Response of hydrological processes To land-use and climate changes:

Case of Mountain Hydrology in Kejie Watershed, Southwest China

World Agroforestry Centre
TRANSFORMING LIVES AND LANDSCAPES

Objective

To investigate the impacts of climate and land-use changes on hydrological processes and to simulate the different land-use/ climate scenarios by applying the Soil and Water Assessment Tool (SWAT).

Methodology

1.Assess the land use change on basis of satellite imagery of Landsat MSS (1974), Landsat TM (1991), Landsat ETM (2001), and IRS P6 LISS 3 (2006).

2.Analysis the climate change on basis of long time historic meteorological record.

3.Study the hydrological response to land use/climate changes by applying the Soil and Water Assessment Tool (SWAT).

Study area

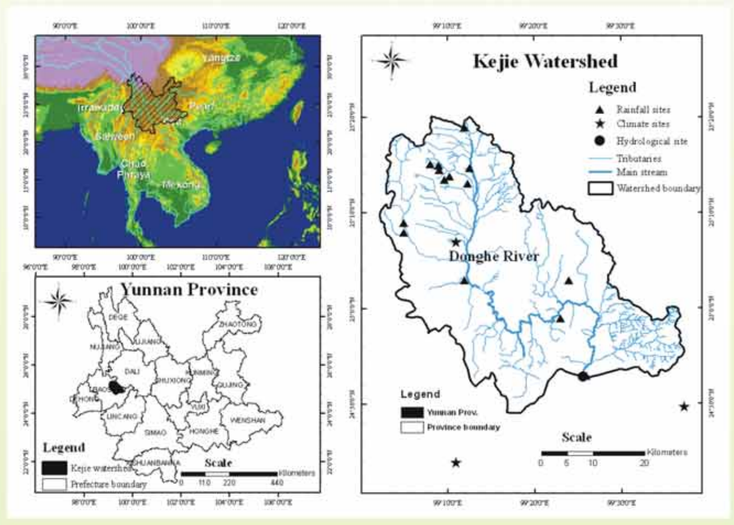

Figure 1. Location of Kejie watershed, China

Results

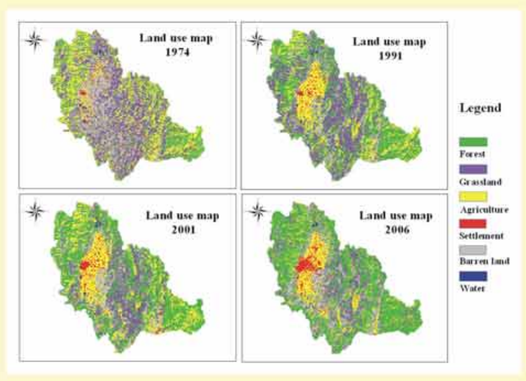

Figure 2.Land-use maps, Kejie watershed

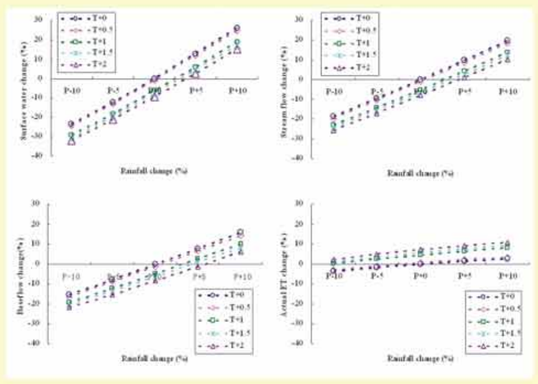

Figure 6.Relative changes of surface water, stream flow, base-flow and actual ET to changes of rainfall from 1965-1986 in Kejie watershed

