GEOSPATIAL ANALYSIS OF LANDSCAPE FRAGMENTATION UNDER RAPID HUMAN INTERVENTION IN THE KELANI RIVER BASIN: ISSUES AND HYDROLOGICAL CONSEQUENCES

Wijeratne V.P.I.S.[1], Gang Li[1&2]*, Muhammad Sajid Mehmood[1]

1 College of Urban and Environmental Sciences, Northwest University
Xi'an 710127, P.R. China
2 Shaanxi Key Laboratory of Earth Surface System and Environmental Carrying Capacity
Xi'an 710127, P.R. China
*Corresponding Author's E-mail: liglzu@gmail.com

ABSTRACT

This study was conducted in the Kelani River Basin, Sri Lanka, and the overall objective of the study was to evaluate spatiotemporal changes of landscape fragmentation and its impact on the river basin hydrology. Land use Land cover (LULC) data from 1982 to 2020 were analyzed to build landscape metrics using FRAGSTATS, and Landscape Fragmentation Analysis Tool for ArcGIS was used to examine the spatial pattern of the landscape changes. Annual and peak discharge data were analyzed to interpret the correlation between landscape transformation and hydrological changes in the river basin. The results revealed that the river basin's human intervention has remarkably increased in the river basin, and the built-up/home gardens have rapidly increased (58.67 per cent) during the past 38 years. Forestlands and low land areas have declined from 1982 to 2020, -20.91 per cent and -41.46 per cent, respectively. NP in build-up/home garden has dramatically increased from 641 in 1982 to 1570 in 2020. Most of the agricultural and low land has been replaced into urban uses, and human encroachments in the flood plain have negatively influenced on hydrological changes and extremes in the study area. Moreover, the river basin's annual mean discharge has increased during the past four decades, and the frequency of the flood peak has shown an upward trend in the study area.

Index Terms— LULC, *landscape fragmentation*, *FRAGSTATS*, *hydrological changes*, *NP*

1. INTRODUCTION

Natural ecosystems are vital components of human and animal lives since they provide essential goods and services for their existence. Moreover, natural lands are one of the main elements of the environment, which provides the basis for life on earth through ecological functions. These areas regulate climate and water resources while providing habitats for plants and animals [1]. However, the ecosystems are under constant threat of degradation or destruction due to increasing human interactions. At present most of the recognizable natural ecosystems around the world have transformed into artificial ecosystems due to the impact of human activities. Alternatively, many natural ecosystems can be identified as being degraded by the effects of anthropogenic activities. Converting natural land to human uses is one of the primary forms of global change and may potentially have significant impacts on the ecosystem and climate, including river basin hydrological balance and quantity and quality of water resources [2]. Human intervention and associated landscape fragmentation of a river basin have been shown an adverse impact on natural hydrological balance and ecological health, such as the decline in ground and surface water yield and biodiversity [3],[4]. Therefore, the interaction between human intervention and river basin landscape changes has been researched extensively [5].

Landscape fragmentation is considered an essential phenomenon in global landscape degradation driven by environmental change and socio-economic process [6]. Landscape fragmentation influences the watershed hydrological cycle [7] by altering evapotranspiration, infiltration, interception rates, and groundwater, changes in surface runoff, river discharge, and flood frequency [8]. Therefore, understanding landscape fragmentation impacts on watershed processes are essential for managing multipurpose water resources [9].

Landscape fragmentation matrix is a quantitative landscape analysis tools, which can be used to quantify the characteristics and spatiotemporal changes of a river basin landscape. The characteristics of landscape attributes can be expressed by calculating fragmentation patches, relative richness, porosity, patch density, diversity and dominance, function, and change [10].

This study aimed to examine the spatiotemporal changes of landscape fragmentation over 38 years in the study area and evaluate the hydrological consequences of natural land fragmentation in the study area.