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Assessment of water availability under past, present and future landuse with management scenarios: A case of Bagmati River Watershed in Kathmandu Valley

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1. INTRODUCTION

The issue of sustainable water management has been a global challenge of the present generation. Rapid urbanization has resulted in the dramatic change in the landuse pattern across the world. Change in the landuse due to urbanization has affected sustainable management of water resources.

In this study, efforts have been made to quantify the impact of landuse change on the water resources of Kathmandu valley, the capital of Nepal which has been facing a severe water crisis in the recent years.

2. STUDY AREA

The study area, Kathmandu Valley, has witnessed significant change in its landuse due to rapid and development in the last few decades. It has worsened the already water deficit situation of the basin which includes capital of the country, Nepal. Such scenario has demanded the need of appropriate management practice and water-management techniques for long-term solution.

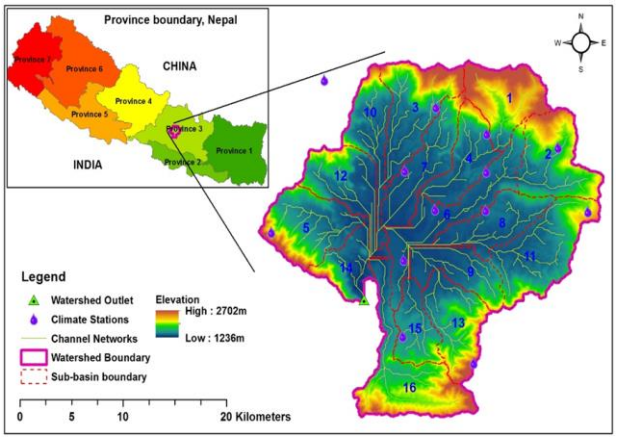

Fig 1: Location map of the study area

3. MATERIALS AND METHODS

In general, the overall methodology adopted in this study can be categorized under three different topics. First, the application of a hydrological model followed by the projection of future landuse and finally the implementation of a management scenario as illustrated in Fig. 2.

In this study, the Soil and Water Assessment Tool (SWAT) model has been applied to the study area with an objective of assessing the catchment water-balance analysis under different landuse scenario. Model is first calibrated and validated for the baseline period of 1990-2000. The calibrated is used to predict the change in water-balance under projected landuse.

Landuse for the future scenario is forecasted using the Land Change Modeler tool (LCM) of TerrSet geospatial software system developed by Clark Labs of University of Clark and the Andes Center for Biodiversity Conservation of Conservation International.

Finally, a reservoir and check dams are implemented to investigate their effect in altering the flow regime.

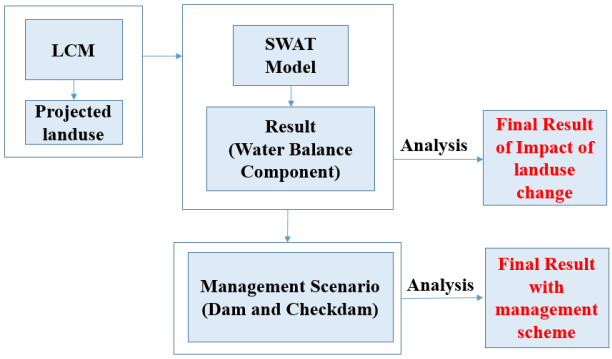

Fig 2: Flowchart of the methodology adopted in the study

4. RESULTS AND DISCUSSION

4.1 Calibration and Validation

SWAT model was first calibrated and validated against the observed discharge at two gaging station with reasonable accuracy.

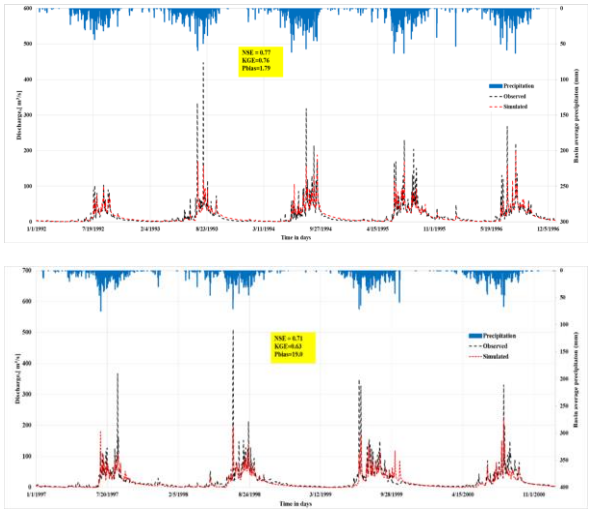

Fig.3: Comparison of the observed and simulated discharge at the outlet for calibration and validation

4.2 Landuse change projection

Based on the trend of 1990 and 2010, future landuse for 2020, 2030 and 2040 were projected as depicted in Fig. 4.

