Application of soil and water assessment tool (SWAT) to evaluate the impact of land use and climate variability on Kaptagat catchment river discharge

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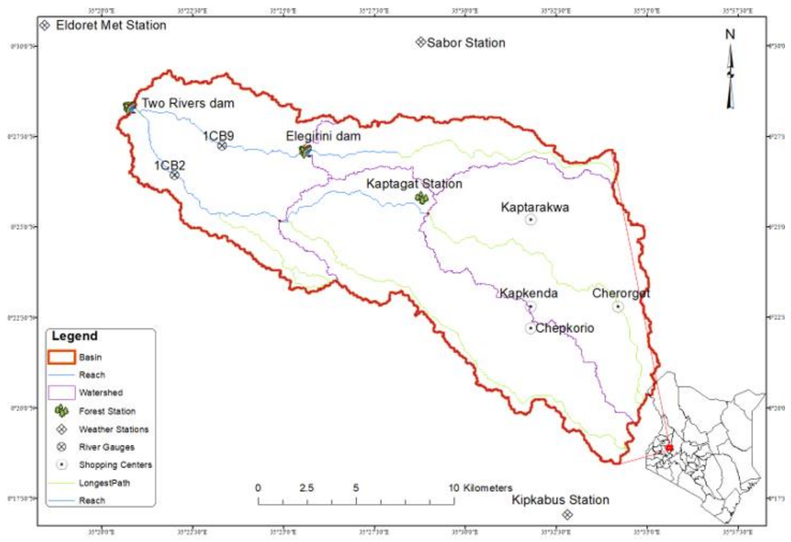
Introduction

- Eldoret town in Uasin Gishu County, Kenya, has a population of about 300,000.
- Water demand is approximately 55,000 m^3/day.
- ELDOWAS company is the sole supplier of water, with an approximate capacity of 36,400 m^3/day .
- Challenge: Huge gap between demand and supply water, hence inaccessibility of clean water, a basic human right.
- Source of Water: Two Rivers and Eligirini Dams along R.iver Sosiani in Kaptagat Catchment.

Study Area

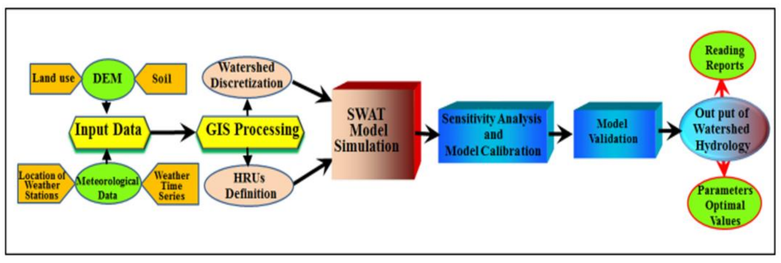


Kaptagat Catchment

Objectives

- To evaluate impact of land use and climate variability on Kaptagat catchment discharge using SWAT model and simulate viable mitigation measures.

Materials and Methods



Overview of the process of SWAT modeling

Results

Land use changed with time due to increased settlement in the catchment, resulting in a decrease in forest cover (natural and planted) from approximately 37% in 1989 to 26% in 2019. The changing land use and climate variability caused changes in the catchment hydrologic response, occasioned by increased surface runoff and decreased baseflow and groundwater recharge, hence the high variations in water levels at the Eligirini and Two Rivers dams during the dry and wet seasons. Modeled catchment management scenarios indicates groundwater recharge increased by 17% and surface runoff decreased by 9%. Ongoing afforestation, reafforestation, and terracing practices by farmers increasing vegetation cover in the catchment if adhered to, catchment response regime will improve significantly with time, despite the increasing climatic variability.

