VISUAL INTERPRETATION OF LANDSAT TM 2001 OF PESHAWAR BASIN FOR LAND USE MAPPING

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Abstract

The LANDSAT TM 2001 image, covering the Peshawar Basin and four glued GT sheets were interpreted through ILWIS (GIS & RS) software and developed district boundaries, land use, drainage & road network, rivers, cities/towns, etc. Classified and resampled image clearly differentiated the basin into vegetated (44%) as a major land use followed by not available for cultivation (38%), range land/barren land (17%) and water bodies (1%). The vegetation map revealed that Charsadda and Mardan were the most vegetated districts. Area-wise districts of basin were arrayed in an order of Nowshera> Mardan > Swabi > Peshawar > Charsadda. The vector map for road network and major settlements of the basin showed that Peshawar was the most interlinked district than the other four ones. Image processing for drainage network depicted 8 large and small rivers/streams drainingout eventually in to the Indus river. All the rivers/ streams were run through Charsadda and Mardan districts except the Shah Alam in the northern part of Peshawar district.

Keywords: Visual Interpretation of Landsat TM, Peshawar Basin, Land use.

Introduction

Peshawar the capital of NWFP standing right at the entrance of the world famous Khyber Pass, holds the key of the gate way of the sub-continent. Its old name "Poshapura" was a Sanskrit word meaning the city of flowers. Later on King Akbar persianized it as 'Peshawar' meaning artisans (Anon, 1998). Historically the valley is situated between 71^0 25' - 72^0 47' E longitudes and 33^0 40' - 34^0 31' N latitudes. Area of the valley is 7176 square kilometers and forms an irregular ellipse shape with the longer axis 116 kilometers west to east from Michni to Pehur and the shorter 84 kilometers from Kui Barmol on the extreme northern border to Kawa in Nilab. The basin is surrounded by Malakand Agency and Swat district in the north, Mohmand and Khyber agencies in the west, Tirah in the south, Kohat district & Kohat tribal area in south-east and Haripur & Attock districts on the east. Climatically the western part of the basin is semi-arid to subtropical and the eastern part is sub-humid to sub-tropical (Sahibzada, 1972). The valley is inhabited by 6,342,149 people with a density of 888 persons per sq.

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kilometer (Anon, 1998). Physiographically the basin is surrounded by the hills almost on all sides, except to the east, where the boundary is open to the great Indus river and its plains. Generally speaking these hills are of a very rugged nature with bare slopes and stand precipitously from the plain.

Humans have left an impressive mark on the world map during the past several decades. With the dramatic growth in population, pressure on the land had greatly increased. The need for greater food production has lead to a massive increase in crop land. By early 1990s almost 40% of land surface has been converted to crop land and permanent pastures. This conversion has occurred largely on the expense of natural vegetation (Shrestha, 1998). More over, climatic changes have also influenced land use patterns over the years. To monitor these changes through conventional methods is laborious and time consuming.

The inception of Remote Sensing (RS) and Geographical Information Systems (GIS) helps to guarantee a timely and reliable data pertaining to the state of natural resources during a particular period of time. The acquired information through these improved and internationally recognized techniques not only help to monitor the trends of the renewable and non-renewable resources but also provide an opportunity to improve quality, flow and validity of data.

Applications of Landsat data are quite diverse, comprising earth sciences, commercial applications and government/military uses. For example, mapping land cover change (deforestation, urbanization, etc), geologic resources, monitoring of agricultural productivity, wetland health, and targeting habitats for eradication of vector-borne diseases, etc. (Rolf *et al*, 2000).

Keeping in view the changing scenario of land use patterns, due to rapid increase in human and live stock population, erratic climatic conditions, geo-physical nature and above all the non availability of up to date data of the basin warrants the use of latest scientific know-how like Geographical Information System and Remote Sensing for timely and proper management of natural resources of the basin. This study therefore, was initiated to interpret the landsat TM 2001 to ascertain the present major land uses of the basin which may serve as a strong tool for correct and timely decision making as well as bench mark for the strategic planning of the basin in future.

