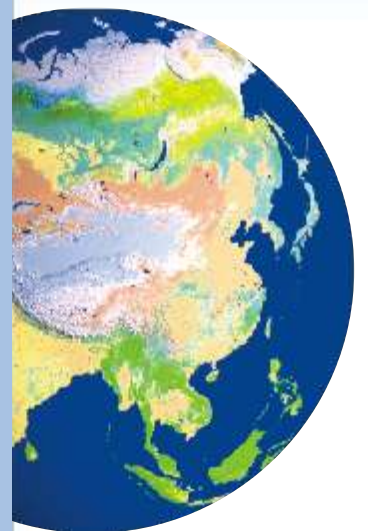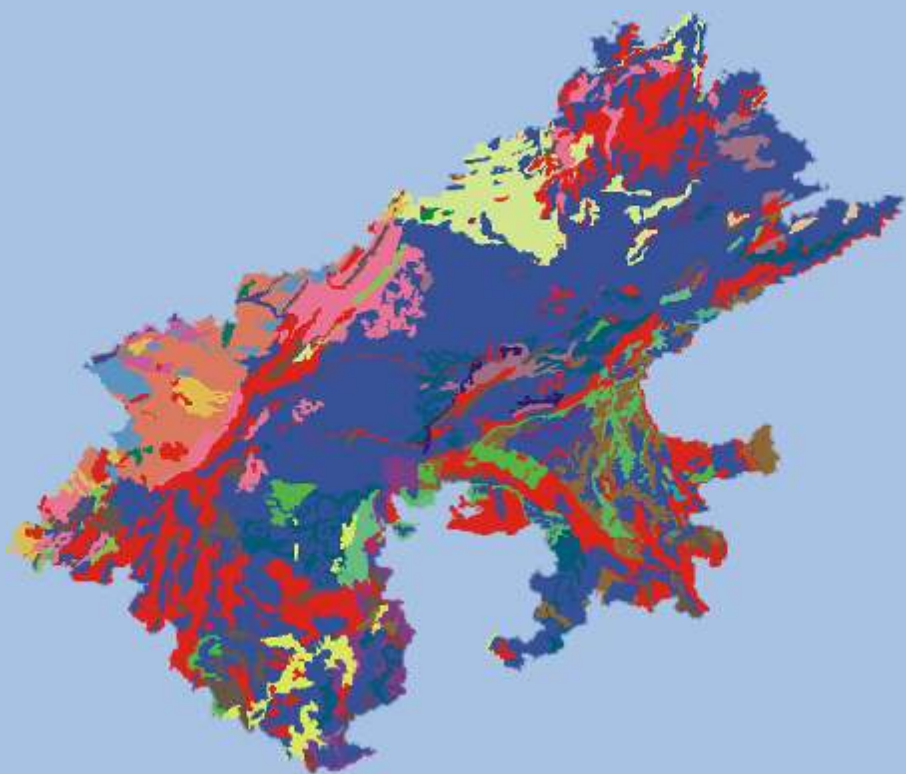# M. TECH THESIS ABSTRACT

Remote Sensing and Geographic Information System
(RS & GIS) (Phase-II)

An Agro-Hydroclimatic and environmental analysis of the changes in cropping style in Bangladesh and their impacts on Rice Crop Yield: A combined Remote Sensing and GIS approach

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Bangladesh is a densely populated agriculture-based country and rice is the major crop of the country. In the past two decades significant changes have been occurred in the cropping pattern and agricultural management of this country. This study presents an analysis on the existing cropping characteristics over the country in relation to land type, topographic characteristics, flooding etc. and includes an agro-hydrological analysis of the crop cultivation. NOAA AV HRR data have been used to estimate the countrywide rice crop area. The accuracy of rice area estimation over some selected districts in Bangladesh using NOAA AVHRR data has been compared with that obtained from high resolution Landsat TM data acquired on approximately same date as that of NOAA. A countrywide digital cropping pattern map has also been produced. Information on spatial crop distribution in each crop season has been obtained through digital analysis of NOAA A VHRR images and GIS based spatial data. As a part of the study, land evaluation has been performed through rice crop suitability analysis in relation to land inundation type, soil quality and ground water level information. Rice crop suitability map has been prepared that shows suitable area for rice cultivation in relation to the mentioned criteria. As the country is most vulnerable to flood, a part of the study is also dedicated to the assessment of rice crop damages over the country caused by the devastating flood of 1998. A rice crop (Aman rice) damage map has been produced using digital analysis NOAA A VHRR derived NDVI image. In this part of the study, post-flood agricultural rehabilitation particularly the post flood Boro rice area expansion has been studied. Remote sensing data (spectral vegetation index e.g. NDVI) and meteorological data (rainfall, temperature) based rice yield models were also developed for rice yield prediction.

