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APPLICATION OF REMOTE SENSING TO STUDY ENVIRONMENT AND ECOSYSTEM. A CASE STUDY OF FOREST VEGETATION USING DIGITAL ANALYSIS

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ABSTRACT

Seven types of vegetations *viz.*, sal forest, sal mixed forest, moist mixed forest, dry mixed forest, seral vegetation, high grass and low grass, were identified and delineated by visual interpretation of satellite data (Landsat TM-FCC 1:50,000 scale). However, there was difficulty in delineating agricultural/fallow lands by visual interpretation. But in computer aided digital analysis, in addition to all the seven vegetations identified through visual interpretation, agricultural fallow lands were identified and demarcated in view of better separability of tonal variations. Comparison of visual interpretation and digital analysis methods revealed that there was no significant difference between these two methods of analysis as far as total areal extent of the study area was concerned. However, there were differences between the two methods of analysis regarding the areal extent of different vegetation/forest types identified within the study area. If situations warrants use of single band data for vegetation studies, we can use band 5 data of Landsat TM as it was able to give better spectral separability among different vegetations.

KEY WORDS : Remote sensing, ecosystem, environment, visual interpretation, digital analysis, satellite imagery

Satellite data are being used in India for National Natural Resources Management System (NNRMS) by collecting thematic informations on various natural resources. At present, the Forest Survey of India (FSI), Dehradun is engaged in the preparation of vegetation maps for different parts of our country with an objective of identifying different types of forests and their distribution interms of geographical area and location through satellite remote sensing (Personal Communication from Gulati, FSI, Dehradun). Using the satellite data, the Government of India has reported that the forest cover of the country is only 64.2 million ha comprising 36.14 million ha of dense forest; 26.66 million ha of open forest and 0.4 million ha of mangarove forests as against the officially recorded forest area of 75.18 million ha as in revenue records (Anon., 1987). The above differences in forest area is due to variation in the defining of forest. As far as revenue records ae concerned, they include even the degraded forest lands, denuded hillocks devoid of vegetations as forests. But the forest area reported by Govt. of India through remote sensing refers to the actual area of forest having vegetation cover irrespective of the density but excluding the forest lands devoid of vegetation.

Forest type maps had been prepared for the north eastern parts of India using computer aided supervised digital classification of satellite data. More reliable informations were obtained on forest vegetation usig vegetation index derived from Landsat 5-TM data (Roy, 1984). The level and accuracy of digital classification of the vegetation cover types have been found to be increased by 90 per cent in a study with Landsat TM 5 data because of high spatial and spectral resolution (Tommernik, 1986). With an objective of studying the separability of spectral signatures of different types of forest vegetation, computer aided digital analysis was contemplated with Landsat data of TM band 3,4 & 5. Also comparison between visual interpretation of FCC and digital analysis was done with reference to vegetation types and their areal extent in the study are viz., part of the Kanha National Park (80° 26′ to 80° 30′ E longitude and 22° 07′ to 22° 27′ N latitude)

MATERIALS AND METHODS

The satellite data *viz.*, Landsat TM-FCC (1:50,000 scale) pertaining to the study area was visually interpreted to find out the different forests types. The Survey of India topohsheets of the study area were used for marking the boundaries. The area under each forest type identified on satellite imagery (FCC) was also estimated. Similarly, the digital data (CCTs - Computer Compatible Tapes) pertaining to the study area were transferred from CCT (L5- 143-44) to disk unit of the computer system (IMAVISION) and the same were displayed in a 512x512 windows (512 scan lines and 512 pixels). Then different manipulations such as contrast stretching, band ratioing, principal component analysis and classification were done in a systematic way for obtaining good quality sharp images of different vegetations of the study area. Band ratioing was done with the Landat - TM band 4 (Infrared region) and band 3 (Red region) to obtain vegetation indices as follows:

(i) Simple vegetation index (VI) $= \frac{IR}{R} = \frac{\text{Band 4}}{\text{Band 3}}$

(ii) Normalised vegetation index (NVI) $= \frac{IR-R}{IR+R}$

$$= \frac{\text{Band 4} - \text{Band 3}}{\text{Band 4} + \text{Band 3}}$$

The spectral reflectance interms of digital numbers (DN) were obtained for training sets (eight numbers) collected during ground truth operations. The areal extent of each type of forest vegetation was obtained from two dimensional map, the final output.