Materials and methods

The LAND-SAT TM 2001 IMAGE, covering most of the Peshawar basin and four glued GT sheets (published by survey of Pakistan) were procured from the National Center of Excellence (NCE) in Geology, University of Peshawar. Extent of the provided image was 34° N and 70° 25`E on lower left and 35° 15`N and 72° 48`E on the upper right. The specifications of the GT sheets were 1:250,000 scale bearing Nos 43B, 43C, 38N and 38O.

ILWIS, a GIS and RS software was used to establish the digital database, geographic analysis and image processing. The Lambert conic conformal, used for map projection, was based on the Everest (India) spheroid. The software was used on the IBM compatible PC platform for data input and digitization. Features developed from GT sheets included:

- District Boundaries
- Road network
- Cities/towns
- Spot heights
- Rivers

Data Preparation

Features of Peshawar basin were digitized by using 1:250,000 scale topographic map information through ILWIS software at the GIS and Remote Sensing center of Forestry Sector Research and Development Project (FSRDP), Pakistan Forest Institute, Peshawar. Information was compared and analyzed by using standard mathematical procedures.

Map Data

The base map of Peshawar basin, indicating the boundary of the basin and administrative district boundaries of Peshawar, Nowshera, Charsadda, Mardan and Swabi were demarcated by using the GT sheets on a scale of 1:900000. Information such as settlement locations, spots height, rivers, road networks, land use classes and coordination grids (LCC) were super imposed on the base map. All the points, segments and polygon features were given distinct identification code numbers 'ID' on the map for computer data input in ILWIS.

Processing of Satellite Data

Scanned topographic maps were imported into ILWIS via general raster format and geo-referenced by LCC coordination system. A natural colour composite was prepared by using Landsat TM band, *viz.* 7(red), 4(green) and

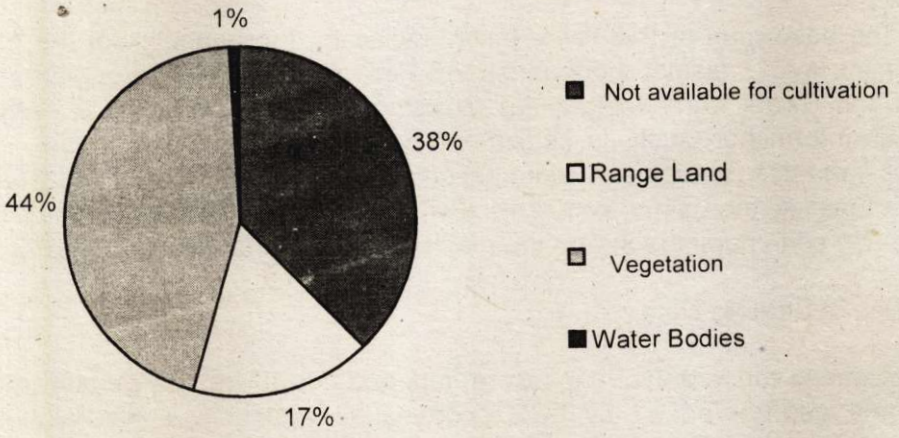
2(blue) for the primary colours to see features as they would be seen by the human eye. Image was rectified in LCC projection system by tie point method using master–slave technique. The training samples were selected through visual interpretation. Supervised classification of image was carried out for land cover mapping as was followed by Ahmad, (2001).

Results and discussion

Natural colour composite of the LANDSAT TM 2001 of the Peshawar basin was visually interpreted as green colour stood for vegetation and blue for water bodies, while other two, i.e. sand brown and whitish were depicting Barren/ range lands and settlements in the area. Classified and re-sampled image of the basin clearly differentiated the major land use of the area on the basis of training samples (Fig 1). Out put of the classification was clearly demonstrating that major land use of the area was agriculture followed by not available for cultivation, range/ barren land and water bodies.