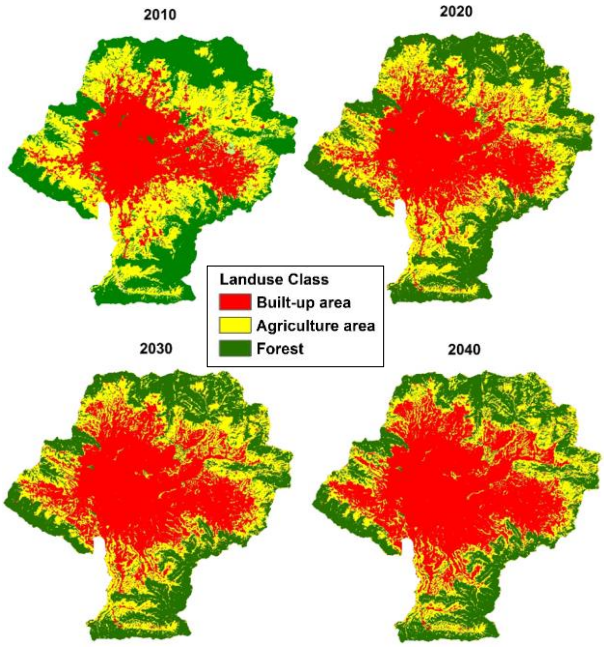

Fig 4: Landuse 2010 and projected landuse (2020-2040)

4.3 Impact of landuse on water-balance

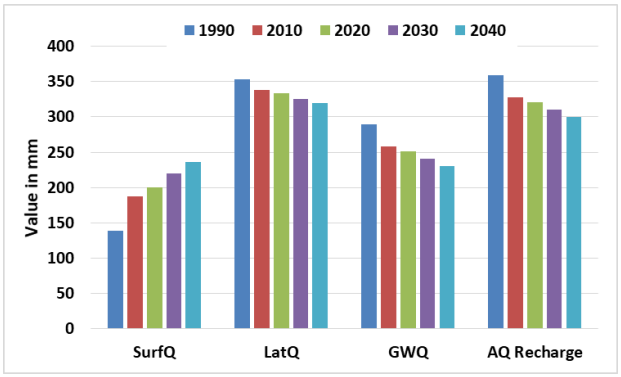

Fig.5: Variation of water-balance components due to landuse change at the outlet of the watershed.

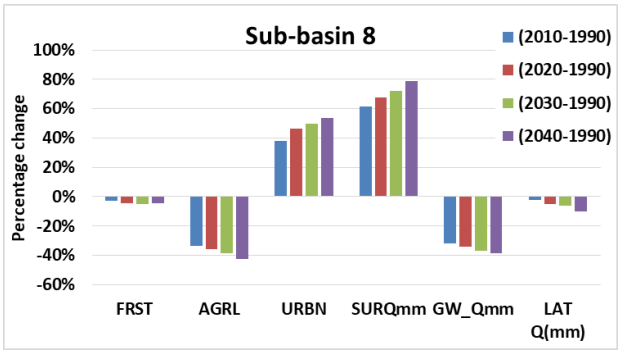

Fig.6: Variation of water-balance components due to landuse change at the sub-basin 8.

The analysis of the results showed that the surface runoff will increase by 97.5mm while lateral Q and groundwater Q decrease by 33 and 59mm respectively as shown in Fig.5. The overall change in the water-balance components were more pronounced at the sub-basin level. A sample of such change for sub-basin 8 is presented in Fig.6 where the surface run-off has increased by more than 80% while groundwater has decreased nearly 40% of the baseline period.

5. CONCLUSIONS

The change in landuse in the basin will alter the hydrological regime and hence intensify water stress. The overall impact of the landuse change can be more prominent at the sub-basin level. Therefore the water management plan should focus at the sub-basin level.