Change Detection Analysis of Somasila Reservoir Using Landsat-8 Data Imagery During 2017-2022

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Abstract **- Remote sensing techniques are widely used in monitoring and management of water resources on the earth. The identification and change detection analysis of Water bodies is useful in managing available water resources. The aim of the paper is to analyze the changes in water spread area of Somasila reservoir during January 2017 to February 2022.The Somasila reservoir significantly serving the mankind in many ways such as drinking water and cultivation. The temporal imagery of Landsat 8 imagery is used for detecting the changes in water spread area in the region of interest.**

Index Terms **- Landsat-8 OLI, Normalized Difference Water Index (NDWI), Somasila Reservoir, Water spread area.**

I.INTRODUCTION

Several change detection procedures based on Multi temporal remote sensing data [1] were developed to generate the changes in the map of the region of interest. Remote sensing helps to obtain multi-temporal data through satellite sensors, and it is categorized into various classes such as forest, water bodies, wetlands, agricultural lands etc [2]. Image differencing [3] is simple method for change detection analysis. Change detection techniques can be used for assessing the changes in wetlands [4] during certain period of time. The accuracy and reliability [5] of change detection can be improved with adopting supervised classification over unsupervised classification. Frameworks [6] in polar domain improves the accuracy in change detection. Normalized Difference Water Index [7] is used to classify the pure water pixels. The image differencing method uses the spatial difference between the two images, the zero value of the difference image indicates the unchanged water spread area of the map in the study area[8],[9].The nonzero value of the difference image indicates the changed water spread area. Supervised classification method used to analyze the structural changes of forest cover [10] using Landsat-8 image. NDWI along with Principal Component Analysis [11] effectively detects the surface water changes of two and three different times simultaneously. Several water indices [12] are used on multi-spectral and multi-temporal imageries for detection of changes in surface water.

II. STUDY AREA AND COLLECTION OF DATA SET

The study area is Somasila reservoir located in the Nellore District, Andhra pradesh, India. The geospatial information of the study area is shown in Table 1.

Table 1: Details of Somasila Reservoir

Reservoir	Path/ Row	Duration	State and Country
Somasila (Lat, Long) (14°29'22.4"N, 79°18'25.6"E)	143/50	2017-2022	Nellore District, State of Andhra Pradesh, India.

The Landsat-8 data is acquired for the period January 2017 to February 2022. These Landsat-8 data were taken for detecting the changes from 2017-2022. The specification of bands and its wavelengths for Landsat-8 data are as shown in Table 2.

Table 2: Specifications of the Landsat-8 data

Band no-Band name	Spectral Range(μ-m)	Resolution
band1 – deep blue	0.433-0.453	30m
band2 -blue	0.450 - 0.5l5	
band3-green	0.525- 0.600	
band4- red	0.630- 0.680	
band5-NIR	0.845-0.885	

band6-SWIR1(MIR)	1.560- 1.660	
band7-SWIR2	2.100 – 2.230	
band8-panchromatic	0.500-0.680	15m
band 9-cirrus	1.360- 1 .390	30m
band10-TIRS1	10.060- 11.190	100m
Band11-TIRS2	11.500-12.510	

III. METHODOLOGY

CHANGE DETECTION: Change detection involves multi-temporal Landsat-8 data to quantitatively analyze the multi-temporal and Spatial-temporal effects. The temporal images are useful in change detection analysis. The change detection technique is useful in many applications such as land cover changes, habitat fragmentation, the rate of deforestation, coastal changes, urban development, Water body's identification and other cumulative changes. In this paper for detection of water bodies we used Normalized Difference Water Index (NDWI) as shown in the (1).The difference images of NDWI is used to detect the changes in the water spread area.

$$NDWI = \frac{Green-NIR}{Green+NIR} \quad (1)$$

The water bodies have low reflectance value in the NIR, band, hence positive value of NDWI, signifies the presence of water body. Change detection is done using difference images of NDWI. The difference images from 2017-2022 are shown in Fig.1-5.The Black pixel indicates the unchanged water spread area. The green pixels indicate the increase in the water spread area and the red pixels indicate the decrease in the water spread area.

