SURFACE WATER DEMAND AND SUPPLY OF GABORONE CITY AND SURROUNDING AREAS: RESPONSE TO CLIMATE CHANGE AND POPULATION INCREASE
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ABSTRACT
The adequate supply of the ever-increasing demand of fresh water continues to be a challenge in parts of the globe. This challenge has been aggravated due to increasing population and climate change. The anticipation for better lifestyles and improved water supply has resulted in an increase in migration from rural settlements leading to an increase in the populations of many cities globally. This study therefore investigates the variability and trends in the surface water demand and supply in the Botswana region. The study includes analysis of population trends, water production and consumption rates, hydrological of the study area as well as projected climate data at a high spatial resolution of 1 km2. The current General Circulation (GCM) or Regional Climate (RCM) models are not able provide such data. Therefore, the climate data for existing GCMs is statistically downscaled using the high resolution Worldclim data to spatial resolution of 1 km2 and bias corrected against Global Climatology Precipitation Center (GIPC) precipitation. The GCM data for the mid-range Concentration Representative Pathways (RCP8.5) and high emission RCP 8.5 future scenarios of Coupled Model Inter-comparison Project Phase 5 (CMIP5) are employed in the study. Under both RCP4.5 and RCP8.5 scenario, the reservoir inflow indicates that the level of reservoirs at Foresthill, Dhemogolo, Gabane hill, Oodi hill and Mabatowe will be reduced during 2081-2097 period. The unmet water demand of the whole study area will be 52.5 million m³ in 2050 as compared to 1400 million m³ in 2100. On the other hand, the unmet water demand will be reduced by as much as 50% under both scenarios if population growth rate of 2.2% is assumed. As an option of water management, increasing water loss reduction by 3% every year could drastically reduce the unmet water demand.

Introduction and objectives
The prolonged surface water stress experienced in Botswana as a whole has been one of the major problems faced by the government of Botswana. Owing to its flat topography, low rainfall amounts, high seepage generally caused by sandy soils, and high evaporation rates, Botswana has very small water resources. This inhibits the sufficient supply of water to many of its areas. High water loss rates lead to reductions in the levels of water resources which also contribute to higher water supply deficits. As an urban area Gaborone is also prone to facing such water supply deficits due to its rapidly increasing population which eventually over flows to its neighbouring sub-cities. The general objective of this study is to investigate the surface water demand and supply prospects of the city of Gaborone and its neighbouring villages through the application of the Water Evaluation And Planning (WEAP) model using scenarios of population growth trends and climate change.

Materials and Methods
Methods WEAP: Water Evaluation And Planning model

Water supply
• through precipitation
• natural processes (evapotranspiration)

Water demand
• Sufficient supply (WEAP)

RESULTS AND ANALYSIS

CONCLUSION
• Increase in population leads to increased unmet water demand hence water management strategies should be drawn and taken into consideration on time.
• For the study area, the RCP 8.5 scenario appeared to be drier than the RCP 4.5 scenario leading to higher unmet water demand in the RCP 8.5 climate projection as to RCP 4.5 which means the government should encourage low green house gas emissions.
• water re-use and proper infrastructural maintenance are some of the solutions to mitigate the impacts of climate change in reducing demand as well as saving it. However cost analysis should be done before implementation.

REFERENCES

Fig 1(a): Observed and simulated flow of Gaborone River Flow

Fig 2(a): Projected area demand of Gaborone and surrounding areas at 2% low pop growth rate (2014-2050)

Fig 3(a): Projected unmet water demands at 2.2% low pop growth rate (2014-2050)

Fig 4(a): RCP 4.5 inflows from the mean (1977-2005)

Fig 5(a): RCP 4.5 future reservoir inflows

Fig 6(a): unmet demands-RCP 4.5 & 8.5 at 2.2% low pop growth rate

Fig 7(a): RCP 3.4-8.5 unmet demands after loss control

Fig 8(a): RCP 8.5 unmet demand before loss control: 1440 MCM. After loss control: 104 MCM.
RCP 4.5 unmet demand before loss control: 1440 MCM. After loss control: 171 MCM.

Possible interventions to the projected water supply deficit
• Water loss reduction by 3% every year via technology advance
• Increase in population leads to increased unmet water demand hence water management strategies should be drawn and taken into consideration on time.