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Spatial and temporal dynamics of urbanisation and its impacts on flash flood risk: a case study from Jordan’s wadi system

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Abstract

Middle Eastern cities have experienced high rates of urbanisation since the second half of 19th century leading to high pressure on ecosystems ecosystem services and functions. Amman city of Jordan is a prime example on this, where the ongoing urbanisation trends also increases the risk of flash flood damages. There is still a lack of knowledge on the underlying driving forces and the complex interrelationship of land use and land cover changes (LULCC) and their effects on flash flood risk.

Therefore, this study aims to quantify the urbanisation dynamics in Amman city, its main underlying drivers, and its possible impacts on ecosystem services and functions to better understand the complex interactions between LULCC and risks from flash floods. An analysis of long- term LULCC from 1968 to 2021 using an object-based classification of multi-temporal Corona and Spot images was conducted. To investigate the underlying driving forces of LULCC and its possible impacts on the changes in flash flood risks, semi-structured experts interviews and participatory mapping with local stakeholders were performed. During the analyzed six decades, the built-up surfaces in Amman’s watershed increased up to 192 km². Urban expansion rates were high throughout the study period with a peak during industrialisation in 1970s and 1980s. Suburbanisation was prominent leading to major losses of Amman’s watershed rainfed agricultural lands and retention areas. This resulted in a reduction in water infiltration and acceleration of runoff rates in wadis increasing both the likelihood of flash floods and the disposition of people and the environment to risk. The urban expansion and its pattern appeared to depend mainly on the high rates of population growth, land prices at the urban fringe, landowners’ pressure on local authorities for the zoning and subdivision of lands as well as accessibility factors such as distance to major roads and nearness to urban areas. The situation was further aggravated due to weak land-use governance where only few investment-oriented plans focused on the transportation and city center were implemented. Given the current state, the expected increase in city’s population as well as the expected climatic variability’s challenges on flash flood risk, sustainable land-use planning for the whole watershed area incorporating adaptation measures to decrease flash flood damages are urgently needed.

Keywords: Corona, land use land cover changes, rain-fed agriculture, spatial analysis, urbanisation