Application of the SWAT and WEAP Models for Integrated Water Resources Management of Kaptagat Catchment

Denis Mailu Kiamba, Job Rotich Kosgei

Department of Civil and Structural Engineering, Moi University, Eldoret.
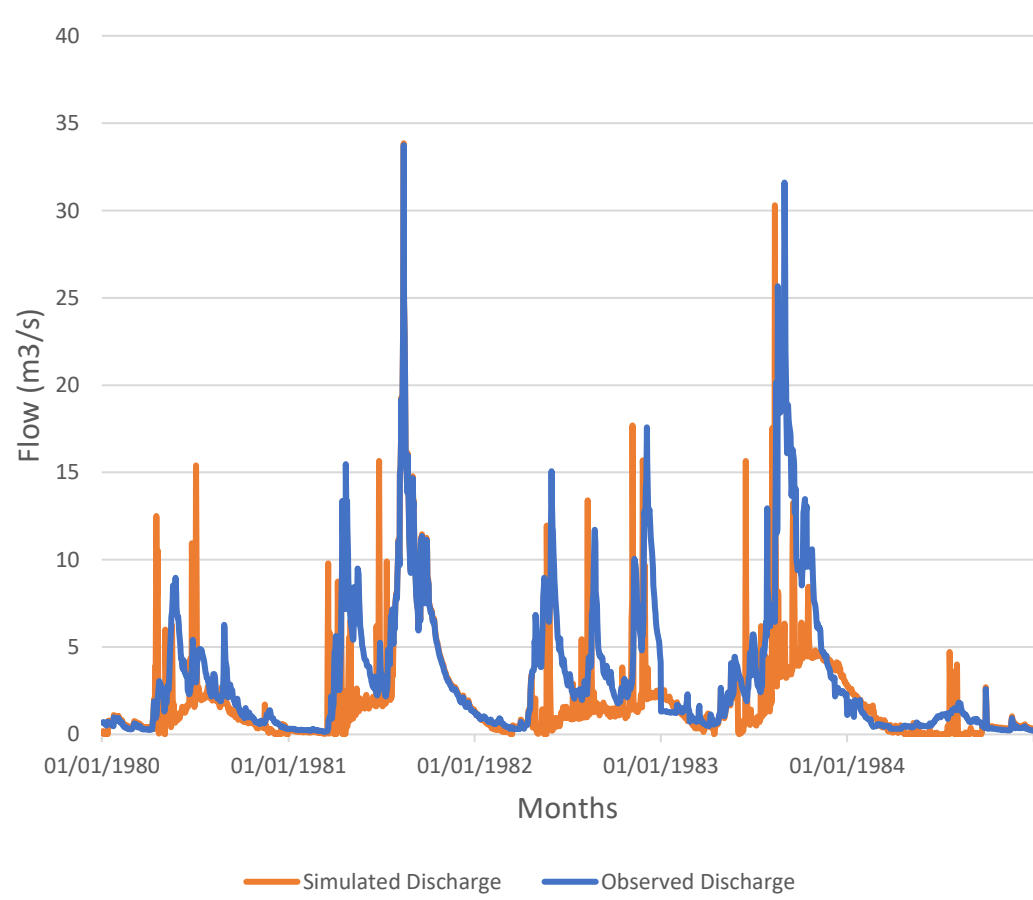
Background/Introduction