The classified clipped image derived from the main classified image with the help of basin/district administrative boundaries indicated over all land use on one hand and percentage of a class wise land use on the other hand. Fig. 2. Outcome is shown in Pie diagram (Fig 1).

Fig.1 Land use wise Area Distribution of the Basin (620979 ha)



Actual area of the basin available in image was clipped from it (image). It was showing the district administrative boundaries of Peshawar, Nowshera, Charsadda, Mardan and Swabi (Fig. 3) Map showed that some of the Nowshera, Peshawar and Swabi areas were not covered by the image. Landsat TM of the basin indicated that the largest district was Nowshera followed by Mardan, Swabi and Peshawar while, Charsadda was the smallest. This is in corroboration with the information of population census report (Annon, 1998).

The road net work was indicating different major and minor roads connecting different village, towns and cities existing in the basin (Fig. 4). It also presented the intensity of road net work which may be the indication of the level of development of the area. Peshawar was the most interlinked district than the other four districts.

Eight large and small rivers/streams were recorded which eventually draining out the Indus river at Khairabad (Fig. 5). In addition to the Indus river name of other seven included Kabul River, Swat River, Shah Alam River, Naguman River, Khiali River, Nara khwar and Kalpani Nallah. All the rivers/streams were appeared as irrigating Charsadda and Mardan areas except the Shah Alam River that run through the northern part of Peshawar. These findings are also reported by Shahina (2001). This indicates that most of the Charsadda and Mardan areas have abundant water resources . This is one possible reason that these two districts have more vegetation cover than the other ones.

The vegetation (Agriculture, Forestry, grass lands, etc) map of the basin indicating the level of land use covered by vegetation in the basin is presented in Fig. 6. It appeared that the most vegetated districts were Charsadda and Mardan followed by Swabi, Peshawar and Nowshera. Rest of the three land uses (not available for cultivation, barren/rangeland and water bodies) were dominant in Nowshera, Peshawar, Swabi, Mardan and Charsadda in descending order.

