DEMAND AND SUPPLY BALANCE ANALYSIS IN IRRIGATION PLAN TOWARDS IMPROVEMENT OF WATER USE EFFICIENCY – CASE STUDY OF WATER BALANCE SIMULATION OF MWEA IRRIGATION SCHEME, KIRINYAGA COUNTY, KENYA –

水利用効率の向上にむけた灌漑開発の水需給解析 －ケニヤ国キリニャガ郡ムエア灌漑地区における灌漑モデルとシミュレーション－

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Introduction

Rice is one of the most important cereal crops in Kenya. It is mainly grown in irrigation schemes located in central (at Mwea Irrigation Scheme, MIS) and western parts of Kenya.

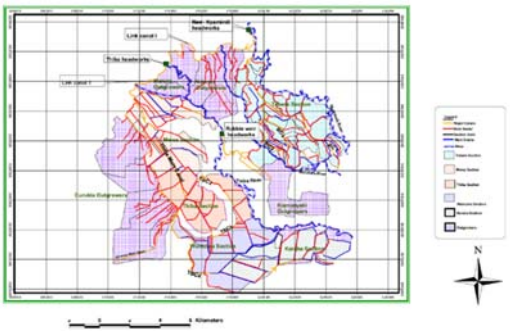

Fig. 1: MIS Layout

The amount of rice produced in Kenya falls short of the amount consumed, with the surplus met through imports from the Asia. The serious challenge of MIS lies in the low levels of efficiency in related to water use against the limited available water resources and seasonal flow variation. (National Irrigation Board et al, Guidelines to Irrigation Water Management in Mwea Irrigation Scheme, Kenya)

Materials and Methods

The research location is located in central Kenya, around 100Km NE of the capital city of Nairobi. Soil Water Analysis Tool, SWAT was used to estimate the available water supply. Input data included DEM, land use maps, soil maps, and climatological data. The results were used to calculate the total available flow. Paddy water balance was calculated based on crop evapotranspiration, water required for land preparation, percolation and effective rainfall. The water demand was calculated for three irrigation management scenarios; conventional irrigation, intermittent irrigation and intermittent irrigation with horticulture for three seasons, 2013-2016.

Results and discussion

Water shortages were experienced across the three seasons analyzed from late August to early November. The largest water shortages for conventional irrigation management was observed as 23.6m³/sec in September 2015/2016 cropping season.

There was a significant decrease in water demand with intermittent management method (calculated as 37.4%, 23.1% and 24% for 2013/2014, 2014/2015 and 2015/2016 seasons respectively)With intermittent irrigation management there was some water deficit exhibited with

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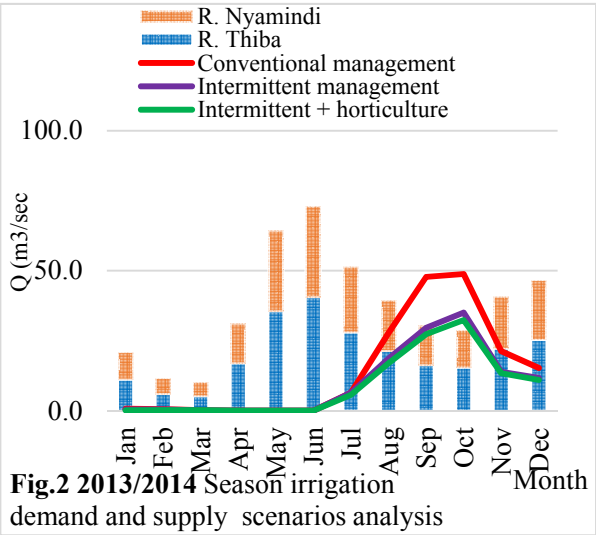

Fig.2 2013/2014 Season irrigation demand and supply scenarios analysis

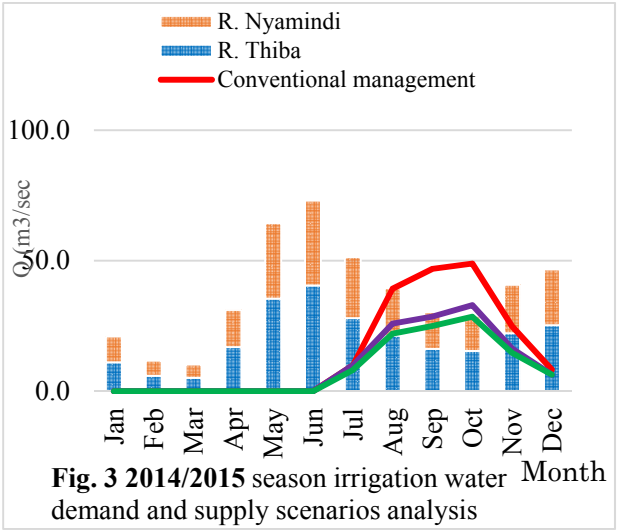

Fig. 3 2014/2015 season irrigation water demand and supply scenarios analysis

the largest water shortages were observed as 4.95m³/sec September 2015/2016 cropping season. Subsequent scenario analyses was conducted with a combination of intermittent irrigation management method with some horticulture practice in the outgrower areas of the scheme.

With this scenario, the only water shortage was exhibited in the month of October 2013/2014 season as 3.6m³/sec. From the results, it is evident that currently, the crop water demand outstrips the available water supply. Illegal abstractions has aggravated this condition. This research strongly recommended that the MIS management should implement the intermittent irrigation management with horticulture to help address the water shortages. Further analysis should be conducted on the nutritional content of the rice (comparing rice from conventional management and intermittent management)

Future plan

MIS is currently constructing a dam on R. Thiba to help in addressing its water shortage problems. This research will proceed to develop a conceptual irrigation dam model that can be used for estimating irrigation water scheduling and scheme maintenance for improved scheme efficiency. The model will be developed in SWAT.

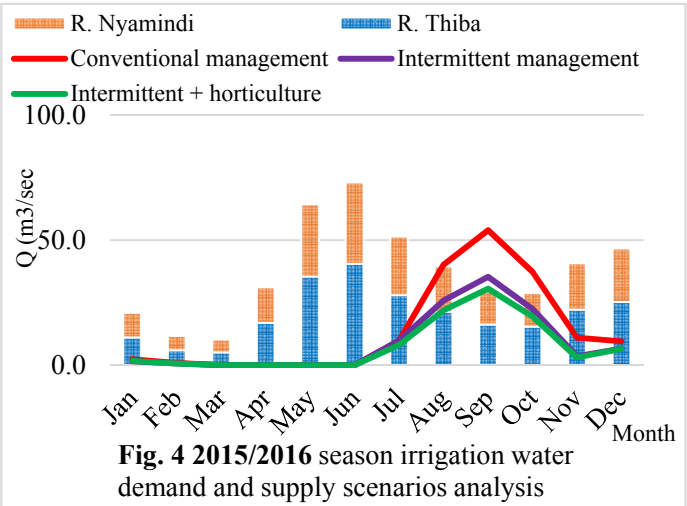

Fig. 4 2015/2016 season irrigation water demand and supply scenarios analysis