Kenya is a water scarce nation and therefore needs proper water management to ensure that all its citizens have adequate water. In recent years, it has become increasingly evident that the water problems of the country can no longer be resolved by the water professionals and/or the relevant water ministries alone. Catchment degradation of the water tower due to deforestation and poor agricultural practices coupled with rising population has put a strain on water resources in the catchment. Kaptagat Forest is the catchment area for Ellegerini River which feeds the Ellegerini Dam and the Two Rivers Dam. The persisting water shortage in Eldoret is as a result of destruction of the Kaptagat forest and poor agricultural practices in the catchment, which is a key source of water for the dams supplying water to the town. This study therefore envisages to apply the WEAP model for the sustainable water resources management of the Kaptagat catchment and therefore contribute by providing solutions to problems related to water management.
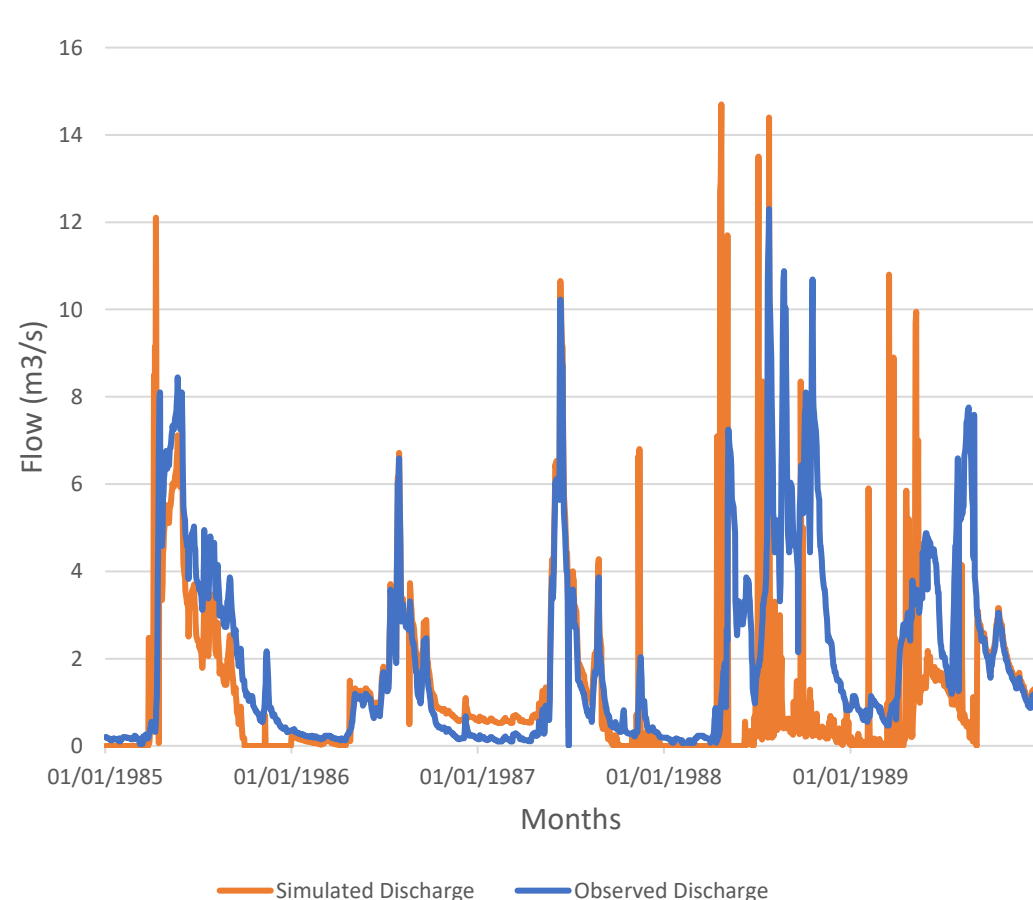
Study area
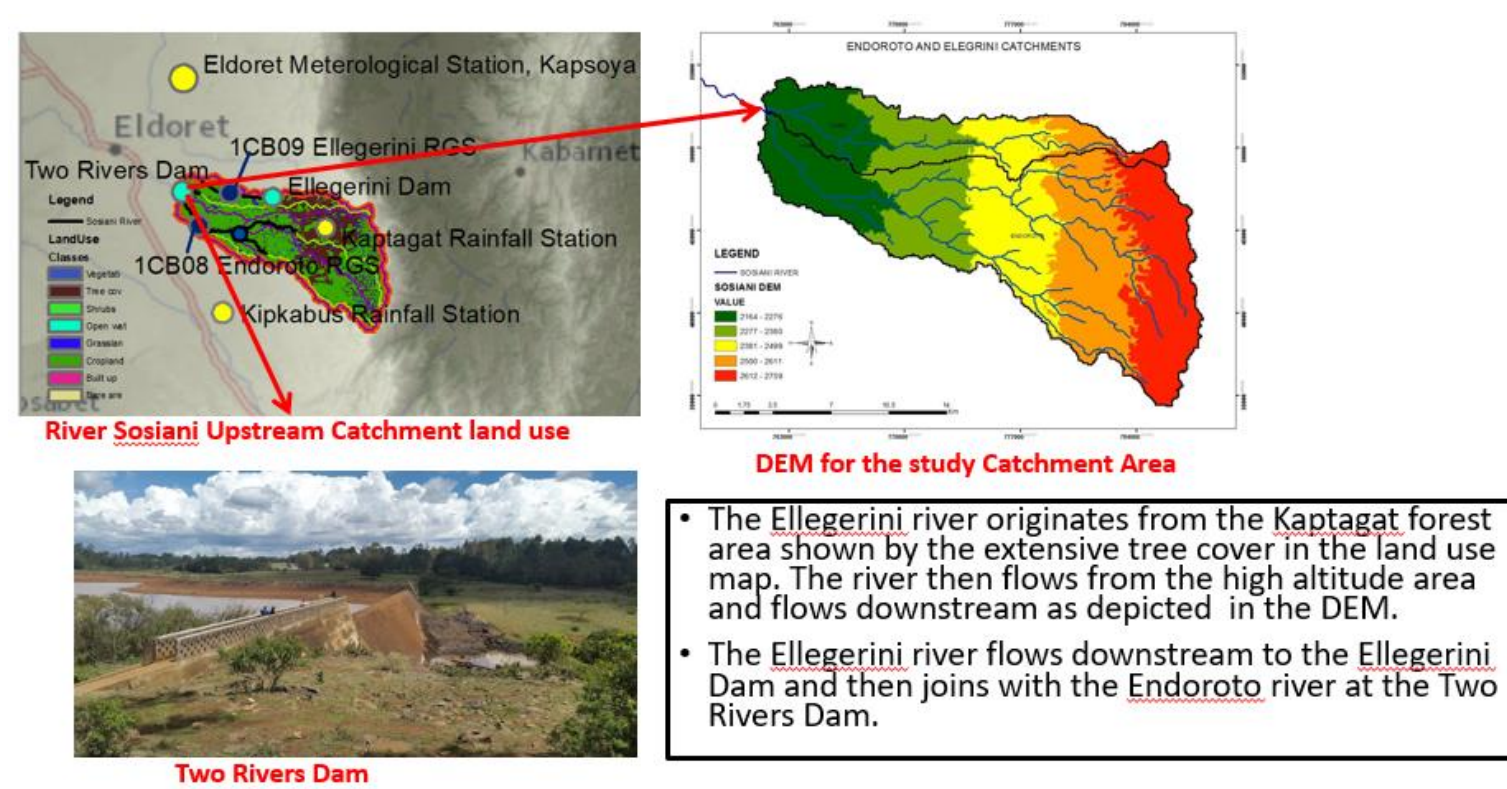

