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Paper Session II-C - Satellite Remote Sensing for Environment and Resource Managment

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SATELLITE REMOTE SENSING FOR ENVIRONMENT AND RESOURCE MANAGEMENT

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ABSTRACT :

In the recent years there have been valuable achievements in data pre-processing, image processing and interpretation and other related techniques. These developments in the field of satellite remote sensing have resulted in much more useful studies of environment and resource management. We present a review of some of such studies with emphasis on different land use /landcover features in some urban areas of Pakistan. These studies were made using SPOT multispectral and panchromatic data. Our analysis will be found useful for updating information of different urban features. In the end we present our future programs regarding the resource management and environment using earth resource satellites like LANDSAT and SPOT.

INTRODUCTION :

Changes in land cover for human settlements and vegetation are among the most prominent and pervasive impacts of human activities on the global environment and have deep implications for the functioning of ecosystems and climate. Traditional sources of landuse/landcover estimations are inconsistent and have major limitations and data collection from these sources is expensive and time consuming. It is therefore appropriate to use remotely sensed data to study the environmental changes. The recent advances in the digital image processing and interpretation and other related techniques have introduced some useful dimensions to the resource and environmental studies. The use of satellite remote sensing for such studies is particularly important for a country like Pakistan [1] where we face problems such as over-population, uncoordinated development in various sectors, environmental degradation, increasing pressure on resources and infrastructure, lack of updated information etc.

In order to monitor the landcover changes by remotely-sense, satellite-based data it is essential to be able to classify different images. With the help of remote sensing techniques people have successfully classified some individual multispectral images. However these techniques have some limitation as well. Due to variation in atmospheric effects, luminosity etc. it has been difficult to obtain consistent classes from images taken at different times. Consequently with a few exceptions (e.g., Hall et al .[2] ; Lucas et al. [3]), the monitoring of changes in landuse/landcover using remotely sensed data has been restricted to measure the spatial changes. To overcome these limitation new techniques are being developed e.g. Adams et al. [4] who have classified images by introducing a new technique based on fractions of spectral endmembers. This new technique may be useful for comparing multispectral images in space and time. Adams et al. have pointed out that the spectral history of each pixel, considered together with the spatial context, provides a powerful way to monitor the environmental changes.

Study of Landuse/Landcover Features in Pakistan:

In this section we present a review of some studies of different landuse/landcover features of urban areas of Islamabad & Lahore. Nasir [5] has attempted to evaluate various landuse/landcover features of Islamabad city, the capital of Pakistan. The panchromatic SPOT data was used to produce a map of Islamabad at the scale of 1:25000. A simple technique of visual Photo-interpretation was applied to evaluate the satellite image data with a good knowledge of topography of the study area. It was found that the given scale (1:25000) of image data was very effective for delineation of drainage patterns, vegetation and especially for road mapping and even good for streets. The satellite's synoptic view of ground features allocated their true position on the image – a prominent feature of the satellite remote sensing. A ground survey of the study area was also conducted which proved helpful while interpreting the image data. It has been emphasized that the results obtained from the satellite data have provided information about terrain elements that can be obtained with difficult and laborious ground observations and measurements. A comparison of the maps of urban and peri-urban areas of Islamabad prepared by the Survey of Pakistan [6] and Nasir [5] shows that the previous one needs to be updated.

Amjad [7] has recognized and classified urban features of Lahore, the second largest city of Pakistan and capital of the Punjab province. High resolution SPOT satellite data was used for this purpose. This study was aimed at (i) using remotely sensed data for the urban landuse/landcover classification mapping and (ii) detection of aberration in the maps prepared by conventional techniques . The identification and demarcation of thirteen landuse/landcover features such as roads, concrete structures, lush green grounds, thickly populated areas etc. was made. The results of Amjad [7] were compared with those obtained by conventional methods [8,9] . A good qualitative agreement was found between them. However inconsistency was observed in the area estimations under different landuse/landcover types. A ground spot-checking of classification results confirmed that the mapping of

landuse/landcover could be undertaken from remotely sensed data with very high accuracy.

