" 灌漑用水資源量の可能性と気候変動が灌漑地区に与える影響の評価 - ケニア国キリニャガ郡ムエア灌漑地区における灌漑シミュレーション - "

EVALUATING IRRIGATION WATER RESOURCES AVAILABILITY AND CLIMATE CHANGE IMPACTS ON SCHEME MANAGEMENT – CASE STUDY OF WATER BALANCE SIMULATION OF MWEA IRRIGATION SCHEME, KENYA–

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INTRODUCTION

Mwea Irrigation Scheme was established in the 1950s and rice is the predominant crop cultivated there. It is located about 100 Km North East of the capital city, Nairobi. The scheme is divided into five major irrigation blocks namely; Mwea, Thiba, Wamumu, Karaba and Tebere (total 8900 Ha, Fig 1) and is supplied by irrigation water from two main rivers, R. Thiba and R. Nyamindi from weir intakes. The irrigation water is abstracted from the rivers via fixed intake weirs and conveyed via lined and unlined canals to the paddy fields. Currently, the National Irrigation Board oversees the water management, operation and maintenance of infrastructure such as the intakes and canals, land administration and making of cropping programs. The scheme has a Water Users Association (WUA) that in also involved in the scheme management. (Mwea Irrigation WUA Constitution).

METHODOLOGY

SWAT model is one of the several hydrological modelling tools that can be used to model and predict some of the hydrological processes. [1] SWAT model was used for analysis of the water availability of R. Thiba and R. Nyamindi). The SWAT model inputs were; Digital Elevation Model (DEM), soil map, land use map, and weather data. The model was set up for running for daily simulation for the period 1979-2009. Calibration and validation of the model was done for the period 1981-1991 using the Sequential Uncertainty Fitting (SUFI-2) algorithm. [2]

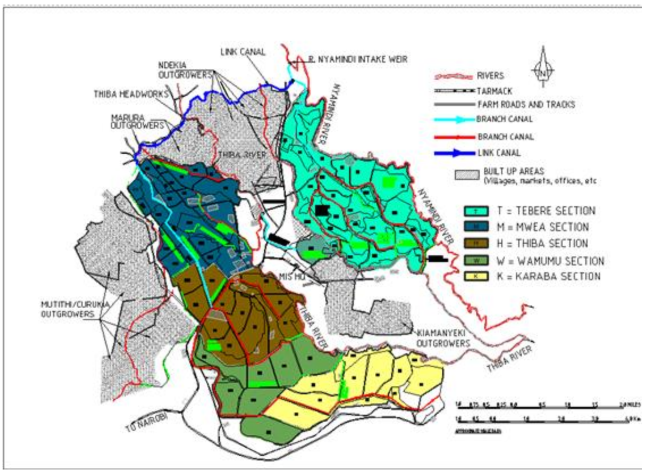

Fig1. MIS Layout

The irrigation water need will be calculated based on the following equation [3];

$$IrrigationWaterNeeded = ETcrop + SAT + PERC + WL - Pe$$

Where (ET crop) is defined as the depth (or amount) of water needed to meet the water loss through evapotranspiration; SAT is the amount of water needed to saturate the soil for land preparation by puddling which depends on the soil type and rooting depth; PERC refers to the percolation and seepage losses that mainly depend on the type of soil; WL refers to a water layer is established during transplanting or sowing and maintained throughout the growing season; Pe is the effective rainfall.

RESULTS AND DISCUSSION

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Calibration and validation (Fig 2) done for the periods 1981-1986 and 1987-1991 respectively.

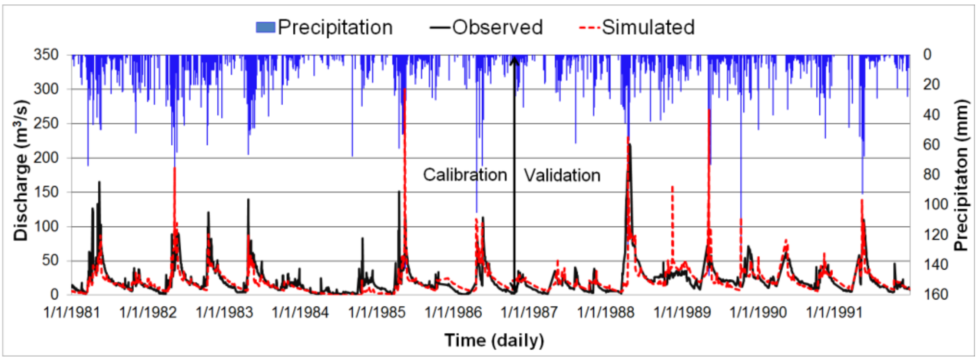

Fig 2. SWAT Calibration and Validation output

Despite the several data gaps, the model performance was described as good. (NSE for calibration and validation were 0.44 and 0.31 respectively; PBIAS was 12.67 and 2.23 respectively) The discharge data for the two weir intakes at R. Thiba and R. Nyamindi were obtained from the model and this data was used to calculate the water supply i.e. the total available flow calculated using the following equation [4]:

$$Total\_Available\_Flow = Q80 - (Q95 \times 0.3) - Accumulated\_Water\_Rights$$

Where Q80 and Q95 represent the flow duration exceedance percentiles. Q80 is the flow that can be expected to be exceeded 80% of the time, while Q95 is the flow that can be expected to be exceeded 95% of the time. (Q95 × 0.3) is the base flow requirements for the downstream riparian uses set at 30% of the environmental flow. The Accumulated Water Rights were obtained from the Water Resources Management Authority offices in Kerugoya,

CONCLUSION AND FUTURE PLAN

From the preliminary assessment, the water demand outstrips the water supply. The current analysis focuses the water demand and supply scenarios. Further analysis will be conducted on the actual water deficit (duration and distribution) and farmers adaptation strategies .The future plan involves reservoir simulation and using future climate data (downloaded and downscaled from PRECIS model) to conduct future scenario analysis for improved irrigation management.

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