COUPLING THE LAND USE MODELING WITH CLIMATE CHANGE TO ESTIMATE THE RUNOFF VARIABILITY IN URBAN CATCHMENT

By

Muhammad Asad Hussain
2018-MS-WRE-05

Research Supervisor:
Dr. Muhammad Waseem

2022

Centre of Excellence in Water Resources Engineering
University of Engineering and Technology,
Lahore

COUPLING THE LAND USE MODELING WITH CLIMATE CHANGE TO ESTIMATE THE RUNOFF VARIABILITY IN URBAN CATCHMENT

By

MUHAMMAD ASAD HUSSAIN

A THESIS

presented to the University of Engineering and Technology, Lahore

in partial fulfillment of the requirements for the degree of

Master of Science

In

WATER RESOURCES ENGINEERING

APPROVED BY:

_____	_____
Primary Advisor/Internal Examiner Official Title & Department	External Examiner Official Title & Department
_____	_____
Chairman of the Department	Dean of Faculty

[Publish Date]

CENTRE OF EXCELLENCE IN WATER RESOURCES ENGINEERING

UNIVERSITY OF ENGINEERING & TECHNOLOGY, LAHORE

ABSTRACT

Urban development-induced land transitions affect urban hydrology, resulting in increased flooding risks. Climate change-related precipitation changes are added completely to flood risks of cities. Hence, this study examined the role of land use and climate change in runoff variability in the urban catchment. In the current study, EPA's SWMM and TerrSet, different climatic parameters, and future climate projections under the CMIP6 scenario were used for the assessment of hydrological response in Punjab University (Quaid-i-Azam Campus) Lahore, Pakistan. Land use images of 2015 and 2021 have been processed using supervised classification to determine the historical trend of land use in the study area and for future projection of land use, TerrSet was used. Based on the analysis, it was observed an increase in percent imperviousness by 0.374% per annum.

Climate change is an important factor in assessing the catchment's runoff variability for forecasting the future. The current study also resulted that climate change could cause an increase in runoff from a minimum of 17.7% with the medium scenario in Nov 2030 to a maximum of 93.2% with the hot scenario in Aug 2050 and 63.9% with the warm scenario by the end of 2060 with the same month. In response to the coupled effects of climate and land-use change, the runoff would likely increase by at least 28% in Nov 2030 under the medium scenario, to a maximum of 146.9% in Aug 2050 under the hot scenario, and to a maximum of 123.1% by the end of Aug 2060 under the warm scenario. According to the medium scenario, the contribution of only land use will range from a minimum of 9.1% in 2030 to a maximum of 36.4% by the end of 2060. Moreover, it was observed that the hydrological response of small catchments was more sensitive to land-use changes as compared to large catchments.

ACKNOWLEDGMENTS

The acknowledgment-related creation should begin in humility with gratitude to Almighty **Allah**, who is the kindest, merciful, and most beneficial, as well as the best hydrologist, climatologist, and land expert. I express my sincere gratitude to the Almighty Allah for making it possible for me to finish my studies. I want to thank my supervisor, Dr. Muhammad Waseem, for all of his help and kindness throughout the years. He served as a constant source of inspiration and direction; without his support and knowledge, I would not have been able to finish my research. I am also appreciative of the other faculty members, who have been quite helpful during my degree. Additionally, I want to express my gratitude to Dr. Saleem Sarwar, who served as my external supervisor, for his insightful feedback. I owe a debt of gratitude to Prof. Dr. Noor Muhammad Khan, Director of CEWRE, for his advice and support during my research. I should not fail to express my gratitude for my friends Qais Yameen & Muhammad Usman Ashraf's encouragement. When I had issues with my research, they were always there to help. I should also mention my parents' specially my **mother's** unwavering support for my desire to continue post-graduate courses. They provided all the resources I would need. I sincerely thank all of my friends, in particular, I am grateful to Engr. Ahmad Mujtaba (Ph.D. Scholar, CEWRE) and Engr. Hassaan Ali (BSc. Agriculture Engineer) for their support and encouraging behavior throughout my research work as well as for providing me with some of the happiest times of my life.

Engr. Muhammad Asad Hussain