# Abstract

Evaluation of soil erosion potential in a hilly, highly undulating, forested watershed with steep slopes (average 45°) is a challenging work. The study area being a part of Cherrapunji, Meghalaya (which holds record for its highest rainfall in a year), receives heavy rainfall with average 10000 mm/year. Moreover, large uranium deposit is discovered in Domiasiat village which falls within the study area. There is a plan to excavate the ore using surface mining method and then dump the overburden materials at two places near the pit. This makes the study more significant as any watershed near to a mining area need special care because of acid mine drainage and waste disposal from tailing dam. Moreover, eroded material from the over burden dump of the mining area can cause serious environmental problems leading to human health risk, ecosystem disturbance and aesthetic damage of water resources. The area has not been explored by the local administration due to its adverse topographic and climatic conditions. Therefore, the ground truth data of the area is very limited and hence any scientific research work related to soil erosion has not been conducted yet in this area. The present study has explored the area for the first time with scientific research work, for the benefit of the society, if mining activity commences in the near future. The thesis comprises of thematic maps characterizing the Kynshi watershed, including geology, soil type, climate, land use-land cover, elevation, slope, rugosity, present infrastructure, available minerals and drainage information. One of the major objectives of the thesis is the estimation of soil erosion rate of the whole Kynshi watershed over the years 1999 to 2014 by existing two-parameter $E_{30}$ model. The result shows that most of the watershed area falls under 0-20 mm/yr followed by 20-40 mm/yr erosion rate. A logarithmic relationship between NDVI and slope is derived for the hilly terrain of the area for the first time and slope is defined as the most significant parameter in $E_{30}$ model. Based on this concept, single-parameter $E_{30}$ model is developed by replacing the NDVI parameter with the function of slope. This study finds that developed single-parameter $E_{30}$ model can be applied successfully up to 60° slope in a hilly region. For verification of the results of these $E_{30}$ models, well known RUSLE model is applied for year 1999 and 2014. Estimated annual average erosion rates of existing $E_{30}$ model and developed single-parameter $E_{30}$ model are then compared with the RUSLE generated average erosion rates. RUSLE provides a comparable result up to a slope angle of 50°. The most important and interesting part of the thesis is the development of proposed mining landscapes in the form of digital elevation model (DEM). A novel GIS based approach is applied to retrofit the shape and size of the excavated zones; backfilled and OB dump areas in the existing topography by alteration of the terrain relief with the advancement of mining activity. The thesis is also devoted to estimate the rate of soil erosion of the proposed mining landscapes (after 5, 10, 15 and 20 years of mining operation). Two-parameter $E_{30}$ model is applied again for this study and estimated erosion rates are compared with the pre-mining rates. This study portrays the severity of erosion rate of the proposed mining sites considering it as barren or progressive planted land. The results show that soil erosion could be a major problem in the study site with the progress of mining activity if proper plantation work has not been carried out in the phases of mining operation. For more protection, sixty necessary check dam locations are also identified on the basis of morphometric analysis, over the drainages near the proposed mine boundary. Finally this study established a methodology for developing progressive mining landscapes and estimating soil erosion rates of those landscapes due to future mining activities using remote sensing and GIS technology.

***Keywords:*** Kynshi watershed, soil erosion, two-parameter $E_{30}$ model, single-parameter $E_{30}$ model, NDVI, slope, RUSLE model, DEM, proposed mining landscapes, check dam