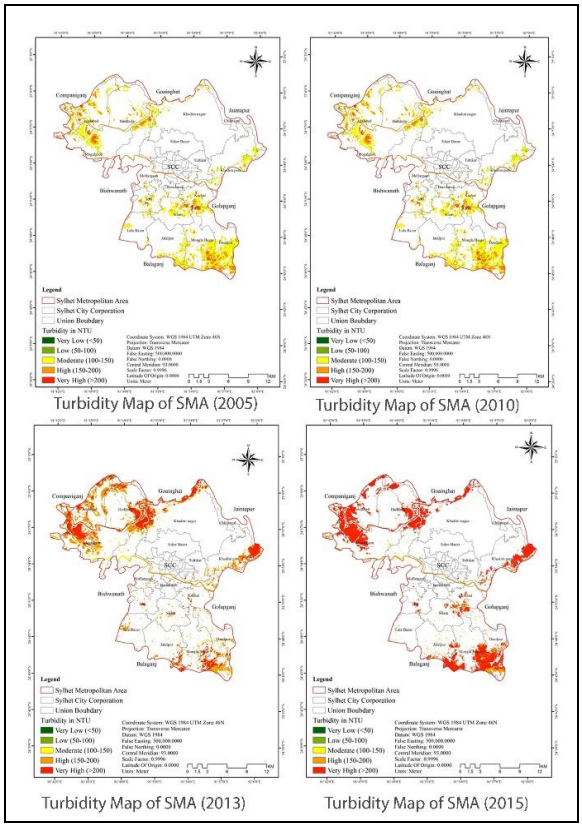
Year	High	Low	Mean
2005	24.55	14.50	19.52
2010	22.09	15.79	18.94
2013	25.73	19.84	22.78
2016	27.28	18.09	22.68

From the above table Chlorophyll describes High (150-200) and Very High (>200) decreases during the period from 2005 to 2016. The Figure 6.1 demonstrates the measure of chlorophyll in the individual years. Above figure delineates that there was an extraordinary misfortune in chlorophyll-an in ongoing

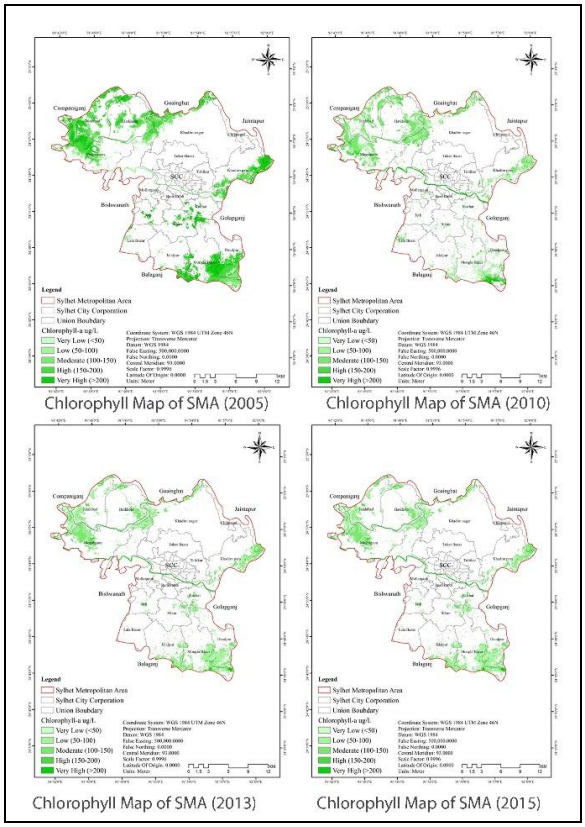
eras (e.g., 2010-2013, and 2013-2016). This implies a few sections of the beforehand very immersed phytoplankton were changed over into some other land cover classes.

Table 4: Chlorophyll-a Percentage for 2005, 2010, 2013 and 2016

Quantity	Percentage of Chlorophyll-a			
	2005	2010	2013	2016
Very Low (<50)	3.83	7.24	10.45	8.32
Low (50-100)	11.10	43.77	26.90	36.79
Moderate (100-150)	18.45	33.57	48.85	44.30
High (150-200)	44.71	10.54	9.28	4.77
Very High (>200)	21.91	4.88	4.53	5.82



[Fig 4]: Turbidity Map of SMA



[Fig 5] Chlorophyll *Map of SMA*

CONCLUSIONS

The water percentage in Sylhet Metropolitan area is 35.21%, 13.96%, 12.33%, 14.67% consecutively in the year 2005, 2010, 2013 & 2016 respectively. It is seen after 2005 land use change in water percentage is gradually decreasing in alarming rate. Focusing on transition of LULC it is seen that water to water land use change 1.12% whereas water to other percentage 12.01%, water to vegetation 22%. But on reverse point vegetation to water transition land use is only 10.34% & other to water is 2.52%. From the above data it is seen water body is gradually diminishing to other land use among them maximum vegetation area. If this condition persists then the water reservoir of the Sylhet city would be nonfunctional with respect to catchment basin area. The maximum temperature in 2005 is 24.55^{o}, in 2010 is 22.09^{o}, in 2013 is 25.73^{o} & in 2016 is 27.28^{o}. Over eleven years 2005 to 2016 the average temperature increases 13.60 & maximum temperature increases 5.53^{o}. The result indicates that heat island is increasing day by day. Since the temperature rising respiration in the plant is influenced by the temperature. Due to this reason the growth of the plant increases which is one of the reasons for transition of water to vegetation (22%) become the second highest of transition land use in 2005 to 2016. Studying turbidity analysis, we can see in 2005 the highest chlorophyll percentage in water body was 21.19%, in 2010 chlorophyll percentage was 4.88%, in 2013 was 4.53%, and in 2016 was 5.82%.

The chlorophyll percentage decreasing in alarming rate day by day. This indicates that the amount of chlorophyll has a great loss in the time period 2005 to 2013. This means that some part of previously highly saturated phytoplankton was converted into other land use. If this condition persists then hazard like water logging and flood will take place as there will be outflow through the catchment area.

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