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Comparison of Vegetation and Water Indices Calculated on IRS LISS-3 and IRS-P6 AWiFS Data

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Abstract

Remote sensing technologies provide stereo images which allow topographic mapping and the functionality gives not only static display but also analytical process. Vegetation indices and water indices have been proposed over last decades as the most suitable vegetation and water indices for a given remote sensing application. In this research study, the suitability and results show these indices (SVI, NDVI, SWI and NDWI) can apply on LISS-3 and Awifs, more comparisons view can get it from Awifs sensor. Using a Geographical Information System (GIS) it is possible to relate location to vegetation and water bodies cover. Indices have become a key for planning, conservation and management of any ecosystem. This has resulted in the habitat quality of varied aquatic flora and funa. Moreover, the seasonal changes affect the land use/land cover characteristics of the landscape. This powerful approach is opening up new opportunities to study the vegetation mapping with sensor comparisons. This information used to enhance the regions for identifying vegetation cover/mapping area.

Keywords: *IRS-LISS-3, IRS-P6 AWiFS, indices, SVI, NDVI, SWI, NDWI, sensor comparison*

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INTRODUCTION

Remote sensing satellites provide data with different spatial, spectral, radiometric and temporal resolutions based on various considerations, processes and techniques. In order to study the spatial cover of vegetation and water, we need two sets of data: at any given point in time, and what landscape features are at that location [1]. Vegetation and water indices are mathematical transformations, usually ratios of visible and near-infrared bands. They are widely used in remote sensing practice to obtain information about surface characteristics from multispectral measurements, reflectance patterns of surfaces. For vegetation and water map used indices as SVI, NDVI, SWI and NDWI to identify land use changes, habitat fragmentation, rate of deforestation and other cumulative changes through image processing technique. These technique helps in analyzing the dynamic changes associated with the earth resources such as vegetation and water cover Water cover, their analysis and also helps to recognize the spatial pattern.

MATERIALS AND METHODS

The area is situated in the eastern part of the state of Maharashtra. It is located between 20°35′ and 21°45′ latitude and 78°15′ and 79°40′ longitude and has a total geographical area of 10032.5 km^2. The district has 13 administrative Tahsils. It is surrounded by Madhya Pradesh state in the north, Bhandara district in the east, Chandra district in the south, Wardha district in the southwest and west, and Amaravati district in the northwest. NRSA (National Remote Sensing Agency, Hyderabad) collected the IRS-P6 AWiFS data (5th November, 2003) (Figure 1) and IRS-P6 LISS-III data (15th November, 2003) (Figure 2) in digital form. The methodology has been used for preparation of thematic maps vegetation and water bodies after geometric corrections, image enhancement techniques and indices.