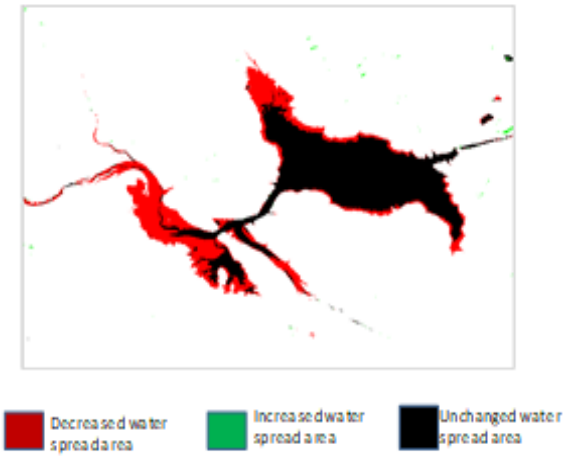

Fig. 1 Change in Water Spread Area during Jan-2017 to Mar-2018

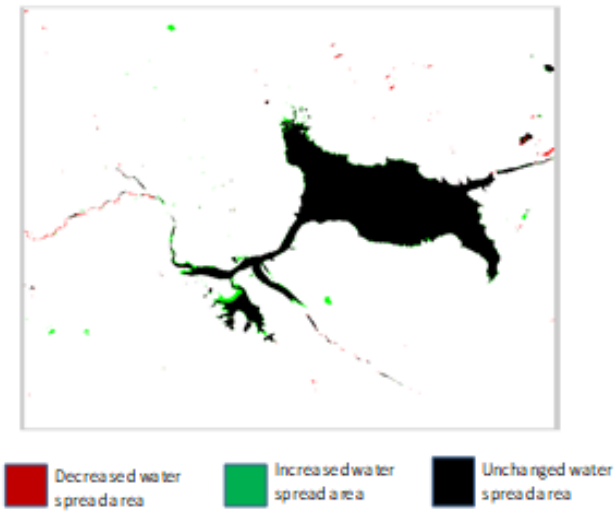

Fig. 2: Change in Water Spread Area during Mar-2018 to Feb-2019

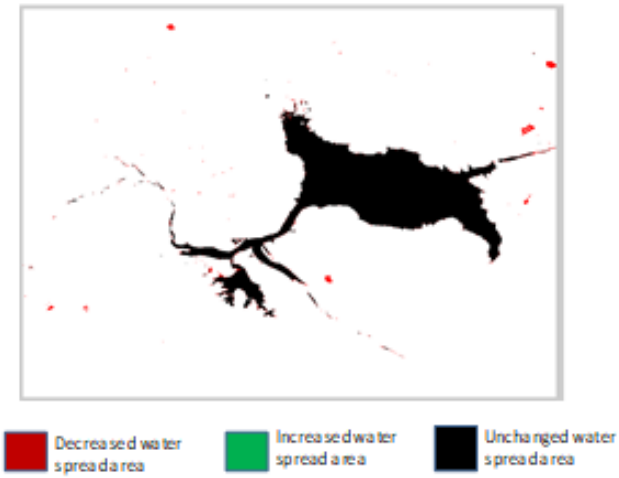

Fig. 3: Change in Water Spread Area during Feb-2019 to Feb-2020

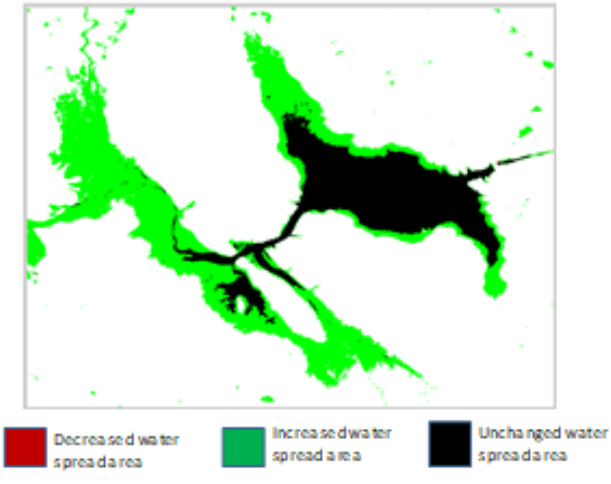

Fig. 4: Change in Water Spread Area during Feb-2020 to Feb-2021

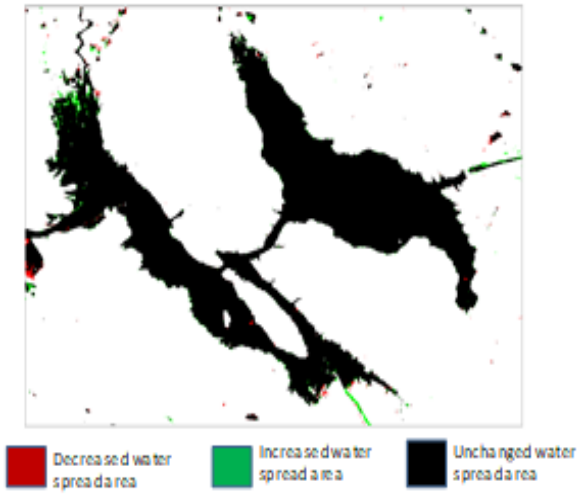

Fig.5: Change in Water Spread Area during Feb-2021 to Feb-2022

IV. RESULTS AND DISCUSSION

The difference images are used for analyzing the spatiotemporal changes in the map of the study area. It is observed from Table. 3 that there is intense decrease in the water spread area during 2017-2018, intense increase in the water spread area during 2020-2021 and maximum unchanged in the water spread area during 2021-2022.The maximum water spread area was observed in Feburary 2022 during 2017-2022. The Results are carried out using Matlab 2018a.

