

Enhancing Water Productivity in Irrigated Ecosystem at ORP Malaprabha Command of Karnataka State

Neelakanth J. K., Halgalimath S. P.,
Gundlur S. S., Dasar G. V.

Received 17 November 2016 ; Accepted 19 December 2016 ; Published online 7 January 2017

Abstract Attempts were made to intervene through proven technologies developed irrigation management strategies to educate farmers to avoid excess irrigation. Operational research program (ORP) on irrigation water management was conducted for two years (2013 and 2014) in the 12-L of 23rd distributary of Malaprabha Right Bank Canal (MRBC) and the study area was 288.94 ha. The maize, wheat and chickpea grain yield was enhanced about 10.26%, 11.54% and 14.67% when compared with the normal irrigation practiced by farmers. The enhanced WUE recorded in maize, wheat and chickpea was 35.33, 22.01 and 13.5% respectively when compared to normal method of irrigation. The amount of irrigation water saved in maize, wheat and chickpea was 28.57, 13.4 and 8.7% when compared to normal method of irrigation respectively.

Keywords Alternative to alternative furrow (AAF) method irrigation, 80% cutoff for strip method of irrigation, Water use efficiency (WUE), Irrigation water management and conservation in ORP.

Introduction

On -farm water management research is necessary to

improve the operation and management of irrigation system, the efficiency of which is generally low. Excess irrigation to crops favors leaching and flushing of salts into the lower horizons, affects nutrient balance in the soil profile and causing changes in the fertility of the soil. In India, during the last three decades, considerable effort has gone into the development of suitable irrigation water management practices. Most of the research has, however, been conducted on experimental research station under controlled condition. Also, the findings have not been tested on a large scale under farmers field conditions which impose their own operational constraints. Appropriate modifications are needed when these are implemented in a live irrigation system. Also water saving techniques in crop production to be adopted in on-farm water management research has been suggested [1]. To assess the water delivery characteristic of the irrigation system and to analyze the total water availability in the distributary command in respect of spatial and temporal variations, detailed information on opening and closing of the distributary and minors. The volume of water delivered and area irrigated in the sub-command of selected irrigation minors may be recorded indicating the frequency of irrigation given to different crops [2].

Materials and Methods

The canal distributaries selected for the study was 12-L of Malaprabha Right bank Canal (MRBC) located at Latitude 14°35' N and Longitude 73°36' E

Neelakanth J.K.*, Halgalimath S.P.,
Gundlur S.S., Dasar G.V.
Agric Engineer, Irrigation Water Management Research
Center, Belvatigi, UAS, Dharwad
e-mail: jkneelakanth@gmail.com
*Correspondence



Fig. 1. Operational research project (ORP) study area at Malaprabha command.

and Altitude 526 m above MSL (Fig. 1). Field channel was having design discharge rate of 0.04—0.19 cumecs with a total command area of 221.70 ha. The experiment was conducted for two years from 2013 and 2014 by All India Co-ordinate Research Project on Water Management, Water Management Research Center Belvatagi. The soil was Chromusterts with clay in structure. The soil pH was 8.3 with EC 0.18 dS/m and organic carbon was 0.55%. The available P_2O_5 was 29 kg/ha and available K_2O 857 kg/ha. The field capacity of the soil was 40.0% and wilting point 21.6%. The data obtained on various characters were analyzed using split plot design replicated thrice analysis and interpretation of the data was carried out potential evapotranspiration (ET_0) was determined from pan evaporation data. US class a pan was installed near the research site to record daily pan evaporation. The pan evaporation method measures the evaporation from the open water surface, taking into account cumulative effect of radiation, wind, humidity and temperature [2].

Crop water demand

The relationship between ET_0 and pan evaporation with, K_c values based on percent growing season (2) were use to determine ET_c .

$$ET_c = K_c \times K_p \times E_p$$

Where, E_p = Pan evaporation (mm/day), K_p = Pan coefficient, K_c = Crop coefficient.

Results and Discussion

Weather

Total annual rainfall recorded was maximum 801.9 mm and 720.7 mm during 2013 and 2014 respectively compared with the normal (555.4 mm). During study period rainfall recorded 44.38 and 29.6% excess rainfall. An event of rainfall during April (31.8 and 4.8 mm), more than normal during May (174.7 mm and 204.7 mm), June (54.6 mm and 24.4 mm), July (42.6 mm and 107.6 mm) and Aug (28.4 mm and 119.7 mm) received during the *kharif* (2013 and 2014 respectively). This trend of rainfall continued during *rabi*-2013 and 2014 also. An event of rainfall was recorded during September 2014 (360.1 mm and 47.7 mm), Oct (107.2 mm and 123 mm) Nov (nil and 31.4 mm) and Dec (nil and 58.2 mm) respectively. The annual mean maximum and minimum temperature was recorded 34.5°C and 33.50°C and 19.2°C and 18.7°C respectively during 2013 and 2014 [3, 4].