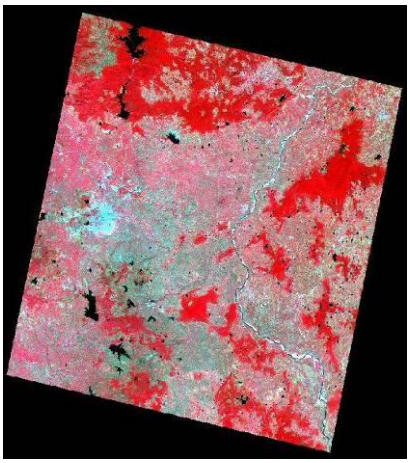

Fig. 1: *Location Map (Awifs, 5th November, 2003).*

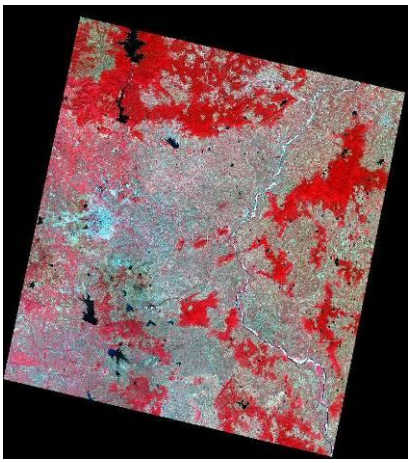

Fig. 2: *Location Map (LISS-III, 15th November, 2003).*

RESULTS AND DISCUSSION

In the study area, Vegetation and water bodies are successfully identified and mapped using satellite data [2]. Band combination involving the NIR band gave good result with distinct discrimination of forest and other land cover categories [3]. The analysis of satellite data acquired during November. The spectral behaviour of the canopy reflectance has helped to detect forest and water. Vegetation and Water index are sensitive to the amount of green biomass [4]. The ratio of leaf reflectance bands has been used as indicators of plant stress. The vegetation and water index images generated for monitoring have helped in identifying the anomaly and water body extract [5]. Indices has been applied, the whole images of Awifs & Liss-3 data of P6. The main reason of the study purpose is to get information regarding vegetation and water so we classified the whole image under five classes as- water, blank open degraded dense vegetation. The analysis has revealed that some classes are very good in LISS-3 & AWIFS data. Below has been described briefly.

Geology and Geomorphology

The geological formations gneisses and schist's resulting from repeated metamorphism of ancient sediments and a younger group of gneisses representing perhaps a grantic intrusion into above Mata sediments. Rocks referable to the talchir, barakar and kamthi stages of the gondwanas system of fluviatile and lacestrine origins were deposited in troughs, generally produced by faults. The western part of the district is covered by layer of dolerite and basaltic lavas. Geomorphological process are generally complex and reflect inter-relationship among the variables such as climate, geology, soil and vegetation.

Simple Vegetation Index

Simple vegetation index (SVI) provides a standardized method of comparing vegetation greenness between satellite images [6]. SVI, which is an index from arithmetic combination of two or more bands related to the spectral characteristics of vegetation (Figures 3 and 4), has been used for vegetation classification, spectral response in red (R) and near-infrared (NIR) portion of the electromagnetic spectrum by using the expression, SVI = (NIR/RED) where, RED = Reflectance in red band and NIR = Reflectance in NIR band. The SVI has been carried out on AWiFS and LISS-3 data on rate, pattern and trend in the study area (Table 1). The SVI output changes of water (0.42%), blank vegetation (12.31%), degraded vegetation (1.97%), open vegetation (5.47%) and dense vegetation (9.13%) have been found in the study area table.

Normalized Different Vegetation Index

Normalized different vegetation index (NDVI) provides a standardized method of comparing vegetation greenness between satellite images. NDVI, which is an index from arithmetic combination of two or more bands related to the spectral characteristics of vegetation (Figures 5 and 6), has been used for vegetation classification, spectral response in red (R) and near-infrared (NIR) portion of the electromagnetic spectrum by using the

expression [7],
NDVI = (NIR−RED)/(NIR + RED)
where RED = Reflectance in red band and NIR = Reflectance in NIR band. The NDVI has been carried out on AWiFS and LISS-3 data on rate, pattern and trend in the study area (Table 1). The NDVI output changes of water (0.4%), blank vegetation (16.41%), degraded vegetation (3.97%), open vegetation (8.7%) and dense vegetation (11.78%) have been found in the study area table.

Simple Water Index

Simple water index (SWI) provides a standardized method of comparing water tone between satellite images. SWI, which is an index from arithmetic combination of two or more bands related to the spectral characteristics of water (Figures 7 and 8), has been used for water identification, spectral response in green (GREEN) and near-infrared (NIR) portion of the electromagnetic spectrum by using the expression SVI = (GREEN/NIR) where GREEN = Reflectance in green band and NIR = Reflectance in NIR band. The SWI has been carried out on AWiFS and LISS-3 data on rate, pattern and trend in the study area (Table 2). The SWI output changes of water (1.33%), blank vegetation (27.04%), degraded vegetation (32.24%), open vegetation (3.42%) and dense vegetation (12.71%) have been found in the study area table.

