# Case study of the possible future impacts of climate change on sediment yield for a semi-arid catchment in South Africa

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**Introduction:** Sedimentation caused by soil erosion and high sediment yields has become a major problem in South Africa, especially in semi-arid regions like the Karoo, where water scarcity and reduction of reservoir storage capacity can cause social and environmental concerns (Fig 1). The uncertainties regarding the impact future climate change may have on the hydrological cycle, and the effect on catchment response increase these concerns.

**Fig. 1:** Empty Nqweba Reservoir due to reservoir sedimentation (2019)

**Methods:** This paper evaluates the possible future impacts of climate change on sediment yield by incorporating predicted future climate data and a physically-based hydrological and sediment yield model, SHETRAN [1]. The Nqweba Dam catchment (3681 km$^2$) on the Sundays River, located in the semi-arid region of the Eastern Cape of South Africa, was identified for the analysis (Fig 2).

**Fig. 2:** Nqweba Dam and catchment viewed from downstream.

The SHETRAN model was calibrated against observed streamflow and sediment data for the current catchment and climate conditions and the calibration parameters were verified. Future climate data projected by eleven climate models for two possible future emission scenarios were used to determine average monthly climate change signals for numerous future periods. The climate change signals were applied to the current climate data to represent possible future climate conditions.

**Results and discussion**: It was determined that future climate change would cause an increase in average rainfall and evaporation in the study area. The effect of possible vegetation change associated with future climate change was evaluated and the calibrated SHETRAN model was implemented for different future scenarios. It was concluded that climate change would increase sediment yield in relation to the baseline period for the Nqweba Dam catchment. However, the predicted sediment yield is still lower than some historical observations. During the early 1900s, sediment yields higher than 400 t/km$^2$/a have been recorded, while the future predictions range between 90 and 200 t/km$^2$/a. The current sediment yield for the Nqweba Dam catchment is 57 t/km$^2$/a. The historical catchment characteristics were evaluated. It was determined that poor farm management and overgrazing during the early 1900s had a more significant influence on catchment response and the increase in sediment yield than climate change. Improved farm practices and the construction of numerous farm dams that act as sediment traps significantly impacted the decline in historical sediment yields. It is suggested that improved farm management must be maintained. In high sediment yield areas, farmers must be educated on the impacts of overgrazing and poor farm management on erosion and the downstream effect. The predicted future Nqweba Dam reservoir sedimentation due to climate change was considered in the water supply planning for the town of Graaff-Reinet.

**Reference:** [1] Ewen et al. (1996). Validation of catchment models for predicting land-use and climate change impacts. 1. *Journal of Hydrology*. 175(1–4):583–594.