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COMPUTER AIDED HYDROLOGIC LAND USE MAPPING USING SATELLITE AND AIRCRAFT SENSED DATA: INDIAN CASE STUDIES

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This paper presents the results of two studies on computer analysis of Landsat-derived and aircraft based multispectral scanner data towards hydrologic land use mapping, necessary for effective water resources planning and management. The analyses were performed on the interactive Multispectral Data Analysis system (MDAS) at the National Remote Sensing Agency (NRSA) headquarters in Hyderabad, India.

The first study involved automated generation of hydrologic land use information to support regional ground water exploration programmes in the Semiarid Southern parts of Tamil Nadu State in India. The accuracy of comptuer categorisation was estimated through stratified random sampling techniques to be around 70 percent. At 95 percent confidence level, the accuracy estimate ranged from 66 to 88 percent.

Computer analysis of airborne 11 channel scanner data, to be optimum, requires that minimum number of channels of data be used commensurate with information requirements. The results of a test study indicate that for a typical MDAS analysis involving 36 spectral groups (8 flood plain land use categories) there can be a reduction of about 130 minutes in CPU time when four channels of data are used instead of all the 11 bands. The discmemory space for 4 channel analysis is only about 50 percent of that needed for 11 channels of data. The categorisation accuracy was comparable even with four channels of data. Further the uncategorised area was 15.7 percent with 11 channels of data compared to 1.14 percent with 4 channels of data. Thus, in this regional level flood plain land use categorisation effort only 4 out of 11 channels needed to be used to obtain comparable results but at a significantly lower computer cost.

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THE PREPARATION OF LAND USE, LAND COVER, AND PRIME AGRICULTURAL LAND MAPS FOR RAPPAHANNOCK COUNTY, VIRGINIA

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Rural areas are now receiving more attention from planners and natural resource researchers. As existing suburban areas and new towns (including boom towns) spread across the countryside it becomes important to conduct a survey of existing land conditions. The purpose of this research was to supply geographic and statistical data on USDA defined prime farmland in an area undergoing physical development pressures.

A county-wide land use and land cover, and prime farmland inventory was performed in Rappahannock County, Virginia to study agriculturally critical areas. Individual prime farmland soil series were delineated and mapped. The objectives were to measure six characteristics of prime farmland.

The procedure devised to meet the objectives was twofold. NASA Black & White medium scale flight photography was manually classified into 18 prime farmland related land use and land cover categories. Farm plans provided additional information to complete the land use and land cover data base. Soil survey information was manually transferred and combined with the land use and land cover base to complete the prime farmland data base.

The research provided a geographic baseline (1977) distributed and measurement of land use and land cover, and prime farmland soils. Results were two thematic maps showing the location of landuse/land cover categories and prime farmland soil series, and area measurements for each. For rural counties with limited planning capabilities this technique requires minimal equipment and training, and could provide needed information on farmland resources.

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LAND SURFACE FEATURE DELINEATION OF RURAL CENTRAL JAVA REGION USING DATA ENHANCEMENT TECHNIQUES APPLIED TO DIGITIZED LANDSAT MSS DATA

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The use of rotated and non-rotated principal component and vegetation (green biomass) indices to enhance original four band Landsat MSS data has a potential to improve delineation of surface features particularly in underdeveloped regions of the world which have a paucity of organized ground truth. It is vital to analyze and display Landsat data in forms which highlight features of interest most effectively especially in areas with limited or outdated surface data. Principal component and biomass ratio forms of Landsat data have proven to have the ability to identify selected land surface features better than using original Landsat data, consequently improving the potential for accurate surveying, mapping, or resource inventories of large area ecosystems of underdeveloped parts of the world.

