APPLICATIONS OF GIS AND REMOTE SENSING IN THE HYDROLOGICAL STUDY OF THE UPPER BERNAM RIVER BASIN, MALAYSIA

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ABSTRACT

Rising concern over the degradation of the environment, such as erosion and sediment loads, warrants the integration of the complex and dispersed geographical data sets. This paper describes the use of Geographic Information System (GIS) and remote sensing for assessing the impact of land use changes to water turbidity in multiple watersheds. In this study, necessary data sets representing land uses, hydrology, weather, soils, elevation, and surface characteristics were integrated in a GIS in tabular, vector and grid formats. The land use maps that were derived from Landsat-5 TM imagery using a combination of different classification strategies gave an average accuracy of 95 %. Results from data analysis had shown that there exists a close relationship existed between the extent of open area and sedimentation loading rate. However, the sediment loading rates were found to be non-linear ranging from 1.47 to 2.13 tonnes per millimeter of rainfall for each kilometer-square increase of open areas, depending on their location of open areas with respect to factors such as availability of sediment, soil type, slope length, and slope steepness etc.

Keywords: *GIS, Remote Sensing, River Basin, Sediment Load, Sedimentation*

1. INTRODUCTION

In recent years, Malaysia has undergone very rapid development with subsequent population growth, urbanisation, industrialisation, logging activities, and expansion of agricultural areas. These changes have caused complex environmental problems and the most affected natural resources is water. Inherent in the solution to the above problem and many environmental problems is the need to bring together dispersed geographical data sets. The complexity and size of these databases make the requirement for application of Geographical Information System (GIS) and remote sensing technology all the more necessary. By bringing key data and analytical components together under a GIS environment, the problems of lack of integration, limited coordination, and time-intensive execution typical of the more traditional assessment tools faced by most users can be overcome.

Rising concern over the degradation of the environment, such as erosion and sediment loads on water ways, justifies the use of remote sensing data as input in a GIS environment. The objective is to simulate the impact of land use changes to particularly water turbidity in multiple watersheds. To achieve the above objective, the Landsat TM images were used to obtain the land use information, and ArcView GIS was used to manage all the necessary data as well as for further analysis.

2. REVIEWS

Remote sensing data has been applied in hydrologic modeling with elements of GIS. Many hydrologically significant parameters can be obtained through remote sensing, including land covers, vegetation properties, thermal and moisture indices. The information obtained from remote sensing allows the determination of parameters for distributed models with an extremely high resolution in space [1]. One of the advantages of satellite remote sensing is that it inherently 2 provides spatial averaging of certain land cover variables that are needed by hydrologic models [2]. GIS is more and more used in hydrology and very valuable for areal representation of relevant parameters and variables. The combination of remote sensing with other GIS data, e.g. digital elevation models (DEMs), digitised maps, weather data becomes a powerful tool for the hydrological modeling. Comprehensive reviews about the utilisation of remote sensing in the partial area hydrology, parameterisation and distributed modeling are found in Van De Griend and Emgman, Schultz, Stewart and Finch, Blyth, and Rango [3, 4, 5, 6, 7].

GIS applications are becoming popular in the application of hydrologic modeling for parameter estimation and watershed partition. Data overlays were used in estimating the selected model parameters such as vegetation type and density, soil physical properties Shih [8] used GIS and Landsat data for land use classification and found that GIS is a very useful tool for land cover classification of Landsat data, moreover the cost and time requirement are much less than the conventional methods. Sasowsky and Gardner [9] used the GIS technique to produce various watershed configurations by progressive simplification of a stream network delineated from DEMs and to obtain model