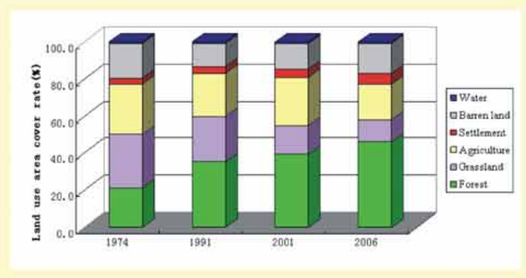

Figure 3.Land-use/cover change in Kejie watershed from 1974 to 2006

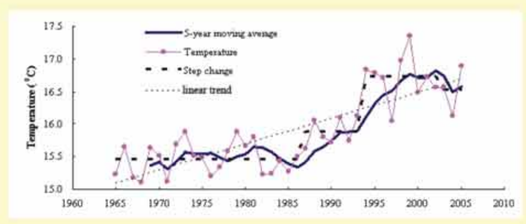

Figure 4.Variation in annual average temperature in Kejie watershed (5-year moving average)

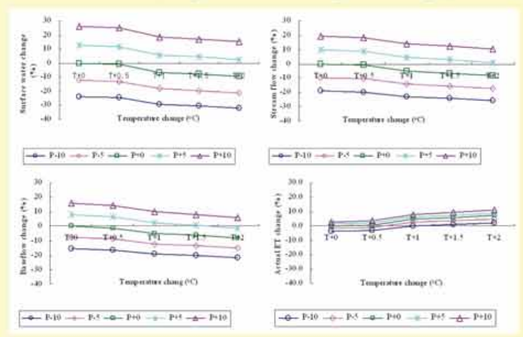

Figure 7.Relative changes of surface water, stream flow, base-flow and actual ET to changes of temperature from 1965-1986 in Kejie watershed

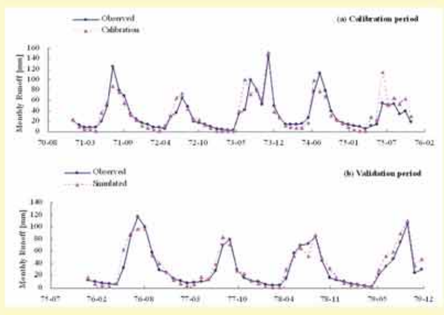

Figure 5.Mean monthly simulated and observed runoff at the outlet of Kejie watershed for (a) the calibration period and (b) the validation period

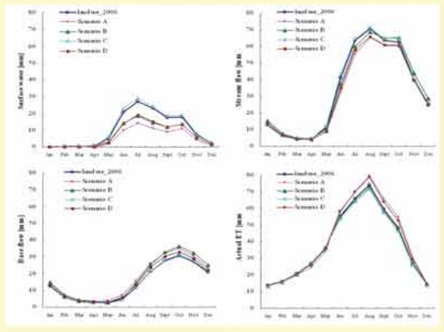

Figure 8.Variation in average monthly surface water, base flow, streamflow, and actual ET with land use changes over the period from 1965-1986 in Kejie watershed (Scenario A- reforestation; Scenario B- increase of grassland; Scenario C- Urbanization; Scenario D-Conversion between forest(increase), grassland(decrease), barren land(decrease),agriculture(increase)and settlement(increase))

Conclusion

1.The major change was increase in forest area (22.4%) at the expense of grassland (15.4%), agriculture (6.7%), and barren land (2.6%) along with an increase in settlement (2.5%).

2.With a rainfall increase of 5%, surface water, base flow, stream flow, and actual ET increased by 11.9±0.3%, 7.4±0.2%, 9.1±0.2%, and 2.1±0.2 % respectively with 95% confidence.

3.Surface water is more sensitive to land-use/ cover changes. Forestation reduces surface water, increases base flow and is a good way to control storms and alleviate droughts. Increases in lateral, base, and stream flows in dry season due to grassland are more apparent than forest. Urbanization increases surface water and stream flow during the wet season.

4.The combined effects of land use and climate changes on hydrological processes are not the simple addition of that of the single factor.

By Xing Ma, Jianchu Xu, Yi Luo, Shiv Prasad Aggarwal,
World Agroforestry Centre, ICRAF-China Program
Centre for Mountain Ecosystem Studies
Kunming Institute of Botany, Chinese Academy of Sciences