Location of Kaptagat catchment in Kenya

Objectives

➢ To determine the impact of land use and land cover change in Kaptagat catchment and the resulting effects on river flows draining to the Two Rivers and Ellegerini Reservoirs.
➢ To set up, calibrate and validate WEAP model for the Kaptagat catchment.
➢ To apply the WEAP model in analyses of various management and infrastructural development projects scenarios to enhance river flow and water storage in the Two Rivers and Ellegerini Reservoirs.

Methodology

SWAT Model Setup Calibration

SWAT Model Setup Validation

HRU Definition

Land use / Soils / Slope		Area [Km2]	Area [Ha]	% Area
LANDUSE:	Range-Grasses --> RNGE	18.949699	1894.9699	6.73
	Agricultural Land-Generic --> AGRL	187.077553	18707.7553	66.47
	Forest-Mixed --> FRST	75.429081	7542.9081	26.80
SOILS:	KE89/4-3	73.656445	7365.6445	26.17
	KE89/4-5	40.427999	4042.7999	14.36
	KE104/3-2	167.371889	16737.1889	59.47
SLOPE:	0-3	45.808464	4580.8464	16.28
	3-7	166.646274	16664.6274	41.44
	7-12	56.180738	5618.0738	19.96
	12-25	62.820857	6282.0857	22.32

