APPRAISING CLIMATE AND LAND USE CHANGES IMPACTS ON GROUNDWATER DYNAMICS USING NUMERICAL SIMULATIONS

By

SAIF HAIDER
2020-MS-WRE-113

Research Supervisor

DR. SAJID MEHMOOD

Co-Supervisor

DR. IJAZ AHMAD

2022

CENTRE OF EXCELLENCE IN WATER RESOURCES ENGINEERING
UNIVERSITY OF ENGINEERING AND TECHNOLOGY, LAHORE,
PAKISTAN

APPRAISING CLIMATE AND LAND USE CHANGES IMPACTS ON GROUNDWATER DYNAMICS USING NUMERICAL SIMULATIONS

By

Saif Haider

2020-MS-WRE-113

A thesis submitted in partial fulfillment of the requirements for the Degree of

MASTER OF SCIENCE

IN

WATER RESOURCES ENGINEERING

APPROVED BY:

_____	_____
Dr. Sajid Mehmood	Dr. Muhammad Kashif
Research Advisor/	External Examiner, Punjab
Internal Examiner	Agriculture Department

_____

DIRECTOR, CEWRE

Approval Date: _____

CENTRE OF EXCELLENCE IN WATER RESOURCES ENGINEERING

University of engineering and Technology, Lahore

ABSTRACT

Groundwater depletion has become a major concern all over the world. Recently, the rapid population growth and need for water and food have placed a massive strain on land and water resources. According to estimates, 42 percent, 36 percent, and 27 percent of the world's groundwater is used for agricultural, domestic, and industrial purposes, respectively. The present study aimed to investigate both climate and land use change impact on groundwater dynamics by utilizing a finite-difference 3D Visual MODFLOW and the latest Coupled Model Intercomparison Project (CMIP6) dataset of global climate models (GCMs).

The Cellular Automata Markov Chain (CA-Markov) model was used to prepare future land use land cover (LULC) maps in the Bari Doab of Pakistan. Statistical Downscaling of precipitation and temperature was done by the CmHyd model. Downscaled temperature and precipitation projections from the best performing GCM out of four GCMs named MIROC6, ACCESS-CM2, MPI-ESM2-0 and MPI-ESM1-2-HR under two Shared Socioeconomic Pathways (SSP2 and SSP5) and future land use were forced in a calibrated groundwater model.

The output of selected GCM MPI-ESM1-2-HR indicated an increase in the future precipitation, maximum and minimum temperature, and crop water requirement under both scenarios SSP2 and SSP5 by the end of the 21st century when compared to the baseline period (1981-2020). The results also indicated a significant declining trend in groundwater levels ranging between 0.21 m/year to 0.45 m/year for a baseline period (2008-2020) in the region. The results of Scenario-I (present land use and future climate) and Scenario II (future land use and climate) revealed that groundwater depletion would range between 5 to 11 m and 6 to 15 m respectively till 2100 in the

region. The findings of this study can provide an understanding of the impact of land use change and climatic variability on groundwater resources. Therefore, the present study is essential for city planners, the irrigation department as well as for other government officials for making climate adaptation plans in the region.