Spatial Decision Support System for Planning location of additional village amenities considering Iso-tropical and anisotropic cost distance

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Planning for distribution of optimal levels of support facilities and infrastructure in relation to a human population is determinant in a balanced development of any region. The impact of these amenities is very significant for these activities. The spatial location of amenity is very important when allocation of amenity on demand and supply basis I sunder consideration. In this context planning requires both location and allocation aspects. The present study is taken up to develop a Spatial Decision Support System (SDSS) to aid decision maker to plan development in villages with reference to spatial information. This system helps planners to find various alternatives to add the amenity at any of the feasible locations and assess the impact of an option against predefined decision rules. It provides facility to add an amenity at any one or more of the feasible settlements. Graphic User Interface (GUIS) is provided for all the decision norms and relevant statistics and query options. If the added amenity does not satisfy the decision criterion the users can append, update and/or delete the amenity by pointing at the previously selected location on graphic screen against the background of the spatially displayed current scenario. It provides a precursor for supporting decisions on infrastructure and natural resource planning by fostering enhanced user interaction in a heuristic manner and combining the knowledge base of planners and decision makers.

Evaluation of parameters and development of a methodology for generating landslide hazard zonation map for Bhutan

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The slope failures in high mountain terrain such as Sikkim Himalayas have played havoc affecting socio-economic life and natural environment of the region. The aim of this study was to develop a methodology to generate landslide hazard zonation map for the study area using various integration techniques and different geo-environmental parameters. This would help in delineating the slopes that are prone to fail at a future date, so that the protective or preventive measures can be taken prior to occurrence of landslide hazard, so that life and property losses can be minimized. The remote sensing technology

has emerged as a powerful tool to accurately map the existing landslide areas, as well as the degree of instability of the terrain. The present study, therefore, aims to use the Remote Sensing and Geographic Information System, aided by field data collection to prepare a landslide map and also study various terrain parameters for landslide modeling and hazard zonation in the study area. The data integration technique applied in this study involved the information value calculation and the resultant information value map was classified into 5 classes on the basis of percentile classification with user defined cut-offs at 20%, 40%, 65%, 85% and 100%. The high and very high hazard classes classify almost 81% of the known slides in the region, thus showing the validity of the model.

Solid waste management in Dehradun city: A Remote Sensing and GIS approach

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The study of solid waste management system for an area incorporates assessment of sources of waste generation, collection system being used and method of waste disposal being practiced. The case study investigates a typical problem faced by the local municipal organisation to estimate the amount of garbage generated, the collection and transfer of garbage to the disposal area and the selection of suitable area for disposal based on environmental indicators. IRS-1C PAN and LISS- III data were digitally processed to derive the present Land use Land cover Information. Care is taken to ensure that the potential sites are built away from rivers, lakes, floodplains, less leaky geological foundation, on gently or moderately sloping terrain and are accessible even in wet conditions. The analysis resulted in potential sites suitable for landfill operations. An investigation of the application of 1m PAN and 4m Multispectral IKONOS imagery for extraction of large-scale urban infrastructure was carried out for in a small area of a Municipal ward of the Dehradun city to improve the Micro level management of solid wastes. The study involved Identification and quantification of sources of generation of solid wastes within the selected study area using the high resolution satellite data, Assessment of the requirement of additional waste collection bins and Optimum path analysis for the solid waste disposal within the study area.

Prioritization and management needs of Kawal Khad watershed in southern Himachal Pradesh using Remote Sensing and GIS

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This study was carried out with the objectives to investigate the effect of watershed characteristics on soil erosion, prioritise the sub watersheds using RS&GIS and to suggest the suitable soil conservations measures. Land use/land cover, physiography cum soil and hydro-geology spatial information and maps have been derived from IRS-1C LISS-III imagery (February, 1997) by visual analysis. The watershed was divided into 12 sub-watersheds on the basis of toposheet and satellite data derived drainage pattern. The erosional soil loss using Universal Soil Loss Equation (USLE) and Sediment Yield Index (SYI) were computed to prioritise the sub-watersheds. Out of 12 sub watersheds, only one sub watershed and three sub watersheds had been categorized as very high and high priority, respectively, based USLE and SYI models estimated erosional soil loss. The major soil conservation measures had been also suggested for different soil erosion intensity unit which was generated by integration of satellite dervid soil, land use/land cover, terrain slope and soil erosion hazard maps