Classified and resampled image

Fig. 2

Classified and clipped image of Peshawar basin

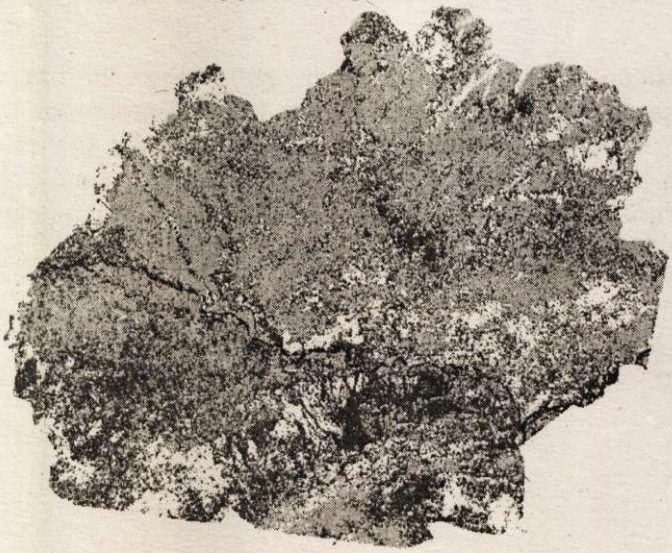


Fig. 3

District wise area of Peshawar basin covered by the landsat TM

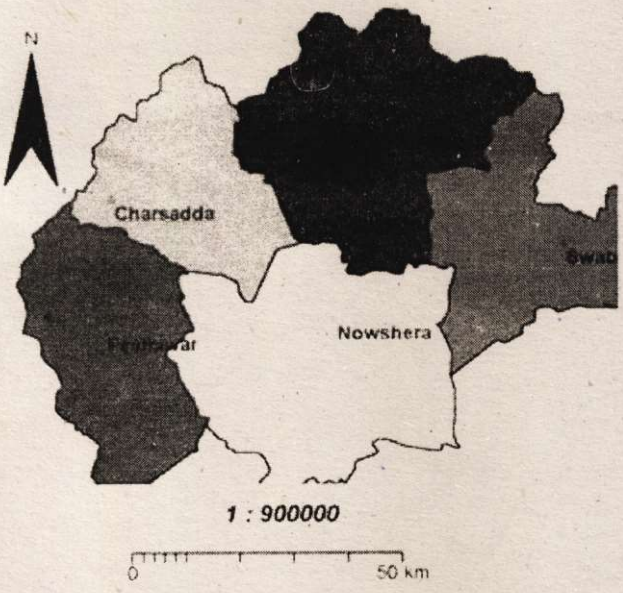


Fig. 4

Road network of Peshawar basin

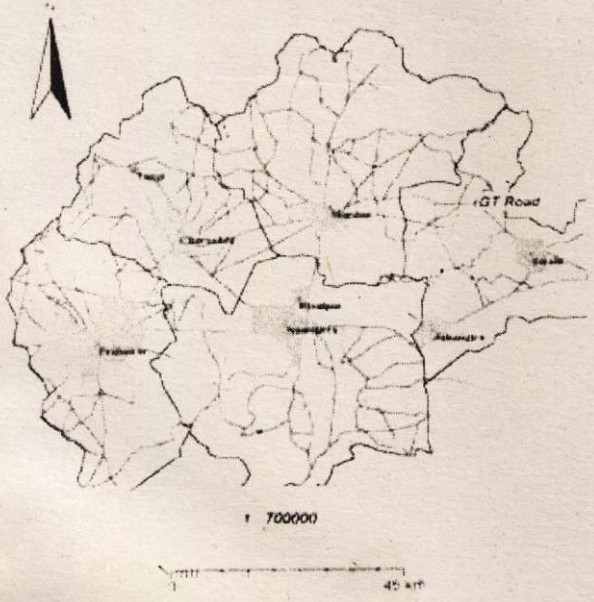
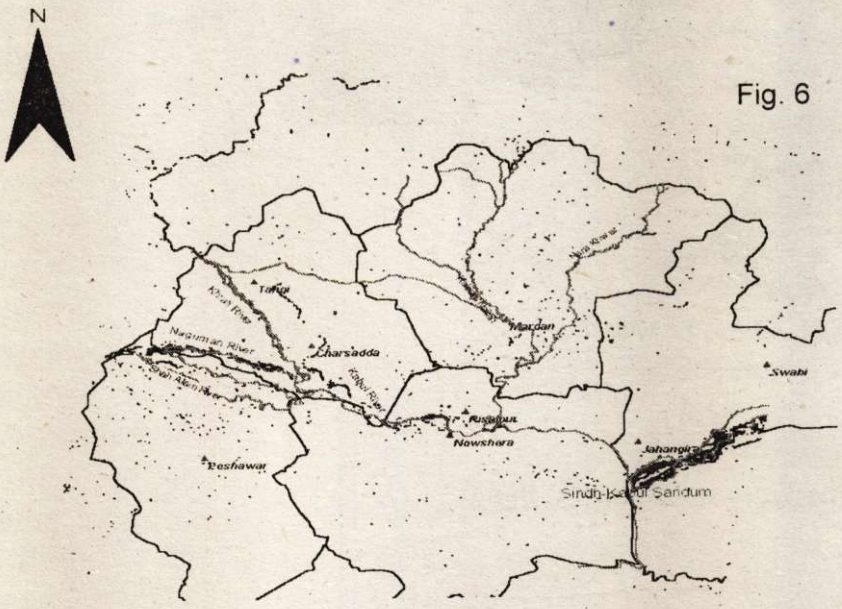


