Land Cover Classification and Forest Normalized Difference Vegetation Index (NDVI) Analysis of Manaslu Conservation Area, Central Nepal

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This is to certify that the dissertation work entitled **Land Cover Classification and Forest Normalized Difference Vegetation Index (NDVI) Analysis of Manaslu Conservation Area, Central Nepal** submitted by **Mr. Janardan Mainali** has been carried out under our supervision. The entire work is primarily based on the results of his research work and has not been submitted for any other degree. We recommend this dissertation work to be accepted for the partial fulfillment of Master of Science in Botany.

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Abstract

Remote sensing is nowadays widely used in study and management of environment both in spatial and temporal scales. Land cover classification is one of the earliest applications of remote sensing. Remote sensing can also be used in understanding different ecological phenomenon. This work encompasses land cover classification and productivity (NDVI) analysis of five high mountain forests of Manaslu Conservation Area (MCA) of central Nepal using remote sensing and GIS. Normalized Difference Vegetation Index (NDVI) calculated from remote sensing image is an indicator of vegetation vigor, productivity and health. It is the simplest index to understand the vegetation performance in different scales.

Landsat ETM+ image is used to classify land cover. Unsupervised and supervised methodology was used for classification in ERDAS imagine software. Accuracy of classified map was assessed by confusion matrix. NDVI analyses of five different forest patches (*Betula-Abies, Larix, Pinus wallichiana, Quercus* and *Picea-Tsuga*) were done using MODIS terra data products. NDVI of each forest patches was acquired from 16 days composite 250 m MODIS data of year 2000 January to 2008 December. Relation between NDVI and total monthly precipitation and average temperature of nearest weather station (Gorkha) was also tested.

Land cover map is acquired with 60.14 percent of overall accuracy. Boulder & Grass occupies highest area in MCA followed by human influenced land cover Agriculture & Settlement. Among five forest examined *Picea-Tsuga* forest is found with highest NDVI followed by *Quercus* forest. *Betula Abies* forest of highest altitude is found with lowest average NDVI value. *Larix* and *Pinus wallichiana* forests lie in between them. Except maximum value of *Larix* no forest showed any trend of increasing or decreasing NDVI from 2000 to 2008. One month lag of average monthly temperature and two month cumulative rainfall has been found as best predictor of NDVI for most of the forest types. Temperature is linearly related to NDVI and is seen as limiting factor for productivity of high mountain forest. Precipitation, however is unimodally related to NDVI exhibiting highest NDVI in moderate rainfall.

Keywords: NDVI, Land Cover, Mountain Forest, Remote Sensing, Geographical Information System (GIS)

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Abbreviations

ANOVA:	Analysis of Variance
AOI:	Area of Interest
AVHRR:	Advanced Very High Resolution Radiometer
DBH:	Diameter at Breast Height.
DHM:	Department of Hydrology and Meteorology
DN:	Digital Number
ERDAS:	Earth Resource Data Analysis System
ETM:	Enhanced Thematic Mapper
EVI:	Enhanced Vegetation Index
GCP:	Ground Control Point
GIS:	Geographical information System
GLCF:	Global Land Cover Facilities
GPS:	Global Positioning System
GVI:	Gross Vegetation Index
ICIMOD:	International Center for Integrated Mountain Development.
IUCN:	International Union for Conservation of Nature
Km:	Kilometer
m:	Meter
masl:	meter altitude from sea level
MCA:	Manaslu Conservation Area
MCAP:	Manaslu Conservation Area Project
MENRIS:	Mountain Environment and Natural Resources' Information System
mm:	Millimeter
MODIS:	Moderate Resolution Imaging Spectroradiometer.

NASA:	National Aeronautical and Space Administration, USA
NDVI:	Normalized Difference Vegetation Index
NIR:	Near Infrared radiation
NOAA:	National Oceanic and Atmospheric Administration, USA
NTNC:	National Trust for Nature Conservation, Nepal
RS:	Remote Sensing
sp.:	Species
spp:	Many species
SPOT:	Systeme Pour l'Observation de la Terre
SPSS:	Statistical program for Social Science
TIFF:	Tagged Image File Format
USA:	United States of America
USGS:	United States Geographic Survey
UTM:	Universal Transverse Mercator
VDC:	Village Development Committee
WGS:	World Geodetic System
^{o}C:	Degree Centrigade
.img:	Imagine file extension