Khalid et al. [10] have presented preliminary results of a study of various aspects of urban development in the thickly populated city of Lahore. The details of their work are given somewhere else [11] . SPOT multispectral and panchromatic data were used to earmark various landuse/landcover features such as newly developed housing schemes, road networks, vegetation, water channels etc. The edge enhanced, contrast stretched gray scale image processed by Khalid et al. [101 in the panchromatic mode is shown in figure 1. Due to varying shades of color grey, different features are identified by their tone, texture, pattern etc. This image shows a balanced distribution between constructed area and vegetation consisting of lawns, play grounds, parks, green belts etc . Thinly populated and well planned areas of Model Town, Gulberg, Muslim Town and Garden Town can be identified in this image .

Figure 2 shows a theme classified image obtained from the multispectral data of the same southern areas of Lahore city as those shown in figure 1. In this image populated areas are in magenta color, grassy fields in cyan color, thick vegetation and crops in blue color, bare soil in yellow and young plantation along the roads in green color. This classification was used to identify trees, thick vegetation, sparse vegetation, barren land, water bodies and industrial area. The results obtained by Khalid et al. [101 , when compared by earlier maps indicate that there is a rapid depletion of vegetation in the urban and peri-urban areas of Lahore . This has resulted in environmental degradation and disturbance in ecological balance.

From the above discussion we conclude that satellite remote sensing technique provide a useful way of updating maps and other landuse/landcover information. These data if fully exploited, would result in improved environmental conditions, better development and planning of towns, better natural resource management etc.

Figure 1: Edge enhanced, contrast stretched gray scale image of some southern areas of Lahore in the panchromatic mode.

