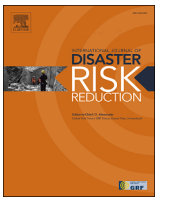
International Journal of Disaster Risk Reduction 68 (2022) 102715

Contents lists available at ScienceDirect

International Journal of Disaster Risk Reduction

journal homepage: www.elsevier.com/locate/ijdrr



Urban sprawl and its stress on the risk of extreme hydrological events (EHEs) in the Kelani River basin, Sri Lanka

V.P.I.S. Wijeratne [a, b], Gang Li [a, c, *]

[a] College of Urban and Environmental Sciences, Northwest University, Xi'an, 710127, China
[b] University of Colombo (UOC), Kumarathunga Munidasa Mawatha, Colombo, 03, Sri Lanka
[c] Shaanxi Key Laboratory of Earth Surface System and Environmental Carrying Capacity, Xi'an, 710127, China

ARTICLE INFO

Keywords:
EHEs
Night-time lights
Landsat
Land use/land cover
Urban sprawl
Shannon's entropy

ABSTRACT

Land modification and urban sprawl cause incremental changes in hydrological processes due to the results of novel or hybrid ecosystems. This study mainly investigated the unforeseen urban expansion in the lower Kelani River basin, Sri Lanka, and its impact on the increment of hydrological extremes. Remote sensing data, including night-time light images (NOAA/AVHRR) and Landsat (TM/ETM + /OLI) data of different wavelengths, were analysed in this study. Land use and land cover data of the river basin were obtained from 1995. Shannon's entropy was used to demarcate urban sprawl in the river basin over nearly two decades. A spatial regression model was built to identify the correlation between increments of hydrological extremes and urban sprawl. This study revealed that the Kelani River basin has experienced a high urban sprawl rate over the past 23 years and that the total urban land area has increased by 130%. The flood risk analysis revealed that the flood frequency has also dramatically increased due to urban sprawl, and nearly 20 minor flood events have been recorded over the last two decades. Most of the urban areas situated in the lower river basin have invaded into the area with a higher flood risk, and the total flood damage has increased over the study period. The built-up land extent increased from 24.07 km^2 to 56.39 km^2. In 2018, the flood plain and the lower basin were mostly occupied by human settlements. Therefore, it is essential to improve current policies and mitigation plans to minimize the negative impact of rapid urban sprawl in the study area.

1. Introduction

Currently, the most significant part of the global population is living in an urban environment and the proportion is increasing rapidly. At the beginning of the 20th century, only 14% of the global population lived in an urban environment. It became almost half of the world population in 1992, and it has not yet stopped increasing [1]. Currently, the population living in urban areas is higher in developed countries than in developing countries. Moreover, most cities worldwide are expanding rapidly, and most of the growth is expected to occur in low-income countries in Africa and Asia [2]. The population growth projections of the world indicated that approximately 60% of the world population is expected to live in urbanized areas by 2030 [3,4].

Urban sprawl is a phenomenon that causes changes in land use and land cover patterns, demographics and economic processes. It mainly converts lands with natural vegetation to manmade built-up societies focused on industries, services and other manufacturing. In addition, "urban expansion" is a vague and ambiguous concept, with no theoretical consensus [5,6]. Around large cities, suburban areas are often the most affected by the corresponding urbanization and urban sprawl [4,7]. Currently, both urbanization and urban

* Corresponding author. College of Urban and Environmental Sciences, Northwest University, Xi'an, 710127, China.
E-mail addresses: sandamali@geo.cmb.ac.lk (V.P.I.S. Wijeratne), lig@nwu.edu.cn (G. Li).

https://doi.org/10.1016/j.ijdrr.2021.102715
Received 18 April 2021; Received in revised form 17 November 2021; Accepted 1 December 2021
Available online 4 December 2021