Landscape characterization on Biodiversity prioritization in a mountainous districts of central Himalayas

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There is an urgent need for national and sub-national studies to increase the understanding of the underlying causes of change and change processes, the factors contributing to forest cover degradation, and the effect of vegetation change on other forest resources. Accurate, up to date information on the Himalayan forests is important for conserving the biological wealth and for an understanding of factors, which may affect forests tomorrow. Mountainous districts of central Himalayas were taken in this study.

Satellite data (IRS-1C : LISS III) and GIS had been used to-identify the major forest communities, analyze landscape attributes of various land units, and realize the area and other attributes of protected landscape under control of state forest department. Biological diversity with respect to vegetation structure in different communities under a forest type and along the environmental gradient (elevation) was also studied through detailed field inventory and these data were co related with satellite extract information. Fragmentation in the landscape was also studied by deriving various landscape parameters. Possible factors responsible for fragmentation phenomenon had been identified. Various issue related to fragmentation processes and threat to biodiversity were also investigated.

Application of Remote Sensing and GIS for Identification of Ground Water recharge areas on Yarada Hill of Visakhapatnam, India

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Visakhapatnam city where a rapid expansion of residential and other built-up areas both horizontally and vertically is causing reduction in recharge area and more pumpage per unit area respectively. Now due to lack of plain areas for further expansion of residential areas the elevated built-up land is spreading over the hills of the city. The continuous increase in exploitation of ground water due to inadequate supply of water to meet the domestic, industrial, and agricultural purposes and reduction in recharge area in the city has caused continuous depletion of groundwater in many areas. This has brought into focus of the need to locate groundwater recharge zones and to under take the planning for water harvesting systems on the foot hills of Kailasa and Yarada. Therefore, the Yarada hill of Visakhapatnam city is taken as study area for the present study. In the present study remote sensing data and GIS tools have been used for identification of areas suitable for water harvesting structures in the study area. There are three suitable locations for the construction of check dams were identified suitable sites for contours trenches were also identified for ground water recharge using Remote Sensing and GIS.

Hydrological modelling using Remote Sensing and GIS

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In this study flood forecasting of Nagwan watershed of the Damodar river basin has been done using a hydrological model and GIS. The objective was to test what extent the integration of a hydrologic model and a GIS can contribute to the quantitative estimate of the required parameters for the HEC-1 model. The softwares used are HEC-1 hydrological model, Arc/Info and ILWIS GIS. Five sets of input variables are required for the model: Precipitation, Sub-basin area, Infiltration rate, Surface runoff and Flood routing. The HEC-1 model has been described in detail about the methods available and how the input parameters can be derived using remote sensing and GIS techniques. PC Arc/Info is used to create database and ILWIS for analysis and derivation of few input variables (excluding precipitation) for the model. Few rainfall events during 1993 and 1994 are used to calibrate the model. The computed hydrograph at the outlet of Nagwan watershed are found to be quite similar to the observed hydrograph, except the time to peak was more by 1.5 hours in computed hydrograph. Few more event data is required to arrive at the best-calibrated model parameters to validate the model's ability to predict the flood pattern at the watershed outlet in future.

Palaeo environmental reconstruction of Godavari delta during quaternary period a Remote Sensing and GIS approach

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To a large extent the nature and the amount of the sediments in a delta is related to the nature of the drainage basin which contributes the materials that transported and accumulated at the coast as the delta plain. The morphology of the delta depends upon a number of factors like, totality of hydrologic regime, sediment level, geologic structure and tectonic stability, climate and vegetation, tides, winds, waves, seawater density contrasts, coastal currents and innumerable spatio-temporal interactions of all factors. On screen visual interpretation has been carried out from the digital data for the preparation of land use pertains to the palaeo land forms. Aquaculture farms in the area have been delineated by on screen visual interpretation of the digital data. In the Godavari delta several land form units were identified using RS data namely, Palaeo channels, Palaeo beach ridges, Delta

plain, natural levees, meander scroll, channel islands, point bars, mangrove swamps, marshy area, coastal sand dunes, Tidal area, Salt pans, spits etc. The geomorphic characteristics of the delta are well marked in the study. The palaeo geography and six prominent stages in the development of the delta have been demarcated taking the trends and dislocation of palaeo beach ridges and distribution of palaeo channel into consideration.

