効率的な水配分に向けた灌漑開発計画における水需給バランスの分析
– 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 –

Demand and supply balance analysis in irrigation plan towards improvement of water use efficiency
– Case study of water balance simulation in Mwea Irrigation Scheme, Kirinyaga County, Kenya–

ジョージ　アココ*　加藤　亮**
George Akoko, Tasuku Kato

1. INTRODUCTION

Rice in Kenya was introduced in Kenya in early 1900s from Asia. It is one of the most important cereal crops in Kenya (It is ranked as the third most important cereal crop after maize and wheat) and its mainly grown Mwea Irrigation Scheme, MIS which contributes to about 60% of the locally produced rice in Kenya. (National Rice Development Strategy, 2014) The scheme is divided into five major irrigation blocks; Mwea, Thiba, Wamumu, Karaba and Tebere. It is supplied by irrigation water from two main rivers, R. Thiba and R. Nyamindi. MIS is divided into 60 units, each with an average area of 100ha. (Mohammed A. et al, 2003)

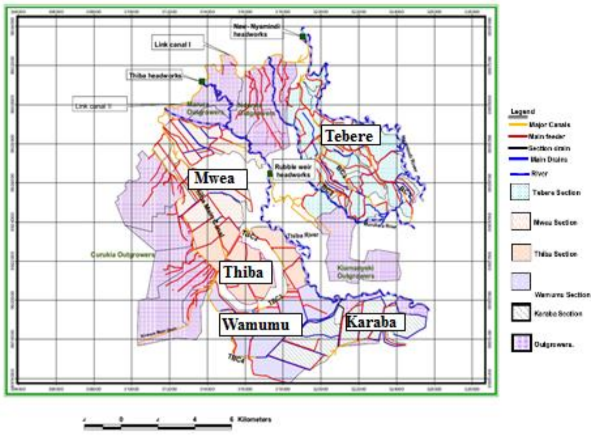

Fig. 1 Mwea Irrigation Scheme layout

Table 1 Input data

Data type	Source
DEM	USGS Global Digital Elevation Model (30m)
Land use map	Global Land Cover Characterization (2009)
Soil map	SOIL- Food and Agriculture Organization of the United Nations database (FAO, 1995)
Weather Station	Climatological data from Mwea Irrigation and Agricultural Development Center(MIAD), Castle Forest and Embu Stations
Water discharge	Average monthly discharge data for R. Thiba and R. Nyamindi

2. METHODOLGY

2.1 Watershed supply analysis using SWAT

SWAT is one of the several hydrological modelling tools that can be used to model and predict some of the hydrological processes (Arnold et al., 1998; Neitsch et al., 2005)Input data is as tabulated.

*東京農工大学大学院連合農学研究科 United Graduate School of Agricultural Science, Tokyo University of Agriculture and Technology. **東京農工大学農学研究院 Institute of Agriculture, Tokyo University of Agriculture and Technology.
Keyword: 水収支, 蒸発散, 利用可能量, SWAT, Water balance, ET, Availability, SWAT

2.2 Paddy water balance analysis

For rice, the irrigation water need was calculated based on the following equation;

Irrigation Water Need = ET crop + SAT + PERC + WL – Pe (FAO, 1986)

Where (ET crop) is defined as the depth/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; PERC refers to the percolation and seepage losses; WL refers to a water layer is established during transplanting and maintained throughout the growing season; Pe is the effective rainfall.

3. RESULTS AND DISCUSSION

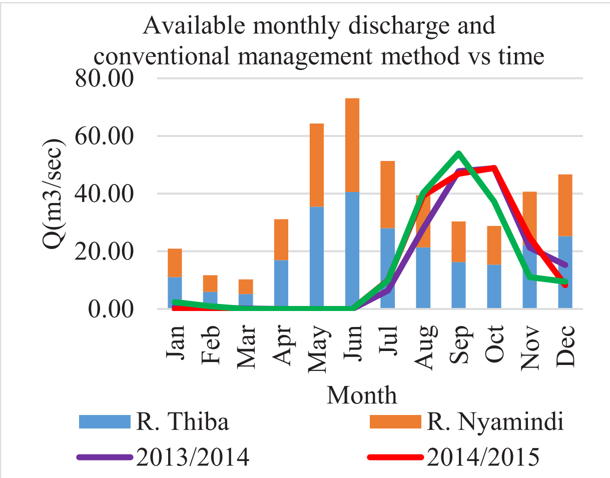

Fig.2 Available monthly discharge and conventional management method vs time

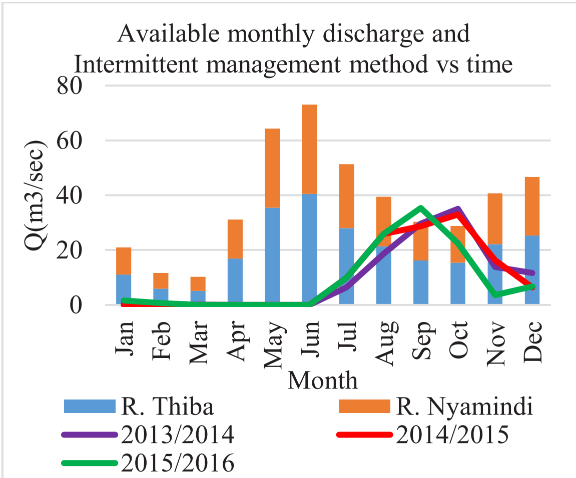

Fig.3 Available monthly discharge and intermittent management method vs time

As seen from the above figures (Figs.2 and 3), convectional irrigation management method has a higher irrigation water demand than the available supply. This can be attributed to the higher water levels maintained in the paddy fields during the growing period. Intermittent irrigation management method was analysed to utilize lower irrigation water demand for the 3 cropping seasons. (as 31%, 32.4% and 35.7% less water requirement for the cropping seasons 2013/2014, 2014/2015, and 2015/2016 respectively) Also, intermittent irrigation management method showed a slight deficit for irrigation water over the months of September and October.

4. CONCLUSION

From the preliminary results, it is evident that currently, the crop water demand exceeds the available water supply. It is thus imperative that the MIS management considers adapting to more sustainable water management methods in order to try to alleviate the gap that currently exists between demand and supply.

The MIS has plans to incorporate a dam (Thiba dam) in the near future to try to address the water problem. However, the plans have been stalled with several impediments e.g. court cases over land compensation. This research will seek to continue to conduct integrated watershed management scenario with the dam component for MIS. The main output would be development of a crop production model that can be applied for integrated watershed management in Mwea that can be used for mathematical forecasting and planning and adopted for other schemes in Kenya.