RESULTS AND DISCUSSION

The total extent of the study area as obtained from the Survey of India toposheets was about 236 square kilometers. The total extent of the study area as obtained from Landsat TM-FCC through visual interpretation and digital analysis were 235.50 a 235.92 square kilometers, respectively. Thus it stated that there was no significant differen between visual interpretation and digital analysis satellite data as far as the total extent of the stu area was concerned. However, there we variations in the areal extent among differe vegetation/forest types identified within the stu area, by visual interpretation and digital analy (Table 1).

Totally, seven forest/vegetation types and th non-forest/non- vegetation types were easil identified by visual interpretation of satelli imageries. They were sal forest, sal mixed fores moist mixed forest, dry mixed forest, se vegetation, high grass and low grass. In the visu interpretation there were difficulties in delineati the agricultural/fallow lands and the shadow areas. The agricultural/fallow areas were ve similar to the low grass areas and hence it could n be delineated exactly. Similarly, the shadowe areas (dark brown in tone) were mistaken for th dark toned sal mixed forests and the ridg vegetations of the hill tops. The differences in th area between each of the forest/vegetaion type due to visual interpretation and digital analysis might be attributed to the over lapping tonal variations and merging of details due to generalization in view of lesser discriminability of human eyes.

In monoscopic visual interpretation we delineate the features of details based on the photoelements viz., tone, texture, pattern and location (association). In satellite data, the scene

Table 1. Areal extent of different vegetation types estimated by visual interpretation and digital analysis

Vegetation types	Area (km^2)		
	Visual interpretation	Digital analysis	Difference in area
Sal forest	95.05	90.97	4.08
Sal mixed forest	60.50	54.81	5.69
Moist mixed forest	18.25	20.20	1.95
Dry mixed forest	35.40	33.90	1.50
Seral vegetation	7.55	11.09	3.54
High grass	12.44	9.94	2.50
Low grass	5.31	2.98	2.33
Agricultural/Fallow	-	3.98	-
Non-forest			
Water	1.00	1.69	0.69
Shadow	-	5.48	-
Others (Unclassified)	-	0.88	-
Total	235.50	235.92	0.42

Table 2. Spectral reflectance for different types of vegetation under TM bands 3,4 and 5 of Landsat

Vegetation types	Spectral reflectance (DN values)		
	Band 3	Band 4	Band 5
Sal forest	16.33	52.89	43.57
Sal mixed forest	16.79	57.71	48.62
Moist mixed forest	15.11	52.78	40.21
Dry mixed forest	18.94	72.45	63.01
Seral vegetation	26.67	57.59	68.56
High grass	27.40	47.72	77.88
Low grass	34.57	57.40	98.68
Agricultural/Fallow	33.69	52.39	87.40

information within a frame of vast area (185 x 185 square kilometers in Landsat) is recorded pixel-by-pixel. The pixel size vary from sensor to sensor within satellite (80 x 80 m in MSS, 30 x 30 m in TM etc.,). Sensors have been so designed to record the scene radiance or reflectance within a dynamic range of 0-256 grey levels in each pixel. Since our human eyes can not discriminate tonal variations beyond 11 to 12 grey levels or shade of the same tone (colour) we are unable to delineate thematic information pixel-by-pixels instead we delineate a physiognomic unit of vegetation consisting of many pixels based on tonal variation to the extent discriminable by our eyes. This ultimately leads to misinterpretation or deterioration in the quality and accuracy of information on vegetation types by visual interpretation. On the contrary, by digital analysis with the aid of a computer the subtle tonal variations between the pixels which were not discriminable by our human eyes are enhanced in a dynamic range of 0-256 grey levels (DN) by increasing the contrast for easy discrimination. This ultimately results in the improvement of quality and accuracy of thematic information.

Based on the spectral reflection (DN values) it has been observed that separability between sal, sal mixed and moist mixed forests, between low grass and agriculture; between seral vegetation and high gras were not obvious in band three as they were having almost same spectral reflectance. However, there was a difference in spectral reflectance between low grass and high grass; seral vegetation and dry mixed forest in band three. Highest reflectance was observed in low grass and agricultural or fallows lands and lowest reflectance in moist mixed forest, sal forest and sal mixed forest. This was attributed to chlorophyll absorption by these vegetations in band three (0.63-0.69 micrometer) (Table 2).

