

HYDROLOGICAL MODELING UNDER DATA-SCARCE CONDITIONS IN AFGHANISTAN: HOW TO COPE



Agriculture plays a crucial role in Afghanistan's economy, although only 12% of the country's land area is arable. Yet, the agricultural sector engages around 66% of the country's workforce and consumes around 98% of the overall water withdrawal. Around 46% of the total arable area is equipped with irrigation infrastructure. For more than three decades, the country has suffered from war and political conflict. Beside causing tremendous human tragedy, its aftermath has inflicted huge damage upon urban and rural infrastructure such as the hydraulic system. This has led to huge water losses and it continues to hinder effective water management of irrigation schemes and watersheds.

Natural resources, especially water, under pressure

Since 2001, natural resources have been under serious pressure in the country, mainly due to internally displaced people (migrants and refugees within the country), of whom many moved to the Kabul River Basin. The pressure on water resources is particularly high as food production mainly depends on irrigated agriculture. Also, the demand for domestic and industrial water use is rising, due to population growth and expanding industry.

Beside these constraints, many regions in Afghanistan are semi-arid and even arid, so severe gaps between water supply and demand are occurring at least in parts of the country during critical periods. These gaps are expected to even widen in the future because of the impacts of climate change (rising temperatures are leading to higher evapotranspiration) as well as changes in land use, making the availability of water resources limited and more variable.

Big action required with small data

Whereas Afghanistan is in urgent need for updating and refining the planning and management of its water resources, hydro-meteorological data are very scarce in the war-torn country. So data scarcity poses the main problem for carrying out hydrological modelling in Afghanistan. In this doctoral research carried out at ZEF, the Soil and Water Assessment Tool (SWAT) was used to cope with

this challenge and to evaluate the water availability in the data-scarce Kabul River Basin of Afghanistan. Climate data (wind, relative humidity, and solar radiation) was used from the Climate Forecast System Reanalysis of the National Centers for Environmental Prediction while the precipitation data was collected from various meteorological stations installed across the Kabul River Basin.

How smart is SWAT?

The calibrated and validated SWAT model proved to be able to simulate the streamflow appropriately by using observed data in combination with global weather data sets and land use information derived from remote sensing techniques. Furthermore, it can be used for supporting adaptive water management across the basin, identifying the most suitable sites for intensification of the existing irrigation schemes, and finding adequate locations for reservoirs for raising storage capacity of basins or sub-basins. In this way the disadvantageous impacts of climate and land use changes can be counterbalanced. A further strength of applying the SWAT model (supported by remote sensing techniques for hydrological modelling) under data-scarce conditions is its ability to simulate different scenarios under changing climate, cropping pattern and irrigation management practices. Furthermore, SWAT could be an effective discussion tool when addressing water allocation among different consumers and sub-basin users.

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