Normalized Different Water Index

Normalized different water index (NDWI) provides a standardized method of comparing water signature between satellite images [8]. NDWI, which is an index from arithmetic combination of two or more bands related to the spectral characteristics of water (Figures 9 and 10), has been used for water identification, spectral response in green (GREEN) and near-infrared (NIR) portion of the electromagnetic spectrum by using the expression
NDWI = (GREEN−RED)/(GREEN + RED)
where GREEN = Reflectance in green band and NIR = Reflectance in NIR band. The NDWI has been carried out on AWiFS and LISS-3 data on rate, pattern and trend in the study area (Table 2). The NDWI output changes of water (0.84%), blank vegetation (7.03%), degraded vegetation (0.11%), open vegetation (1.54%) and dense vegetation (9.52%) have been found in the study area table.

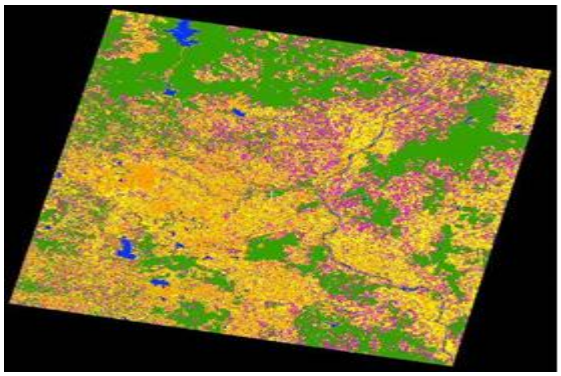

Fig. 3: *SVI of* AWiFS.

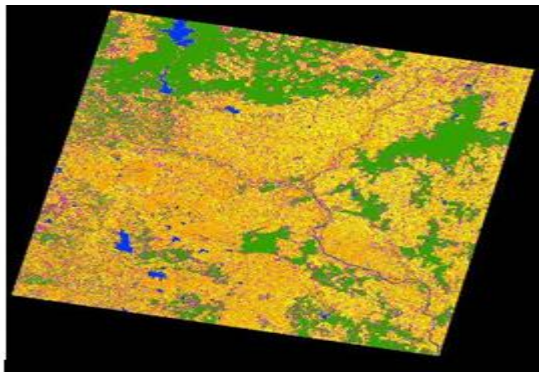

Fig. 4: *SVI of LISS-III.*

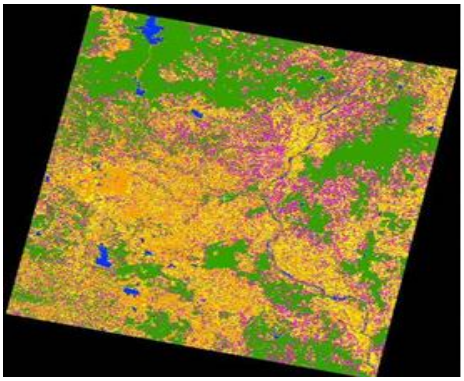

Fig. 5: *NDVI of* AWiFS.

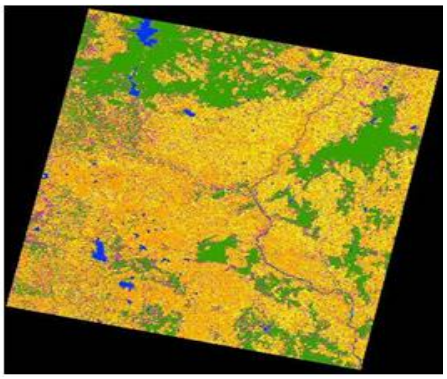

Fig. 6: *NDVI of LISS-III.*

Table 1: *Comparisons of SVI, NDVI on LISS-3 &* AWiFS *Data.*

Land use	SVI-LISS-3 (%)	SVI -AWIFS (%)	Comparison (%)	NDVI-LISS-3 (%)	NDVI –AWIFS (%)	Comparison (%)
Water	1.69	2.11	0.42	2.15	1.75	0.4
Blank Vegetation	15.6	27.91	12.31	32.52	16.41	16.41
Degraded Vegetation	27.86	29.83	1.97	28.11	24.14	3.97
Open Vegetation	19.13	13.66	5.47	11.28	19.98	8.7
Dense Vegetation	35.6	26.47	9.13	25.91	37.69	11.78

