Research Article

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Assessment of the impacts of land use/land cover change on water resources in the Diyala River, Iraq

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Abstract: In this study, the analysis was carried out concerning previous changes in land use/land cover (LULC) for 2 years, 2000 and 2020, and their impact on water resources in the Diyala River Watershed in Iraq was assessed. The Soil and Water Assessment Tool (SWAT) model is a hydrological model used to perform the hydrological modeling process for LULC maps. The data for LULC were collected using the Landsat satellite with a resolution of 30 m, and it was classified using geographical information systems (ArcGIS). Using the confusion matrix, the accuracy of the maps for the years 2000 and 2020 was evaluated, the overall accuracy was more than 90%, and the kappa coefficient (ka) was more than 88%, which indicates the accuracy of the classification and is ideal for use in modeling work. SUFI-2 included with the SWATCUP program was used to perform the calibration and the results were validated for the outflow of the two gauging stations within the study area of Hemren station and Derbendikhan station as a monthly time step for a baseline map LULC 2000, in the period 1996–2020 with 4 years as warm up. Coefficient of determination (R^2), Nash–Sutcliffe efficiency (NSE), and percent bias (Pbias) were used, which were the most common indicators for evaluating the performance of the statistical model. The results indicated that the values of R^2 during the calibration and validation processes were (0.84–0.88) and (0.85–0.87), respectively; the NSE was (0.87–0.85), and the Pbias was (4.2–6.8)% and (5.8 to −4.1)%, respectively. Therefore, the calibration and verification results were good and satisfactory. In addition to the two LULC maps for 2000 and 2020, the parameters of the modified SWAT model were utilized to estimate the effects on the Diyala River Basin. The study found that LULC change affects basins and sub-basins differently. At the basin, hydrological parameters were largely unaffected by LULC changes. However, at the sub-basin level, the water yield and the surface runoff were changed between (−6.45 to 4.67)% and (−2.9 to 9.88)%, respectively.

Keywords: Arc SWAT model, Diyala River, hydrological model, LULC changes

1 Introduction

By altering land use and water flow routes, human activities are causing dangerous shifts in aquatic ecosystems and their resources [1]. Land use/land cover changes (LULCC) affect components of the hydrological cycle [1], which is the main factor controlling the management of water resources and hydrological models [2]. The land use/land cover (LULC) is the biophysical lid on the earth's surface that has a substantial effect on the water balance and geomorphologic processes of the natural world, and its categories could be general agricultural lands, settled areas, shrublands, barren lands, etc. [3,4]. The effect of LULC on hydrological processes and water resources has been seen in the last few decades, as urbanization, agricultural practices, and climate change have had a clear impact on evapotranspiration, percolation, surface runoff (SURQ), and water yield [5,6].

LULCC has been predicted to have more serious impacts than climate change by 2025; therefore, we must have a clear understanding of how LULC has changed in the past, present, and future. Consequently, by learning more about how LULC impacts hydrological processes, policymakers may be able to make more sustainable and effective decisions when carrying out watershed improvement and development plans [4].

The use of satellite remote sensing for past images and geographical information systems (GISs) provides a substantial base in the administration of the surface of the earth by supplying information on the spatial–temporal in LULCC, particularly in large, unmonitored areas, and

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