Multi-criteria evaluation for Agro-based industrial site suitability GIS based decision support system approach : A case study of East Godavari district, Andhra Pradesh, India

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The purpose of this project was to develop and implement a method of choosing an optimal land allocation model for the development of Agro based Industrial sites in Six Mandal Administrative Units in East Godavari District, State of Andhra Pradesh, India. Several criteria were incorporated into the analyses; these included Central and State Government policies and regulations for the industrial site development. Multi Criterial Evaluation (MCE) Weighted Linear Combination Model (WLCM) has been applied for an Optimal Landuse Allocation Plan to establish Agro based Industrial sites in the study area. The MCE final suitability map indicate the varying ranges of suitability for locating the best suitable site for developing Agro based Industries throughout the study area. The spatial patterns on the map are strongly influenced by the proximity to road and railway factors and popultion density, wasteland and land use/land cover constraints. The influence of the population density in Southwest and Northeast part of the study area is clearly evident in the resultant map. Most part of the study area constitutes agriculture land, settlements, plantation, water bodies where unsuitable areas are found. The resultant images were satisfied all the criteria by being located nearby transportation proximity, canal proximity, market places, located away from the settlements, populated areas, agriculture land and existing land cover, minimizing the disruption to such environmentally sensitive areas.

Remote Sensing and GIS applications in the environment analysis of wetlands - A case study of Kollera lake region, East Coast of India

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Kolleru is an important Wetland ecosystem along the east coast of India. The study was Kolleru lake region, situated between the Krishna and Godavari rivers. The temporal variations in the lake spread during recent years indicate that the lake was reduced by about 110 km^2 between 1992 and 2001 mainly due to aquaculture activities. The multi-date land-use/ land cover analysis using multiperiods IRS-IA, IB & IC: LISS II & LISS III data revealed that the cropland had decreased by about 337 km^2 in nine years from 1992 to 2001 mainly due to increase in aquaculture. A GIS analysis of the 1992 and 2001 land use/ land cover data clearly points out that aquaculture is encroaching on the lake proper, cropland and marshy area. The large scale encroachment and reclamation of Kolleru lake area and digging up cropland for aquaculture ponds is by no means a desirable trend.

Drought monitoring using NOAA/AVHRR data in I.R IRAN

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Drought is one of the most common disasters, which occur in Iran. Satellite Remote Sensing can play a major role in drought monitoring and assessment in a near real time basis. Due to the specific characteristics of NOAA data such as wide ground coverage, wide spectral resolution, near real time data acquisition, repetitive data collection capability, and low cost it has become as a most popular data sources for disasters monitoring. The aim of current study is to evaluate the capability of NOAA/AVHRR data in drought monitoring and assessment, for later studies to create a model for early warning purpose. June August 1977 (drought year) and 1998 (Normal Year) period data were selected for the study. Mean monthly NDVI images were generated for 1997 & 1998 years and the study show that there is a close relationship between NDVI and drought conditions. The area for the highest NDVI value has reduced to less to 40% in year 1997 than the normal year (1998). The wheat yield was also reduced to 356000 tonnes in 1997 as compared to 700,000 tonnes in 1998 for in Golestan Province. The Methodology adopted for this study is proven to be useful for evaluation of drought condition using NOAA AVHRR data.

Studies on ground water salinity, related impacts and mitigation plans in Jakarta coastal region

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Degradation of water quality due to saltwater intrusion affects the land use pattern along coastal region. Jakarta is, the capital city of the Republic of Indonesia, is located in a coastal region where saltwater intrusion problem occurs in this city as a result of land subsidence. The purpose of this study is to identify saltwater intrusion using remote sensing and GIS technique. Salt affected area on coastal region, is an indicator of saltwater intrusion which can be interpreted from satellite data. The result showed that there was good agreement between the digital image processing results and the analysis of ground water samples. Ground water with chloride content more than 500 mg/L which is not advisable for drinking purpose, distributed along the coastline in average of 1.5 km inland in 1998, 2.1 km in 1996 and 5.6 km in 1988.

