

RELATION BETWEEN URBANIZATION AND THE VEGETATION ENVIRONMENT IN THE COLOMBO METROPOLITAN REGION IN SRI LANKA

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1. INTRODUCTION

In recent times the importance of urban vegetation in providing a satisfactory environmental condition within the urban areas has been well recognised. However, in most cities these areas are threatened by alternate urban land use due to pressure on land. Hence the continuous monitoring of urbanization and the vegetation environment in an urban area is of great significance for which satellite remote sensing data provides an affordable and convenient means due to repeated coverage of the earth's surface. In this study it is shown how satellite remote sensing data could be used to relate urbanization with the vegetation environment so that it could be used to monitor the changes in urban vegetation. For this purpose the authors use a proposed index UI (Urban Index) computed by using Landsat TM bands 7 and 4 and the Normalized Difference Vegetation Index (NDVI). As a case study the Colombo Metropolitan Area in Sri Lanka is selected.

Colombo City is the commercial and industrial center of Sri Lanka. The study area shown in figures 1 and 2 covers a land area of 137 Sq.km within the Colombo Metropolitan Area.

2. DATA AND INDICES USED IN THE STUDY

2.1 Conventional Data

A vegetation map of 1981 covering a large portion of the Colombo Metropolitan Area was used in the study. (See FIG.1) The types of vegetation in this area include rubber, paddy, coconut, parks, grassland, mixed vegetation, mangroves, deep marshes, shallow marshes and artificial green areas. The vegetation map was scanned and the data was used in the analysis.

A map showing the boundaries of the larger Urban Council and Town Council areas around the Colombo City and the boundaries of the smaller planning units within the Colombo City (See FIG.2) was used in the analysis. Available population data relating to these urban units was also used.

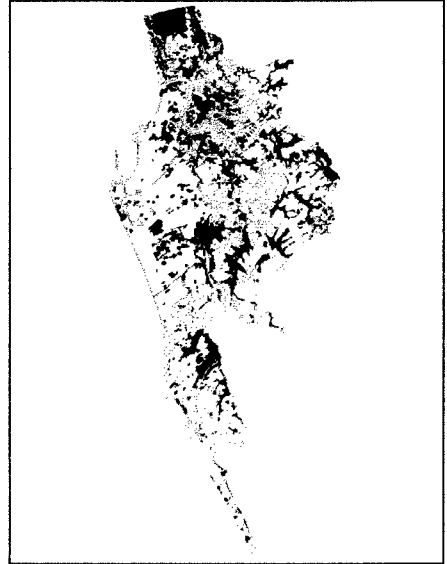


FIG.1 Distribution of Urban Vegetation in the Colombo Metropolitan Area



FIG.2 Planning Units within the Colombo City and Urban Council and Town Council Units in the Colombo Metropolitan Area.

2.2 Remote Sensing Data Used.

Digital data from a Landsat TM scene over the Colombo Metropolitan Area acquired on the 12th of February 1993 was used in the analysis.

2.3 The Urban Index UI

UI was computed as shown below using Landsat TM band7 (B7) and band4 (B4). These bands were chosen because band7 gives high reflectance values for urban areas while band 4 gives low reflectance values for urban areas.

$$UI = \left(\frac{B7 - B4}{B7 + B4} + 1.0 \right) \times 100.0 \quad (1)$$

2.4 The Normalized Difference Vegetation Index (NDVI)

NDVI is computed by using Landsat TM band 4 (B4) and band3 (B3). In this study NDVI was defined as shown below.

$$NDVI = \left(\frac{B4 - B3}{B4 + B3} + 1.0 \right) \times 100.0 \quad (2)$$

3. ANALYSIS AND RESULTS

The scanned urban vegetation map was registered with the scanned map showing the boundaries of the urban units and the Landsat TM image. The percentage urban vegetation in each urban unit was computed. The average UI and NDVI values for each urban unit was calculated after omitting water areas by registering with a classified Landsat TM image. The relation between NDVI and the Urban Vegetation Density is shown in Fig.3. From this figure it is seen that NDVI is strongly related to the percentage of vegetation of urban units. Fig.4 shows the relation between UI and population density of urban units. UI was also related to other parameters of urban development and it was shown that UI is strongly related to the density of development in an urban area[1]. Hence the relation between UI and NDVI shown in Fig.5 relates urbanization with the vegetation condition in the urban area. Fig.6 shows the relation of the average UI values of the urban units with the average NDVI values of vegetation pixels in the urban unit for paddy and coconut. From this figure it could be seen how the vegetation areas have been influenced by the density of development in the urban unit.

4. CONCLUSION

From this study it was shown that satellite data could be used to relate urbanization with the vegetation condition in the urban area so that these

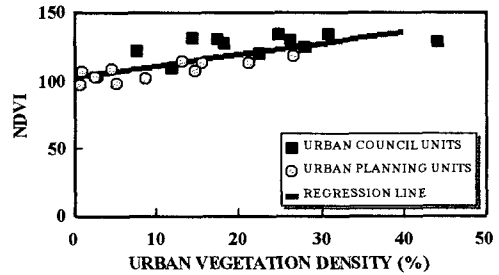


Fig.3 NDVI-URBAN VEGETATION DENSITY

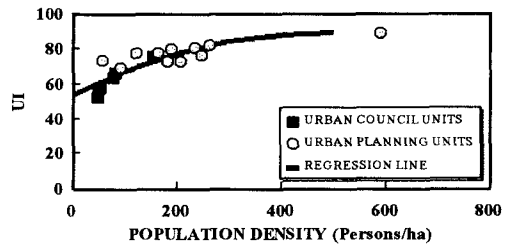


FIG.4 UI-POPULATION DENSITY

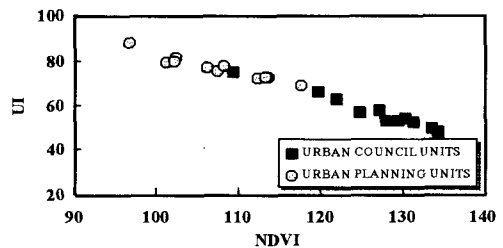


FIG.5 UI-NDVI

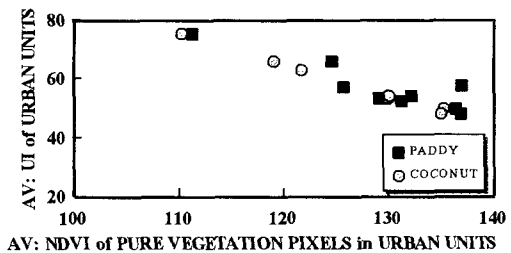


FIG.6 RELATION BETWEEN AVERAGE UI of URBAN UNITS AND AVERAGE NDVI of VEGETATION PIXELS in URBAN UNITS

relations could be used to monitor the changes in vegetation due to urbanization.

REFERENCES

- [1] Kawamura M., Jayarama S., Tsujiko Y., 1996, "Relation Between Social and Environmental Conditions in Colombo, Sri Lanka and the Urban Index Estimated by Satellite Remote Sensing Data" Proc. 18th Congress, International Society for Photogrammetry and Remote Sensing, Vienna/Austria, Vol.31, Part B7, Comm. 7, pp321-326.