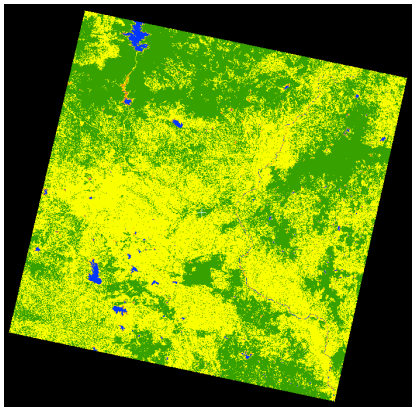

Fig. 7: *SWI of* AWiFS.

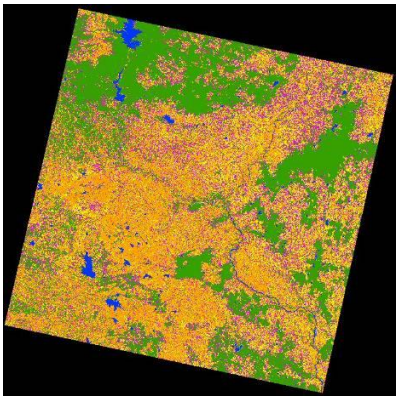

Fig. 8: *SWI of LISS-III.*

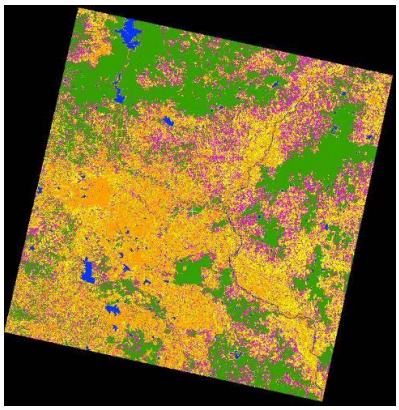

Fig. 9: *SWI of* AWiFS.

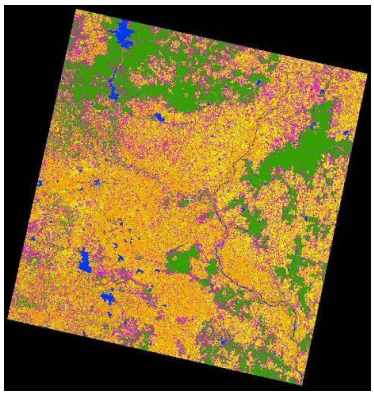

Fig. 10: *SWI of LISS-III.*

Table 2: *Comparisons of SWI, NDWI on LISS-3 &* AWiFS *Data.*

Land use	SWI-LISS-3 (%)	SWI-AWIFS (%)	Comparison (%)	NDWI-LISS-3 (%)	NDWI –AWIFS (%)	Comparison (%)
Water	2.35	1.02	1.33	2.84	2	0.84
Blank Vegetation	27.79	0.75	27.04	28.9	21.87	7.03
Degraded Vegetation	19.7	51.94	32.24	24.3	24.19	0.11
Open Vegetation	16.56	19.98	3.42	20.48	18.94	1.54
Dense Vegetation	33.57	46.28	12.71	23.45	32.97	9.52

CONCLUSIONS

The study has shown that it is possible to map water and vegetation on IRS-P6 AWiFS and LISS-III satellite images. IRS-P6 AWiFS and LISS-III satellite images provided view of vegetation (open, degraded, blank vegetation) and water based on resolution. Moreover, the study has validated the applicability of satellite data based on the satisfactory values. However, mapping of water & vegetation area

was not feasible due to cartographic limitation and poor spectral resolution of data in the regard. This could benefit a large section of uses involved in planning and management of land resource. Based on vegetation and water indices on satellite images finally we conclude, for large area Awifs data is suitable because of it is having 56 m resolution. It is covers more area compared compassion with LISS-3 but in case of Liss-3 is suitable for small area with high accuracy because it is having 23.5 m resolution. LISS-3 having spectral resolution is very good but Awifs spatial resolution & swath are very good.

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