Use of Remote Sensing and GIS techniques in mapping of erosion in Yassy sub watershed (Kyrgyzstan)

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This study allowed to gain GIS experience through integrating land-resource surveys and related geo-data from various sources. GIS could significantly assist in every stage of thematic and cartographic modeling. The model shows that especially for regions with limited information about topography and soil data, an integration of data of different origin can help to solve mapping problems. Most steps needed can be achieved through GIS. In this study soil erosion was estimated and depending on erosion types and erodibility degree, the following erosion preventing measures are recommended. The very simple, reliable and the main way to decrease soil erosion is to plough across slope and conduction of anti-erosion measures. This is sharply decreases the surface flow and erosion, increase the crop

productivity, conserve soil fertility. Location of agricultural crops should be identified based on steepness of slopes and landuse. In this case all agro-technical measures should be carried out across slope. One of the most active soil erosion prevention measure is afforestation. The afforestation has effect for mountain slope stability. The types of forest plants recommended are: *Acacia wheith, Elm, Greece and Mountain Nut, Apricot, Pistachio, Almond, Poplar and etc. The bushes can be used are Acacia yellow, Rose hip and etc.*

Land cover mapping of Selenge Basin, Mongolia using Remote Sensing and GIS

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This research study was carried out to meet the needs of Mongolia to improve land allocation and its management. Land and its cover together characterise the Mongolian ecosystem. A big issue is the impact of global warming as well as the affect human activity has on the land. Effective policy making and appropriate measures for the reduction of negative impacts on the land cover change requires detailed study of the land by provinces and subprovinces. The overall objective of the reseach was to develop a land cover classification system using remote sensing and geographic information system to produce a land cover map for multi-class area, that meets international standards using Landsat Thematic Mapper data. In addition, output of this research were intended to contribute towards the international efforts to create a worldwide land use/cover database. The study area is located between 40°50°N, and 104°108°E. This study helped immensely in (i) development of classification and information processing technique for the integration of satellite data, thematic and topographic maps and field survey by their spatial and temporal scales and by contents, and in generation of 1:50,000 scale land cover maps for 4.8 million hectare area of Selenge and Tov provinces, (ii) development of a classifcation system, which confirms to international standards, and (iii) generation of land cover database for main crop area of Mongolia.

Comparison in forest fire risk modelling in part of west and central Mongolia using Remote Sensing and GIS

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Forest fire is a natural component of forest ecosystem but it can adversely affect the ability of the forest to maintain its diversity, loss of habitat for indigenous flora and fanna loss of timber etc. Satellite remote sensing provides systematic and consistent measurement of a series parameters related to fire and fire impacts. This study deals with the application of Remote Sensing and GIS techniques for fire risk mapping in part of west and central Mongolia in different ecological zones. Fire risk index map for both the study areas were generated by GIS aided integration of forest vegetation type; terrain slope and aspect, buffer zones for roads and habitation (proximity) maps with appropriate weightage coefficient for forest fire risk of each classes under each thematic layers. Senstivity analysis of forest fire risk map was carried out using field data of actual forest fire event.

Urban expansion, land use change and their impact on environment of Yangon city using Remote Sensing and GIS

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Rapid and haphazard growth of urban area and increasing population pressure in the city are causing deterioration of infrastructure facilities, loss of productive agricultural land, loss of water bodies, besides causing air pollution, contamination of water, health hazards and micro-climate changes. Yangon city was chosen as study area for this investigation. Landsat TM data of 1989 and 1995, and IRS- IN (PAN) & LISS III data of 1998 had been used. This study demonstrated the usefulness of temporal satellite data for carrying out inventory of land use/land cover and monitoring urban expansion of the city. The impact of land use changes in Yangon city on environment was also investigated in this study with reference to positive parameters viz. facility of health, education, recreation, and road

network etc., negative parameters viz, traffic, noise pollution, air pollution, garbage dumping sites etc. This study indicated that GIS is a tool which allow town planner to design models for development and to determine the various solutions available to government to deal with the rapid growth of cities and the rapid deterioration of the environment.

Assessment of forest cover for selected test site in northern Myanmar

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This study intended to analyze the forest type, land use, forest distribution conditions of tropical forest in Northern Myanmar using IRS-ID WiFS Satellite sensor data. The result of the study showed that coarse resolution IRS-WiFS data could be effectively utilized for forest type and land use inventory and forest vegetation condition mapping following digital classification technique in northern part of Myanmar. Land cover change analysis over the past decade using temporal satellite data had also been investigated in the study area.