The definition of HRU's was achieved by defining threshold percentage areas below which the land use and soil types would be discarded. Here the land use threshold of 5%, a soils threshold of 5% and a slope threshold of 20% was selected. These values ensured that most land use and soil types in the basin were represented for a fully semi distributed model. Out of this HRU definitions 60 HRUs were created. The table represents the land use soils and slope distribution created.
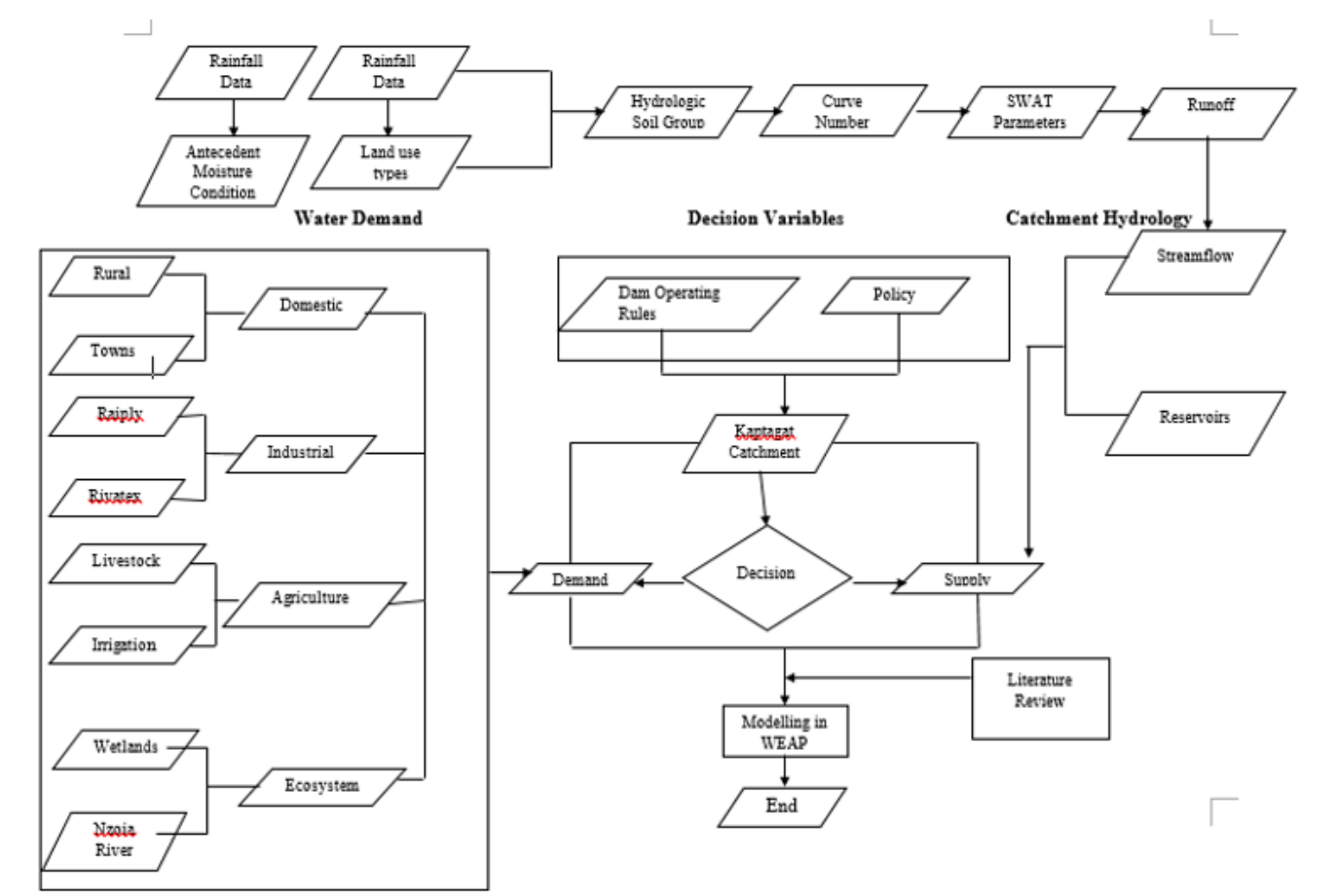
Results

➢ Quantitative estimates of the impacts of land cover changes on peak runoff rates and baseflow, and their resulting effects on river flows to the Two Rivers and Ellegerini Reservoirs.
➢ A calibrated and validated WEAP Model for the Kaptagat Catchment.
➢ The analyses of different management and infrastructural development projects scenarios in WEAP that enhance river flow and water storage in the Two Rivers and Elleerini Reservoirs and the presentation of the results in the form of written text, tables, figures, charts and graphs.