

Climate change unlikely to decrease Metolong dam yields

A study to research the potential impacts of climate change on the long-term yield of the proposed Metolong dam, suggests that it is highly unlikely that the available long-term yield of the dam will decrease in the intermediate future (30 to 50 years from now).

The study found that, as such, no special adaptation measures will be required to account for the impacts of climate change on the yield of the dam over a 50-year planning horizon.

The findings are based on selected general circulation models (GCMs) and the A2 greenhouse-gas (GHG) emissions scenario.



PROPOSED SITE

The dam will be located on the South Phuthiatsana river, in the Lesotho Lowlands, about 35 km outside Lesotho's capital, Maseru

However, since inflows to the dam as well as expected variability increases have been projected, design engineers should account for the possibility of associated increases in the magnitude and the severity of extreme flood events in the future.

The study was commissioned by the Metolong Authority, in Lesotho, which appointed consulting firms Arcus Gibb and Jeffares & Green to undertake the study. The Metolong Authority is the project implementing agency operating under the government of the Kingdom of Lesotho's Ministry of Natural Resources.

The dam, which will be located on the South Phuthiatsana river in the Lesotho Lowlands, about 35 km outside Lesotho's capital, Maseru, will form part of the Metolong dam and water supply programme and is an initiative aimed at providing clean and safe drinking water for local inhabitants, as well as support to a burgeoning industrial sector, particularly textile factories.

The programme will consist of the dam, water treatment works, a downstream conveyance system, advance infrastructure and a comprehensive environmental and social management programme.

Climate Change Impacts on Yield

Jeffares & Green's earth science division member, Darryn Knoesen, says estimates of dam yields are traditionally based primarily on historical climatic behaviour and the observed occurrence of precipitation and stream flows in upstream catchment areas.

"However, scientists and engineers are now developing new ways of assessing yield and, in particular, the possible impacts of precipitation and stream flow changes caused by climate change," he says.

To investigate the possible impacts of climate change on the yield of the Metolong dam, the behaviour of the dam was modelled for a range of different future situations, each of which assumes an alternative set of inflows to the dam based on the climate change scenarios developed by the Climate Systems Analysis Group (CSAG) at the University of Cape Town. The result of the analysis is a range of possible changes in yield, which can be used by planners as an indication of future trends.

Inflows used for the analyses were developed by the School of Bioresources Engineering and Environmental Hydrology (SBEEH) at the University of KwaZulu-Natal, based on the CSAG scenarios and using the Agricultural Catchments Research Unit's (ACRU's) hydrological model. Inputs into the ACRU model by the SBEEH included, besides others, the daily rainfall for each climate change scenario, the daily minimum and maximum temperatures for each scenario, soils information and land cover information, which was assumed to be under natural conditions.

Resulting future inflow scenarios for the Metolong dam represent three distinct time horizons, each 20 years in length, namely present climate (1971 to 1990), intermediate future climate (2046 to 2065), and distant future climate (2081 to 2100).

They suggest that, in the intermediate future, the average inflows to the dam are likely to increase moderately to significantly, together with some increase in variability.

Research Derivations

To understand the impacts of climate change on water resources, three things have to be predicted, namely the changes in the magnitude

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and variability of rainfall and stream flows, which determine water availability and storage requirements; changes in the magnitude and severity of extreme flood and storm events, and the design of infrastructure to withstand them; and the related changes in vegetation and land use.

Predicting such changes generally involves the use of computer models, referred to as GCMs. GCMs are sophisticated numerical representations of different parts of the earth's climate system that attempt to model the global effects of incoming and outgoing radiation, the way the air moves, clouds form and precipitation falls, besides other things.

Very importantly, they also attempt to model the impacts of global warming caused by the ever-increasing emission of GHGs.

In a recent collaborative study by the SBEEH and the CSAG (Water Research Commission Report 1562/1/10), five GCMs were selected for the purpose of developing climate change scenarios for the Southern African region.

For this purpose, scenarios from the GCMs, which were derived from a large geographical scale, were downscaled by the CSAG using so-called empirical (or statistical) downscaling methods in order to ob-



FUTURE INFLOW SCENARIOS

Suggest that, for the Metolong dam in the intermediate future, the average inflows are likely to increase moderately to significantly, with some increase in variability

tain corresponding results at a smaller scale.

The downscaling undertaken by the CSAG was for more than 2 500 rainfall stations and 400 temperature stations in Southern Africa, and were all based on the so-called A2 GHG emissions scenario, which assumes that emissions continue relatively unabated into the next century.

Planning Ahead

Jeffares & Green associate **Gerald de Jager** says that planners are increasingly concerned about the possible negative impacts of climate

change on the usable yields from dams and water resource systems.

“Emphasis is now being placed on the need to implement special adaptation measures to mitigate such impacts and to consider how such efforts can fit within the mainstream of developmental strategies.

“We are now taking into account the fact that the useful life of large water infrastructure is often measured in multiple decades, and investments that are made today will still be operating under the new climates of the twenty-second century,” he says.