Integrated use of Remote Sensing and GIS for establishment of planning Databases for Sustainable Development of Myingyan district, central dry zone, Myanmar

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The major objectives of this study were to built a spatial database of Myingyan district for detailed planning purposes emphasizing on multi-sectoral approach for integrated sustainable development; to formulate a methodology for integrated use of Remote Sensing & GIS for further planning of other dry zone districts, and analysis of the database and subsequent suggestions for integrated approach for sustainable development. The study area was Myingyan district of Central Dry Zone of Myanmar. Temporal Landsat TM (1995 & 1995) data were used in this study. This study indicated that remote sensing data has a key role at many levels in collating and mapping information about land surface and its current state. However, this information only fully utilized when put into the context of a GIS and only provides all of its information when directly analysed with collateral data.

Rice and sugarcane crop Acreage estimation and land evaluation for sustainable agricultural land use planning of Yemethin district using Remote Sensing and GIS

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Rice is the main staple food crop of Myanmar, accounting for 97% of total food grain production. Sugarcane is the second important crop of this country. There is a urgent need for accurate assessment of area and suitability analysis for further expansion of these crops. The major objectives of this study were crop acreage estimation of rice and sugarcane using Landsat TM data; land evaluation for suitability analysis of these crops to find extendable area in non-reserve forested area. The study area was Yamethin district of Myanmar. Digital classification of satellite data showed that the area under rice and sugarcane are 16.8% and 4.40% of the total area of the district, respectively. The overall classification accuracy of rice and sugarcane was 98.4% and 91.8%, respectively. GIS was an effective tool for creating agricultural resources digital database viz. soil, terrain, non-reserve forest etc. Potential area for expansion of cultivation of rice and sugarcane crops within non-reserve forest area was found out based on GIS aided crop suitability analysis using soil and terrain information following FAO Land Evaluation.

Characterization of mountain Agro-ecosystem

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Agro-ecological zoning (AEZ) method support the screening of new and improved land use option by assessing the ecological suitability of the selected land utilization types. The objective of this study was to develop a methodology for characterization of mountain agro-ecosystem and develop a case study to demonstrate the application of agricultural planning at a district level. The study area selected, was "Hindukush" Himalayan region. The methodology was also tested at district level and for this purpose. Lamjung district of Nepal was selected. AEZ maps was prepared by GIS aided integration of climatic variables viz. rainfall, temperature, length of growing period, and edaphic variables like land use, soil

texture, depth, drainage, salinity etc. A Decision Support System (DSS) was also developed for suggesting suitable crops based on each AEZ characteristics. Temporal satellite data monthly NOAA AVHHR derived NDVI and Landsat-TM data were used for generating existing land use/land use maps which was one of the inputs for AEZ delineation

Quantification of forest growing stock using remote sensing data for management planning in Tikauli forest of Chitwan district, Nepal

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The study aims at the utilization of state-of-the-art technology, remote sensing and GIS in the quantification of forest growing stock required for forest management as well as in forest development and planning activities. The study area (7540 ha.) is situated in the Doon valley of Chitwan District of Nepal. The study has been accomplished by using remotely sensed data (Landsat TM, Jan. 1998; for comprehensive digital image processing) and GIS (intensive mapping and modeling). Forests have been stratified into forest cover types and canopy cover density classes (supervised classification). Basing upon stratified random sampling technique, an inventorization of sampling plots (45; 0.1 ha size) has been carried out. Inputs from remotely sensed data and forest inventory data have been processed and analyzed in the GIS domain (Arch View Image Analyst). Comprehensive forest cover type and land use maps have been prepared. Spatial extent of various forest classes has been used to determine the quantification in stratum-wise as well as total growing stock through statistical analysis. Different maps depicting forest cover types, canopy cover density classes, compartment map, block map and aspect map were analyzed through geo-spatial approach. Digital elevation model have been also generated. The results and conclusion have highlighted in reference to available growing stock and its scope in the utilization for preparation of detailed forest management plan keeping in view the defined objectives of forest development and planning in the forest division.

Issue of urban environment in Kathmandu valley - A case study of Kathmandu municipality

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Increasing population pressure, changing socio-economic condition and with lack of physical infrastructure have collectively contributed to the degradation of urban environmental condition in Kathmandu valley. This study attempted to analyze some of the physical parameters of urban environment in valley derived from aerial remote sensing and also tried to evaluate their impact particularly over the environment of Kathmandu municipality through GIS. The analysis of land use indicated that the urban areas had increased at the cost of productive agricultural land and depletion of forest areas deteriorating the eco-system. The urban facility provided by the road accessibility, park/garden and hospitals to the municipal inhabitants is concentrated only along the central part. Likewise negative physical parameters such as river odour, industrial affects, dust pollution and airport noise have direct effects to nearly one third of the total population in Kathmandu municipality.