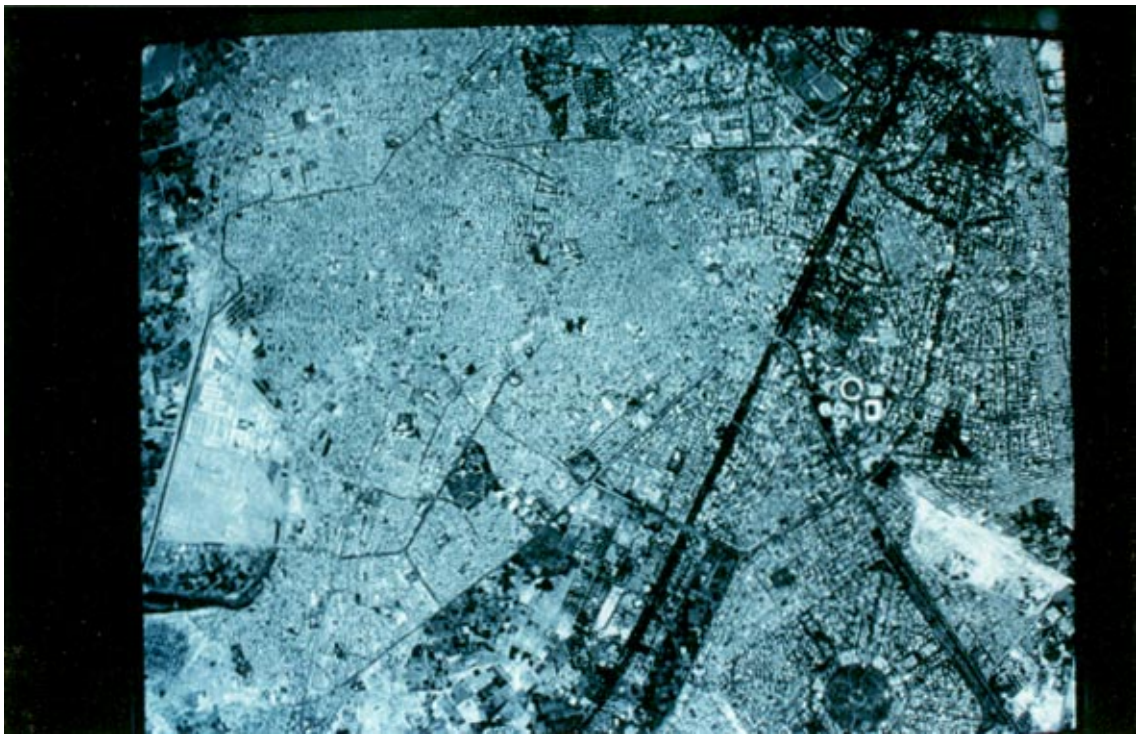
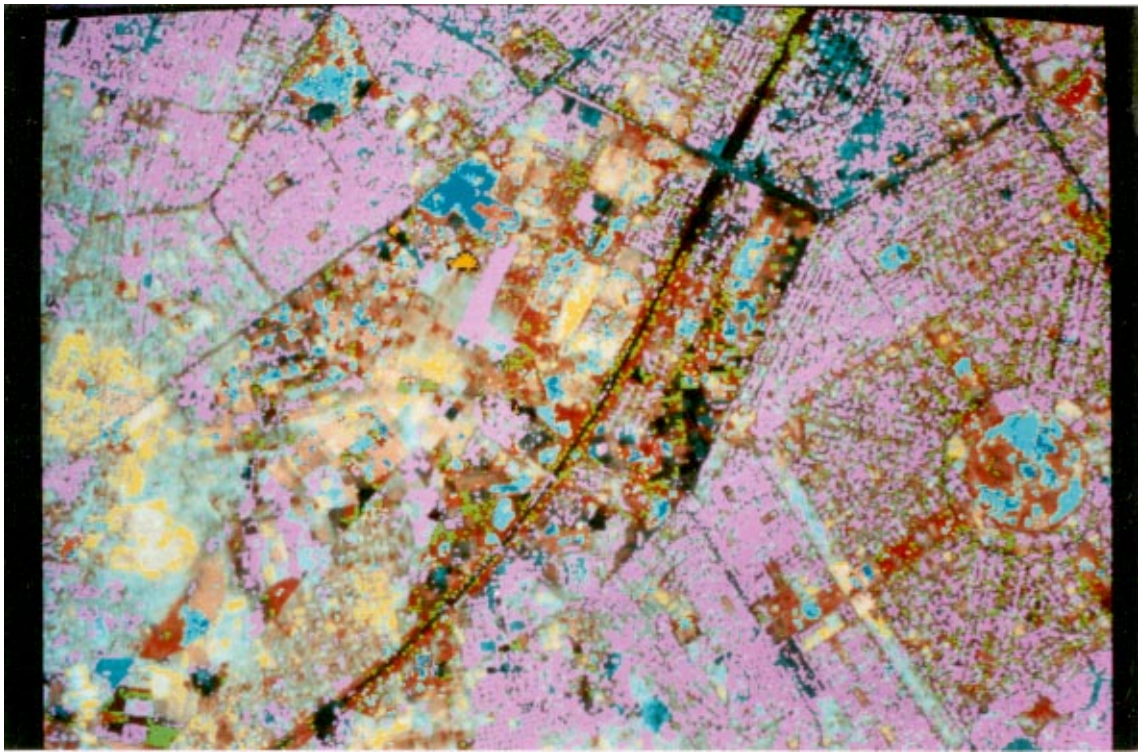


Figure 2: Theme classified image of southern Lahore as detailed in the text.



Future plans:

The subject of remote sensing has been introduced by the University of the Punjab with the object of producing trained manpower in this rapidly developing field. Because of its practical applications in a vast area of life, the satellite remote sensing has gained much attention. Pakistan has an agriculture-based economy and contains the largest system of canals in the world. Therefore due emphasis must be given to remote sensing for its agriculture, hydrology, water resources and management

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