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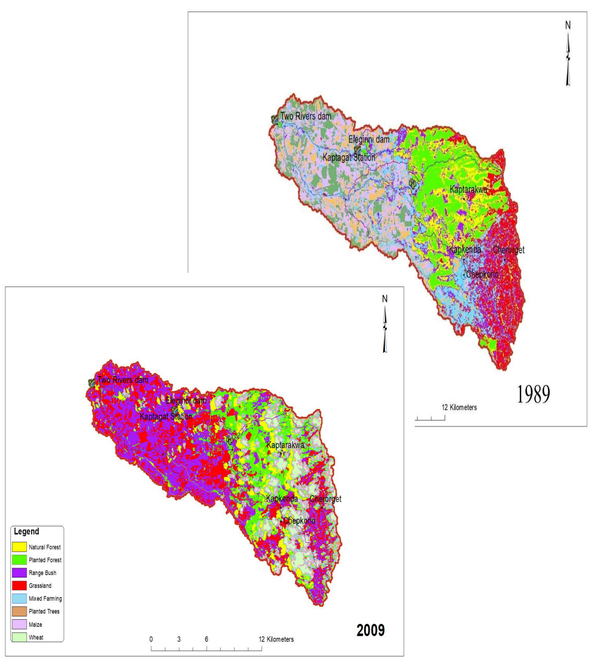
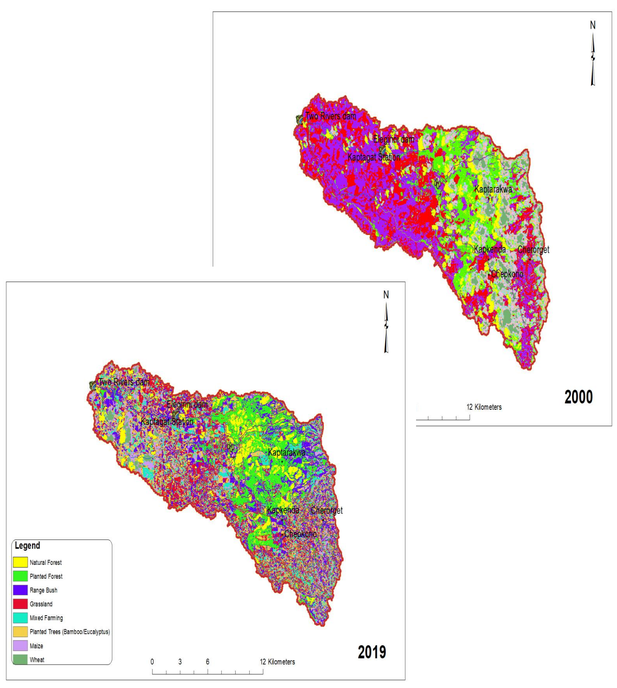
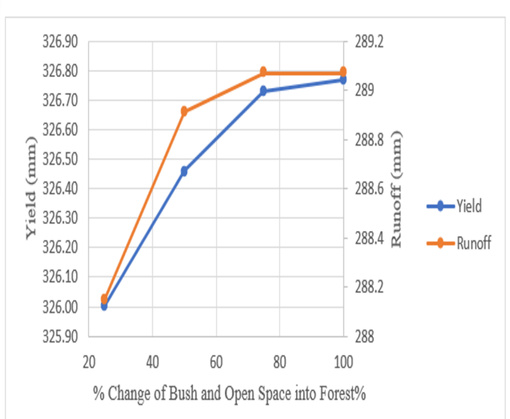
Land use changed with time due to increased settlement in the catchment, resulting in a decrease in forest cover (natural and planted) from approximately 37% in 1989 to 26% in 2019. The changing land use and climate variability caused changes in the catchment hydrologic response, occasioned by increased surface runoff and decreased baseflow and groundwater recharge, hence the high variations in water levels at the Eligirini and Two Rivers dams during the dry and wet seasons. Modeled catchment management scenarios indicates groundwater recharge increased by 17% and surface runoff decreased by 9%. Ongoing afforestation, reafforestation, and terracing practices by farmers increasing vegetation cover in the catchment if adhered to, catchment response regime will improve significantly with time, despite the increasing climatic variability.

Recommendations

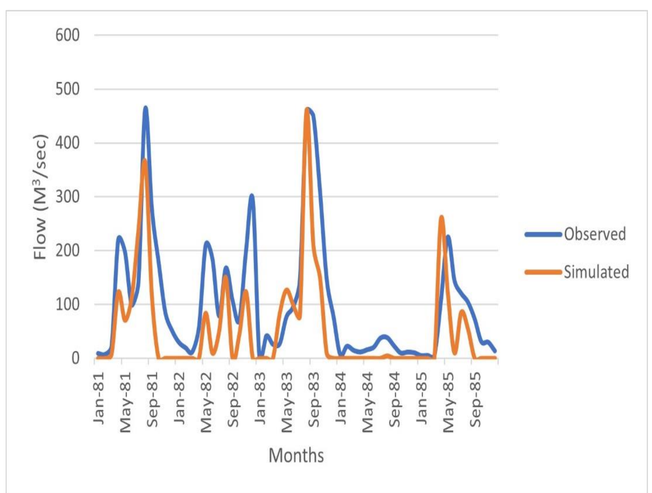
- Environmental conservation initiatives should also be implemented through payments for environmental services by downstream users offering incentives to upstream farming communities, in exchange for managing their land and resources for providing environmental services.
- Further, there is a need for modeling of sediment transport and groundwater in the catchment, as they play a role in the amount of water stored in the catchment reservoirs and river flows.