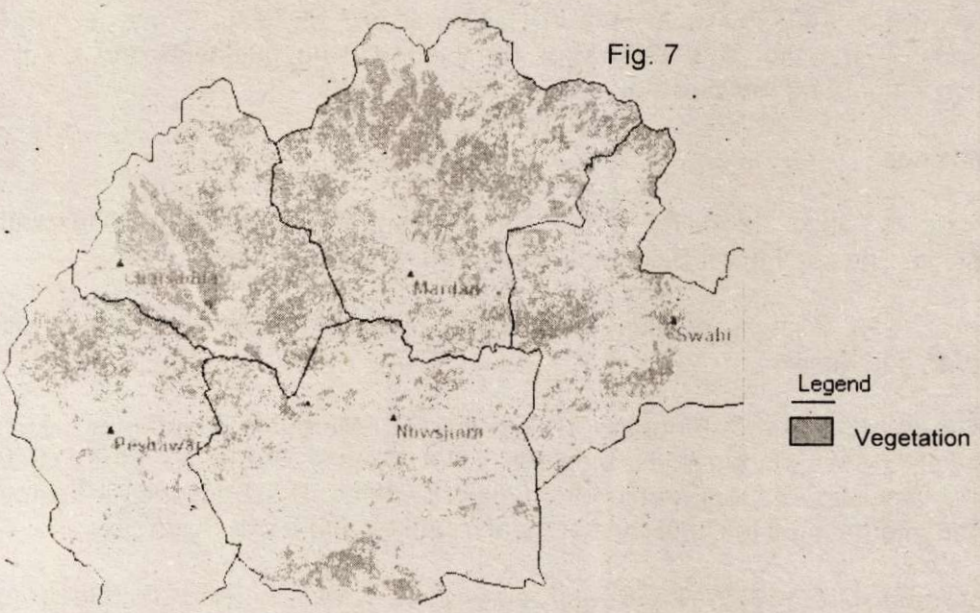
Fig. 5

Drainage Network of Peshawar Basin



Vegetation Map Extracted From Classified Image

Fig. 7



Conclusion

Based on these findings it is concluded that the modern technology of using satellites sensors can be utilized for the detection of changes occurring in different land uses through the time series in Peshawar basin as well as any other area. Besides, it can correlate these changes with dynamic forces resulting into changed scenario.

Therefore, it is recommended that a full-fledge digital database of the basin is of critical importance for the proper management and future planning of natural resource of the basin. In addition, it is also recommended that high resolution images and 1:50000 GT sheets may be used to mark the exact location of the earth features. These studies should also be substantiated through GPS data.

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Reference

Ahmad, G. 2001. Mapping a dry shrub forest for biodiversity conservation planning. Thesis. Forest Science Division ITC, The Netherland.

Anon., 1998. District census reports of Peshawar, Nowshera, Charsadda, Mardan and Swabi.

Rolf A. D., A. Richard, Kinppers, S. Yuxian, C.E. Martin, K. Menno-Jan, J.C.W. Michael, Y. Georgiadou, M.R. Mostafa, V. W. Cees J, W Kainz and E.J. Sides, 2000. Principles of Geographic Information Systems. ITC Educational Textbook Series International Institute for Aerospace Survey and Earth Sciences.

Sahibzaba M.Z. 1972. Land use survey of N.W.F.P (part I). Geography Department, University of Peshawar, Peshawar.

Shaheen L. 2001. Mapping of saline areas of Larkana District by using Spotxs data. International conference on RS/GIS at Karachi.

Shahina T, 2001. Environmental Geochemistry of surface and subsurface water and soil in Peshawar Basin, N.W.F.P, Pakistan. P.Dd. Thesis. National Center of Excellence in Geology, University of Peshawar, Peshawar.

Shrestha, S. 1998. UNID, Environment Assessment Programme for Asia and Pacific.