Watershed modelling using RS and GIS : A case study of the middle mountain region of Nepal

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In the interactions between climate and land, erosion is a natural feature in which soil is redistributed by wind and water. However, when it is unbalanced through human activity, its effects on agriculture and food production can be devastating. Hence, the pathways and local nature of soil 'redistribution' must be managed. This study has been carried out at Jhikhu khola. Administratively, Jhikhu khola watershed falls in Kabhrepalanchok District, located in middle-mountain of the Nepal. The watershed can be divided into 14 Village Development Committees (VDC) and municipalities. Jhikhu khola watershed lies about 45km east of Kathmandu between 27° 33' and 27° 42' N and 85° 31' and 85° 41' E with an altitude range from 860m to 2200 msl. For surface runoff modeling, Modified SCS curve

number method was used while for soil erosion modeling Morgan-Morgan and Fenney (MMF) model was used. All the basic layers namely Land use land cover, Hydrologic soil Group, soil map and slope map were derived using Remote sensing and GIS. Various factor maps like Kinetic energy, Rooting depth, Interception, ratio of actual to potential ET etc. were derived using attribute data handling. Finally governing equations were applied to obtained the results. Result indicates that rained agriculture is contributing maximum soil loss, 32.5 tonnes/ha/year, while forest area is contributing very less soil erosion. The average annual soil loss of study area is 12.6 tonnes/ha/year. Surface runoff contributing to watershed outlet is just 24 percent of total rain causing discharge to the river.

Application of Remote Sensing and GIS for monitoring land cover changes and its impact on surface runoff in small watershed

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Sundarijal watershed area, from where River Bagmati originates was selected as a study area for the present research. This area lies within the Shivapuri watershed and wildlife reserve area, one of the highly protected areas in Nepal. The methodology consists of visual interpretation of the topomaps, aerial photos as well as digital image processing of satellite imageries. Integrating the thematic maps with field data and meteorological data, various maps such as land use change, soil texture, AET, moisture deficit, runoff potential, moisture surplus change etc. have been derived. The models Thornthwaite-Mather's (1957) and SCS have been applied for the estimation of water budgeting and surface runoff for the years 1988 and 1997, assuming the same meteorological data for both years to evaluate the impact of land use change only. In summary, the integration of 3S technologies: remote sensing (RS), geographic information system (GIS) and global positioning system (GPS) is an effective tool for monitoring, evaluation and management of land water resources.

Geo-Hydrological processes and their impact on the environment and socio-economy of a watershed

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The study is aimed to analyse the impact of geo-environmental parameters to assess the intensity of geo-hydrological hazard and risk in structurally disturbed Himalayan terrain covering about 200 sq.km area of Banganga watershed in mid-western part of Nepal. For this purpose, information on nine thematic parameters like lithology, structure, land use, drainage etc. were generated using remote sensing data products viz., aerial photos and Landsat TM-5 image. In order to generate geo-hydrological hazard map, the inputs maps were integrated under GIS environment using ILWIS 2.2 software package and applying bi-variate statistical approach. Finally, a risk map was prepared by combining geo-hydrological hazard map with vulnerability map. The geo-hydrological hazard map with five classes displays high degree of reliability as major hazardous processes eg. Landslide/erosional processes occur in high to very high hazard classes. About 43% of the total area falls in these categories containing 83% of active slide. Moderate to low hazard areas constitute about 17% of the area. The risk assessment shows that 17% of the total area is under very high-risk zone in terms of expected loss/damage to property.

Optimal land use planning for agricultural development by integrated use of satellite Remote Sensing and GIS - A case study of Vali Kamam region of Jaffna Peninsula, Sri Lanka

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Preparing optimal landuse plan on scientific basis is a must to prevent the deterioration of land to keep sustained agricultural production to continue. Optimal land use planning requires reliable and up-to date information on natural resources viz. terrain, soils, land use hydrology etc. Satellite remote sensing provide valuable and reliable information on aforesaid resources. GIS has emerged as a powerful tool for integration and spatial analysis

of the data of these resources. The study area lie in the Jaffna peninsula of northern Sri Lanka. Land use/land cover and physiographic-soil maps of the area were prepared by digital supervised classification and visual analysis of IRS-IC LISS III data, respectively. Potential productivity of the area was evaluated by GIS aided Land Productivity Index (LPI) method. Suitability analysis for 10 dominant land utilization types (LUTs) was carried out using GIS following FAO frame work of land evaluation approach. Finally suitable cropping pattern maps was prepared by integration of suitability maps of 10 LUTs. Optimal land use plan was also suggested for the area by GIS aided integration of existing land use, suitable cropping pattern and LPI maps.

