Modeling Deforestation Using Logistic Regression, GIS and RS
Case study: Northern Forests of the Ilam Province

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Introduction
Land use and land cover are not static and are frequently subject to change due to human activities, also, with attention to the trend of deforestation in recent years, is very important to estimate the degradation in the different time periods. Access to information related to the past and realizing the changes are necessary for solving deforestation problem. Identify and detect these changes can help planners and managers to identify effective factors in land use and land cover changes and have to be useful and effective programming for their control. Iran west forests is important in terms of area, environmental issues, soil and water resources conservation which during the past decades due to social and economic factors, lack of comprehensive management and etc lost its production capacity and this trend threatens the future of the region forests. As a result, planning and management of these forests are associated with many problems which lack the necessary studies in this area will contribute to the above issue. To explore and evaluate these changes, using remote sensing and GIS techniques and tools can have a considerable effect to generate spatial information and having analytical capabilities.

In the present study, using the information resulting from comparing satellite images of two different periods, identify changes trend in the studied forests and then with applying GIS analyzes to identify effective factors in these changes can measure and the results presented in thematic maps and finally suggested degradation probability model for the study area.

Research Methodology
In this research, remote sensing data include images of MSS (1976) and TM and also 1:50.000 topographic maps and 1:20.000 aerial photos of region were used. In order to classifying and preparing forest map related to the study years, training samples are prepared with help of ground
operations using GPS device and also using processing and satellite images enhancement in environment of IDRISI software and finally, training sites of forest and non-forest areas were prepared. Also, the spectral response of different bands for each of training site classes were drawn and interpreted. After geo-referencing satellite images using ground control points, map of forest extent related to years of 1976 and 2007 through classification on original and processed images of MSS and TM was prepared. After preparing maps of forest extent related to years of 1976 and 2007, each of the mentioned maps were classified into two categories of forest and non-forest and after ensuring the accuracy of the maps produced in GIS environment for preparing changes map in forest area, both maps at the beginning and end of the studied period were crossed with each other. The most important factors in the forest degradation trend are the natural and human factors. In this research, map of slope, aspect, elevation classes as natural factors affecting changes and distance from residential areas, roads, distance from the edge of the forest and forest fragmentation index as human factors were considered in the event of changes. In this direction, map of above factors using Arcview and Idrisi software was prepared in GIS environment and was used to analyze. For preparing maps of classes of slope, aspect, elevation, digital elevation model of the study area should be prepared.

**Discussion and Results**

Accuracy assessment results of classified maps are presented in the related table. With consideration to high amounts of 83% of overall accuracy, these maps can be used for preparing degradation map. After processing the satellite images, amount map and spatial distribution of forest areas in study area was prepared in years of 1976 and 2007 with use of MSS and TM satellite images. With overlay the classification results of two periods, occurred changes map was obtained. From this map, we can extract amount of degraded forest and location of these changes. Results obtained of comparison of two maps related to beginning and end of the time period (1976 and 1388) shows that during this period, 19294 hectare of forest regions area has been decreased. In logistic regression, chi-square statistic (-2Log Likelihood) or (-2LL) is widely used. When a model has a poor fit, having large amount and when a model has a good match, its value is small. In this study, chi-square value was 117.309. Coefficients of the variables in the regression equation are very important and logit equation coefficients list. 1 equation shows statistical model of degradation probability prediction obtained of logistic modeling with seven variables: slope, aspect, elevation, distance from roads and population centers, distance from the edge of the forest and forest segmentation index. Pseudo $R^2$ for the model is 0.1608 and the ROC regression coefficient amount was equal to the amount of 0.7678. Based on this equation, the spatial distribution map of the study area forests was obtained.

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\text{Forest degradation probability} = -4.2303 + 0.007207(\text{aspect}) - 0.020488(\text{distance from villages}) - 0.001495(\text{elevation from sea level}) - 0.00116(\text{slope}) - 0.001908(\text{distance from road}) - 0.087687(\text{distance from the forest edge}) + 0.14544(\text{forest fragmentation pattern})
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Conclusion
This study has been taken place with objective of estimating the spatial distribution of Zagros forests and in order to detect effective factors on forest degradation. In this study, the effect of seven factors, distance from roads and residential areas, forest fragmentation index, aspect, elevation levels, slope and distance from forest and non-forest edge on forest degradation rate was studied. In this study, to investigate changes in forest, MSS sensor related to year of 1976 and TM sensor data related to year 2007 were processed and classified. The Studied images were classified in to two classes of forest and non-forest and in order to study the degradation factors, map of forest degradation with spatial variables of physiographic and human were entered into the model. For modeling and estimating the spatial distribution of studied forests degradation, of logistic regression statistical method was used. Output of regression logistic with Pseudo $R^2$ equal to 0.1608 and ROC of 0.76 represents a relative agreement with the actual degradation and ability to fit the model to estimate changes in forest area. Also, with consideration to negative coefficients related to distance from residential areas and roads can say with decreasing the distance then these factors, urban expansion and man-made regions development, road construction and increase in population plays role in forest degradation of the study area.

Keywords: Deforestation modeling, Remote sensing, Logistic regression, Zagros forests, Ilam.

References