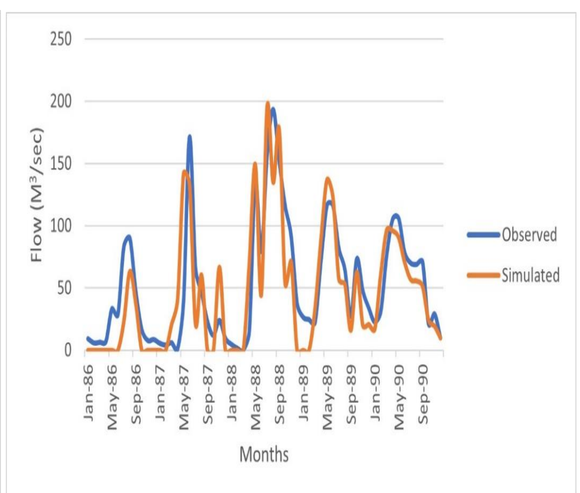


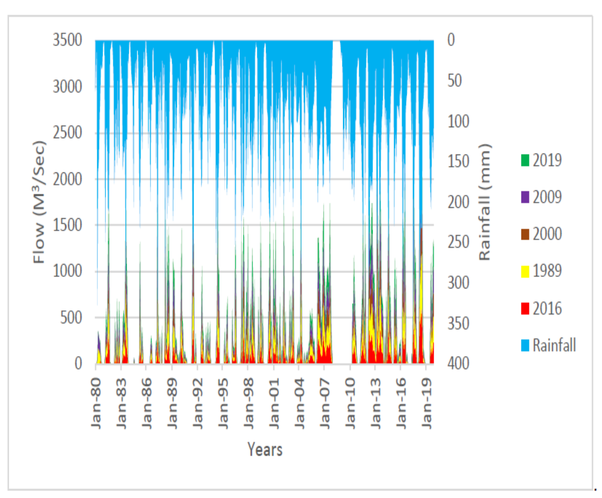


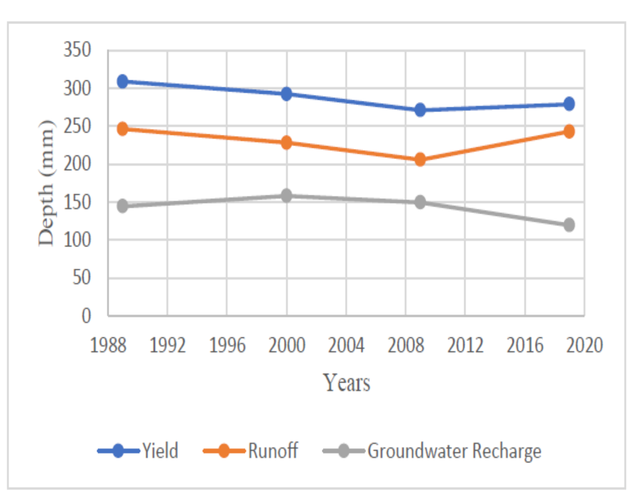


Scheme	Yield (mm)	Runoff (mm)	Groundwater Recharge (mm)	% Change (Yield)
25% of bushes converted into forest	326.00	288.15	131.53	-
50% of bushes converted into forest	326.46	288.91	131.54	+0.14
75% of bushes converted into forest	326.73	289.07	131.73	+0.22
100% of bushes converted into forest	326.77	289.07	131.78	+0.24
10% of agricultural land converted into forest	325.19	282.39	138.30	−0.25
Terracing and the planting of strips of tea plantations on agricultural lands with slopes ≥ 25%	319.90	246.82	165.61	−1.85









Acknowledgment : Building Capacity in Water Engineering for Addressing SDG's in East Africa (CAWESDEA) Project – Internship Programme Strengthening Engineering Ecosystem in Sub – Saharan Africa (IDRC Funded Programme - 2018-2021)

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