In band four (0.76 - 0.90 micrometer - NIR), the highest reflectance was observed in dry mixed forest and lowest in high grass followed by moist mixed and sal forests. This was attributed to absorption of NIR by high grass, moist mixed and sal forests having more of canopy moisture compared to dry mixed forest. Spectral separation among sal forest, moist mixed forest and agricultural/fallow; among sal mixed forest, seral vegetation and low grass were not prominent. But they were more discriminable from dry mixed forest and high grass. Band four was found useful for determining vegetation types.

In band five (1.53-1.75 micrometer - MIR), spectral separability was good for all vegetation types. However, the difference in spectral reflectance was more discernible between low grass (highest reflectance) and moist mixed forest (lowest reflectance). The reason being that band five is in middle infrared region (MIR). The MIR is easily absorbed by moisture. Hence, highest absorption of MIR by moist mixed forest having high moisture content, followed by sal, sal mixed, dry mixed, seral vegetation, high grass and agriculture in the descending order and lowest absorption by low grass having lowest moisture content (highest reflectance) were observed. Band five can indicate the moisture content of soil and vegetation; this helps differentiate between vegetation and soil and also to differentiate between different types of vegetation based on moisture content of canopy. It is better to use fifth band data of TM compared to other bands if at all single band data is to be used for vegetation studies.

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In vitro ANTIFUNGAL ACTIVITY OF SOME HIGHER PLANT PRODUCTS AGAINST SOIL-BORNE PHYTOPATHOGENS

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ABSTRACT

Seed extracts of *Coriandrum sativum*, *Cuminum cyminum*, *Foeniculum vulgare* and *Trachyspermum ammi* were screened against *Pythium aphanidermatum*, *Macrophomina phaseolina* and *Rhizoctonia solani*. Seed extracts of *T. ammi* showed high antifungal potentiality as it inhibited mycelial growth of all three fungi tested. The extracts from seeds of the other three could inhibit mycelial growth of *P. aphanidermatum* only. The essential oils of four plant seeds exhibited strong fungitoxicity as they completely checked mycelial growth of all the tested fungi, even at very low concentrations. These oils were not found phytotoxic on seed germination, seedling growth, general health and morphology of bhindi (*Abelmoschus esculentus*).

KEY WORDS : Antifungal activity, seed extracts, essential oils, soil-borne phytopathogens

Pythium aphanidermatum (Edson) Fitpatrick., *Macrophomina phaseolina* (Maublanc) Ashby. and *Rhizoctonia solani* Kuhn are some of the soil-borne plant pathogens which cause serious diseases of several seedlings and crop plants. A large number of synthetic chemicals are used for control of such pathogens. Due to their non- biodegradable nature and high toxicity they pollute environmental ecosystems (Edwards, 1973) and create human health problems (Arya, 1988). It is therefore, necessary to look for some alternatives for the control of such soil-borne diseases. It has been proved that higher plants are the reservoirs of different secondary metabolites which are easily biodegradable (Fawcett and Spencer, 1970). Recent reports on the possibility of using active principles from higher plants (Pandey and Dubey, 1991, 1992, 1994). have led to the present study *in vitro*, of antifungal activity of some higher plant products against soil-borne phytopathogens.

MATERIALS AND METHODS

Test of crude extract for fungitoxic activity :

The aqueous extract (1:2 w/v) of seeds of 4 plants were tested for their fungitoxicity by the

Table 1. Fungitoxic activity of crude extract of seeds of some higher plants

Name of Plants	% mycelial inhibition at different concentrations					
	Pythium aphanidermatum		Macrophomina phaseolina		Rhizoctonia solani	
	25% conc.	50% conc.	25% conc.	50% conc.	25% conc.	50% conc.
Coriandrum sativum	100	100	0	44.40	0	05.00
Cuminum cyminum	77.78	100	05.00	11.15	28.89	62.20
Foeniculum vulgare	100	100	50.00	88.89	50.00	75.00
Trachyspermum ammi	100	100	100	100	100	100