Evaluation of irrigation system performance using comparative indicators
A case study of Bwanje Valley Irrigation Scheme in Malawi

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1. Introduction

In recent years there has been a growing concern that performance in the context of irrigated agriculture is less than had been expected. The anticipated potential through irrigation of land earlier dependent on unpredictable and unreliable rainfall has not always been achieved. There are a wide range of problems affecting the performance of irrigation systems. The problems are at system level, water distribution level leading to disparities in water supplies and loss of production in some locations, to excess water delivery and development of water logging and salinity in others (Bos 1994). The ultimate purpose of performance assessment is to achieve an efficient and effective use of resources by providing relevant feedback to the scheme management at all levels and ensure that irrigation is practiced in a more productive and efficient way. The aim of the study is to evaluate the performance of Bwanje Irrigation Scheme from the period 2007 and 2008 in order to assess if the scheme is meeting its set objectives.

2. Study Area

Bwanje Valley Irrigation scheme in Malawi is one of the modern and highly complex irrigation schemes in term of infrastructure. The scheme covers an area of 800 hectares benefiting 2240 farmers aimed at producing rice and other crops for food security and economic development. **Fig. 1** shows map of Malawi showing the location of scheme. The main source of water for the scheme is Namikokwe River which feeds water to the scheme by gravity through the main canal which subdivides into three branch canals. Bifurcation structures are used to divert water from main canal into the branch canals which further divide the water into the tertiary canals. Water in tertiary canals is controlled by opening and closing of turnout and check structures gates that are placed below the turnouts in the direction of flow. Field drains collect excess water from fields and convey it to the main drains. The scheme was constructed with funding from Japanese International Cooperation Agency (**JICA**) and was completed in 2000.

Fig.1 Map of Malawi showing project Site

3. Data collection and Analysis

Data was collected from secondary sources which included reports from the irrigation scheme water users association, Department of Irrigation and Department of Agricultural Extension Services. Comparative indicators (Molden 1998) were calculated. Indicators calculated are; output per cropped area(US$/ha) which is the production divided by annual cropped area, output per irrigation supply (US$/$m^3$) which is defined as production divided by diverted irrigation supply and relative irrigation supply which is defined as ratio of irrigation supply and irrigated demand.

Equations: Production=$(\sum A_i*Y_i*P_i/P_b)P_w$ where A_i is area for $crop_i$, Y_i is yield for $crop_i$, P_i is local price for $crop_i$, P_b is price for the base crop and P_w is price of base crop traded at world market; Output/cropped area=Production/cropped area where cropped area is sum of areas cultivated in winter and rain seasons; Output/irrigation supply=Production/diverted irrigation supply where diverted irrigation supply is volume of surface irrigation water diverted to the command area plus net removals from ground water; Relative irrigation supply=irrigation supply/irrigation demand where irrigation supply is surface diversion plus net groundwater drafts and irrigation demand is crop evapotranspiration less effective rainfall; Relative water supply=total water supply/crop demand where total water supply is surface diversions plus effective rainfall and crop demand is potential crop evapotranspiration; Crop intensity=Cropped area/command area where cropped area is area that is cultivated and command area is the design area.

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Key words: Comparative indicators, Performance assessment, Relative irrigation supply

4. Results and Discussion

4.1 Relative Irrigation Supply and Relative Water Supply Relative irrigation supply shows how irrigation supply and demand is being matched. The Relative irrigation supply was 0.53 and 0.1 for the summer and winter seasons in 2007 respectively while in 2008 it was 0.93 and 0.3 for the summer and winter seasons. Relative water supply is the ratio of the total water supply to the crop demand.

Table 1 Cropping intensities for 2007 and 2008

Year	Season	Crop	Area (ha)	Production (Mt)	Crop Intensity
2007	Rain	Rice	788	3208	0.98
	Winter	Maize	280	900	0.36
		Beans	10	21	
2008	Rain	Rice	800	3606	1.00
	Winter	Maize	405	1215	0.51
		Beans	2	2.5	

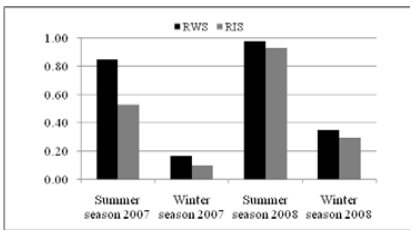

Fig.3 Relative Irrigation Supply (RIS) and Relative Water Supply (RWS)

The relative water supply was 0.85 and 0.16 for the summer and winter seasons in 2007 respectively while in 2008 it was 0.98 and 0.35 for the summer and winter seasons respectively. **Fig. 3** shows the relative irrigation supply and relative water supply for 2007 and 2008. From the values it can be seen that the water supply in the irrigation seasons was tight and hence the low values.

4.2 Annual Cropping Intensity of the scheme

The annual cropping intensity was calculated by dividing the irrigated crop area and the system command area. **Table 1** shows the cropping intensities for 2007 and 2008. The annual crop intensity for 2007/08 season was 1.3 while that of 2008/09 season was 1.5.The low crop intensities were as a result of poor crop selection and limited water supply which resulted in less area to be cultivated in the scheme. In the rainy season, only rice was cultivated and maize and beans were the only crops during the winter season.

4.3 Output per irrigation supply and Output per irrigated cropped area

Table 2 Production from the scheme

Year	Area (ha)	Output/Irrigated Crop Area US$/ha	Output/Irrigation supply US$/$m^3$
2007	788	534	0.48
2008	800	547	0.26

Table 2 shows the output per irrigation supply and the output per irrigated crop area. The output per irrigation supply was US$ 0.48/m^3 in 2007 and US$ 0.26/m^3 in 2008. There was an increase in irrigation supply in 2008 but did not result in significant improved production hence the low value. The output per cropped area was US$ 534/ha in 2007 and US$ 547/ha in 2008. The increase in output/irrigated area in 2008 was a result of a slight increase in production.

5. Conclusions

There is need to improve the production efficiency from the scheme through increased crop intensities. This can be achieved by revising the cropping pattern of the scheme and considering growing more crops. There is also need to improve irrigation water management so that supply in the winter season is not tight as can be observed from RIS values. Output from the scheme should be improved by selecting high value crops that will fetch good prices on the market. Most crops grown on the scheme are grains which fetch low prices. Marketing of crops also needs to be improved as most crops are sold around the scheme only.

6. References

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