Table 3 Change detection in water spread area.

Duration	Decreased Water Spread Area (Sq. miles)	Increased Water Spread Area (Sq. miles)	Unchanged Water Spread Area (Sq. miles)
2017-2018	16.3783	0.2439	28.6396
2018-2019	0.4048	1.5286	28.4787
2019-2020	1.1540	0.0003	28.8530
2020-2021	0.0087	49.2101	28.8446
2021-2022	0.7697	1.6502	77.2850

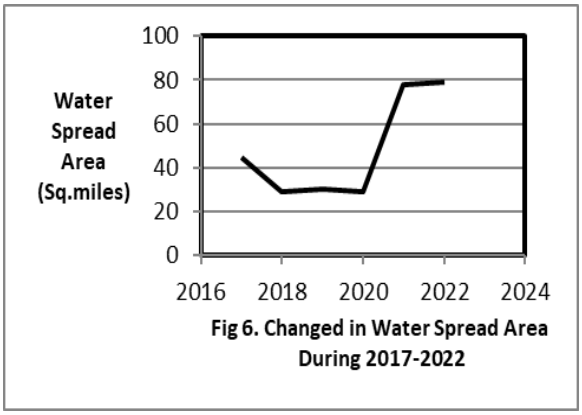

Fig 6. Changed in Water Spread Area During 2017-2022

Table 4.Changed in Water Spread Area during 2017-2022

S.No	Year	Water Spread Area (Sq. miles)
1	2017	45.0172
2	2018	28.8828
3	2019	30.0066
4	2020	28.8526
5	2021	78.0540
6	2022	78.9345

V. CONCLUSIONS

The change detection using image differencing method is used to examine the spatiotemporal changes of Water Spread Area of Somasila Reservoir Located at Nellore District, Andhra pradesh, India. Accordingly the study aimed to provide the useful information for management and monitoring of water in the study area.

VI. ACKNOWLEDGMENT

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REFERENCES

[1] S.Ashbindu Singh, Review article digital change detection techniques using remotely-sensed data, International Journal of Remote Sensing, vol.10 No.6, pp.989-1003, 1989.

[2] Ashraf Dewan and Yasushi Yamaguchi, Using remote sensing and GIS to detect and monitor land use and land cover change in Dhaka Metropolitan of Bangladesh during 1960–2005, Environ Monit Assess, vol.150, pp.237–249, 2009.

[3] Abdullah Alqurashi and Lalit Kumar, Investigating the use of Remote Sensing and GIS techniques to detect land use and land cover change: A Review", Advances in Remote Sensing, vol 2,pp.193-204, 2013.

[4] Renzong Ruan and Li Zhang, Changes of Hongze Lake Wetlands in the Past Three Decades, Jiangsu Province Natural Science Foundation (BK2008360), 978-1-4244-3709-2/10,IEEE, 2010.

[5] Bruzzone.L and Prieto.D. F, Automatic analysis of the difference image for unsupervised change detection, IEEE Trans Geo Sci. Remote Sens., vol. 38, No.3, pp.1171–1182, May 2000.

[6] Bovolo.F and Bruzzone.L, A theoretical framework for unsupervised change detection based on change vector analysis in polar domain, IEEE Trans. Geo Sci. Remote Sens., vol.45, No.1, pp.218–236,July 2006.
[7] S.K.McFeeters, The use of the Normalized Difference Water Index N.D.W.I., in the delineation of open water features, International Journal of Remote Sensing. Vol. 17, no.7, pp.1425-1432, Jan 1996.
[8] Muchoney.D.M and Haack.B.N, Change detection for monitoring forest defoliation. Photogrammetric Engineering and Remote Sensing, 60, pp.1243–1251,Oct 1994.
[9] SOHL.T, Change analysis in the United Arab Emirates: an investigation of techniques, Photogrammetric Engineering and Remote Sensing, 65, pp.475–484,April 1999.
[10] Eric K Forkuo and Adubofour Frimpong, Analysis of Forest Cover Change Detection, International Journal of Remote Sensing Applications, Vol.2 Issue. 4,pp.82-92, Dec 2012.
[11] Komeil Rokni, Anuar Ahmad, Ali Selamat and Sharifeh Hazini, Water Feature Extraction and Change Detection Using Multitemporal Landsat Imagery, “Remote Sensing”. 2014, 6, pp.4173-4189.
[12] Amare Sisay, Remote Sensing Based Water Surface Extraction and Change Detection in the Central Rift Valley Region of Ethiopia, American Journal of Geographic Information System 2016,vol 5(2):,pp.33-39,2016.
[13] http://landsat.usgs.gov/(Accessed on Feb, 2020)
[14] https://spsnellore.ap.gov.in/water-resources-dept-se-somasila-project-circle.