Selection of potential sites for sanitary landfill using GIS techniques in Nakhon Ratchasima, Thailand

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The rapid pace of socio-economic development, urbanization, and growth of population in most cities of the developing countries has caused in increase in the amount and complexity of solid waste, and a greater demand for soil waste management changwat Nakhan Ratchasima province of Thailand was chosen in this study. This study aimed to create of framework for computing the physical environment criteria to identify the suitable areas for sanitary landfill of life span of 20 years. The suitable sites for sanitary landfill were identified in the study area by GIS aided integration of several thematic information viz. terrain characteristics, surface & ground water resources geological characteristics, land use etc., following suitable criteria.

Urban expansion and environmental impact analysis in Ho Chi Minh city using Remote Sensing and GIS

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Throughout the world today, cites are growing faster than their hinterlands in population and economic activity. Migration of people to cites has long been felt by many countries. The growth in human population in a city has profound social, economic, and environmental consequences. The study area was part of part of Ho chi Minh city province. The major objectives of this study was to prepare land use map, to study urban expansion in different periods (1977, 1982, 1992 & 1998); and to make an urban environmental analysis due to expansion of Ho chi Minh City with reference to physical environmental parameters. Temporal aerial photograph and Landsat TM were used as remote sensing data. Temporal remote sensing data were found useful for preparing urban expansion maps in different time periods following visual interpretation technique. GIS was found a very effective tool for creation of spatial and non-spatial databases such as natural, environment, socio-economic, utility system factors for urban and regional planning and managing purpose.

Study and estimate of groundwater resource in Red river delta zone by Remote Sensing and GIS

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The objective of this project is to study and estimate groundwater resource in Red River Delta Zone, Hanoi, Vietnam using remote sensing and GIS-based techniques. Visual interpretation of satellite data viz., Landsat MSS and SPOT paper prints were carried out to prepare various thematic maps viz., geological map, geomorphological map, soil map and vegetation map. Ground survey for selective field check and collection of supplementary ground data were also carried out. Groundwater potential zonation of the area has been attempted by Multi-Criteria Evaluation (MCE) technique. The input layers viz., geology, geomorphology, soil and vegetation layers have been integrated together and hydrogeological map of the area has been prepared. The final map shows relative groundwater potential in different parts of the area. It is observed that in Red River Delta,

groundwater is a unique clean water source presently being exploited for drinking and domestic water supply purposes. The total capacity of all water treatment plants in southern side of Red River in Hanoi city is about 400,000 m3/day which may increase to 700,000 800,00 m3/day by the year 2010. The other cities and towns in Red River Delta Zone do not have favourable groundwater conditions as in Hanoi city. For example, in Hai Phong, Hai Duong, Thai Binh, Nam Ha, groundwater resource is either limited in reserve or saline in nature. In order to meet water requirements of these urban centres, attention should be given on the use of surface water or mobilization of water from other areas.

Groundwater targeting using Remote Sensing and GIS in Ba river valley

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Ground water targeting had been carried been carried out in Ba river valley. The Ba river valley is located on the south of middle Vietnam, covering 13,846 sq. km. Landsat-TM images of March, 2000 and April, 2001 were interpreted for generating various thematic maps. The drainage pattern and density, slope, lineament density, geological and geomorphological, and rainfall zones thematic maps were integrated in GIS, following index overlay method, for preparing ground water potential map. Various ground water prospects zones in the study area were identified such as very poor, poor, moderate, good and very good.

Forest cover and land use planning and monitoring using Remote Sensing and GIS - A case study in Lagri Commune, Chupah district, Gialai Province, Vietnam

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The objective of this study was to detect changes in forest cover and land use of the study area for period from January, 1987 to February, 1996 using remotely sensed data. The study area was Chupah district, Gialai Province of Vietnam. SPOT FCCS of both periods on the scale of 1:100, 000 scale were visually interpreted for the above objective. During the study period in a span of 9 years, forest cover and land use pattern of the study area had been changed significantly. Overall 31% (4696.6 ha) of the total study area subjected to change, either positively or negatively. The cansity factors for negative changes in forested area shifting cultivation, overlogging, spontaneous immigration, coffee, rubber and other perennial industrial trees plantations etc.