Research at the Indiana State University Remote Sensing Laboratory (ISURSL) has been conducted which applies transformed Landsat MSS data in principal component and biomass ratio formats for a synoptic rural survey in a central Java study area. The study area is comprised of a variety of features including complex lowland and upland crop ecosystems, dry crop ecosystems, numerous agricultural rural settlements, forest and grass cover of various types differentiated vertically along volcanic mountain slopes, edaphic zones, and water. The micro-level complexity of this environment coupled with very limited ground information makes Landsat analysis of this region very difficult particularly using the raw data.

Utilizing Landsat data (Scene #106702145, 28 September 1972) in principal component and biomass ratio forms for supervised and unsupervised classification resulted in better delineation of agricultural soil features which were not clearly identified using original four channel data. It was also found that the vegetation indices led to better identification of vegetation cover when compared to original data. Also, the use of vegetation indices in combination with the principal component data is found useful in the overall land surface identification process. The utility of principal component and vegetation indices for data enhancement is thus, recommended for land surface feature identification and delineation in the underdeveloped regions of the world.

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A REMOTE SENSING AND GEO-BASED INFORMATION SYSTEM APPROACH TO THE ASSESSMENT OF IRRIGATION DEVELOPMENT POTENTIAL

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The Earth Resources Observation Systems (EROS) Data Center is engaged in a cooperative demonstration project with the Portland District of the U.S. Army Corps of Engineers. This study is using remotely sensed data and a geo-based information system to evaluate present and future effects of irrigation development on the flow of the Columbia River.

The Stanfield, S.E., Oregon, 7.5 minute quadrangle was chosen as a test area. Land cover shown on a 1972 Landsat subscene was classified as irrigated land, dryland agriculture, rangeland, and wetland. Soils maps of the area were interpreted to determine the potential of the soils to support irrigation development. The resultant potential irrigation map was digitized and entered into a geo-based information system along with slope derived from digital terrain data. A map of the potential for irrigation was then derived based on 1972 land cover, soils, and slope. The composite map revealed that the most favorable terrain for irrigation development was in the southeast part of the quadrangle.

Economic factors involved in irrigation--distance and elevation from the source of water (the nearest point on the Columbia River)--were also entered into the geo-based information system. It was assumed that irrigation pumping costs increase in proportion to distance and elevation from the source of water. When qualitative economic data were included in the geo-based model, it was noted that areas with the greatest probability for irrigation development were in the northwest quadrant of the study area (nearer the source of water than the southeast part). Landsat imagery from 1977 shows that irrigation development occurred as predicted when distance and elevation from water source were included in the geo-based model. Quantitative cost data are currently being derived by the Corps of Engineers prior to expanded use of the model in a 1.5 million acre study area in the Columbia River Basin.

DETERMINATION OF POTENTIALLY ARABLE LAND AND MEASUREMENTS OF NON-AGRICULTURAL USES FOR NINE SELECTED AREAS IN AFRICA

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The purpose of this study was to determine the percentage of total potentially arable land currently committed to non-agricultural human settlement uses in selected African agro-climatic zones.

Nine study areas equal in size to Landsat scenes, were selected by climatic zones as specified by the Food and Agriculture Organization, Rome, Italy. Soils information were fundamental to this project and were combined with climatic and crop suitability information for each study area. This information was manually converted to digital form for input to a computer-aided geographic information system, thereby creating nine independent data bases.

Landsat CCT data for these study areas were processed by computer to identify and map the extent of human settlement. These data were automatically input as files into the appropriate data bases using the registration and aggregation program LEVI, developed at the Holcomb Research Institute.

Potentially arable lands were identified within each Landsat scene, using FAO criteria, based upon soil and crop suitability within each climatic zone. Landsat digital data identified the extent and location of human settlement, and file manipulation techniques identified settlements occurring upon these potentially arable lands. The results of this study indicate that the amount of potentially arable land varied dramatically between the nine study areas, ranging from 778 km^2 in South Africa (.19% committed to human settlements) to 29,017 km^2 in Nigeria (2.1% committed to human settlement).

[1]The research described in this paper was supported by the Food and Agriculture Organization of the United Nations under contract No. UNFPA/INT/75/P13-2/AGL.

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