Crop condition in ORP area

During *kharif* 2013 and 2014 maize was the dominant crop covering an area of 155.5 and 150 ha (70.08 and

Table 1. The details of crop grown extent (ha) and percent cover in study area.

<i>kharif</i> Crop	Year		<i>rabi</i> Crop	Year					
	2013	2014		2013	2014				
Maize	155.50	(70.08)	Wheat	103.2	(46.42)				
Cotton	41.00	(18.57)	Chickpea	70.50	(35.01)				
Sorghum	—	25.60	(11.28)	Cotton	41.0	(18.57)			
Sunflower	—	20.50	(7.09)	Sorghum	—	12.84	(04.50)		
Onion	25.20	(11.35)	17.34	(3.60)	—	—			
G. total	221.70	(99.91)	288.94	(100)	G. total	214.70	(96.76)	288.94	(100)

51.91%) of extent respectively (Table 1). This was followed by cotton 41.00 and 75.50 ha (18.57 and 26.12%), sorghum was nil and 25.60 ha (nil and 11.28%), sunflower was nil and 20.5 ha (nil and 7.09%) and onion 25.02 and 17.34 ha (11.35 and 3.6%) of extent respectively. During *rabi* 2013 and 2014 wheat was the dominant crop covering an area of 103.20 and 130.40 ha (46.42 and 45.13%) of the acreage and it was followed by chickpea 70.50 and 70.20 ha (35.01 and 24.24%) cotton 41.00 and 75.50 ha (18.57 and 26.12) and sorghum nil and 12.84 ha (nil and 4.50%) respectively. Demonstrations of alternatively alternate furrow (AAF), a proven water saving technology in surface irrigation method for maize, sunflower and cotton crops was done also 80% cut off length boarder strip method of irrigation, a proven water saving technology for wheat, chick pea crops was demonstrated for all the farmers field.

Crop water demand

The total amount of water required for crops was analyzed for irrigation during *kharif* 2013 and 2014 was 73,292 and 9,27,158 m³ respectively (Table 2). The total effective rainfall worked out was 75,390 and

6,05,349 m³ respectively. Hence, the excess water balance was 2098 and 3,21,809 m³. Based on data analyzed during the year *kharif* 2013 and 2014 also the field crops were observed satisfactory condition. During *rabi* 2013 and 2014, the crops the net amount of water demand for all crops was worked out 59,150.76 and 6,58,293 m³ respectively. Gross canal supply and net canal supply was observed 51,876.56 and 47,160.63 (*rabi* 2013) where as 5,64,321 m³ and 4,70,268 m (*rabi* 2014) respectively. The effective rainfall was recorded 16,357.00 and 3,48,390 m³ respectively. The excess water supplied was worked out 4,366.87 and 1,60,365 m³.

Proven technology for enhancing water productivity on selected crops

The average maize yield and WUE recorded with the alternatively alternate furrow irrigation was 73.34 q ha⁻¹ and 52.38 kg (ha mm)⁻¹ respectively (Table 3). The corresponding maize yield and WUE obtained by farmers in normal irrigation practice was 60.98 and q ha⁻¹ and 33.87 kg. (ha mm)⁻¹ respectively. The maize yield was enhanced 20.26% (12.36 q ha⁻¹) with AAF technology compared with the normal farmers

Table 2. Crop water demand and water supply in canal distributaries.

Particulars	<i>kharif</i>		<i>rabi</i>	
	2013	2014	2013	2014
1. Net crop water demand (m ³)	73, 292	9,27,158	59,150.76	6,58,293
2. Gross canal supply (m ³)	—	—	51,876.56	5,64,321
3. Net canal supply (m ³)	—	—	47,160.63	4,70,268
4. Effective rainfall (m ³)	75,390	6,05,349	16,357.00	3,48,390
5. Contribution from ground water (m ³)	—	—	—	—
6. Water balance, m ³ excess (+)/ deficit (-)	+ 2098	+ 3,21,809	+ 4366.87	+ 160365

Table 3. Effect of AAF irrigation method compared with farmers practice on maize yield and saving of water.

No. of farmers	Pooled (2013 and 2014) data of alternatively alternate furrow irrigation		Farmers practice pooled (2013 and 2014)	
	Yield (q ha ⁻¹)	Water applied (mm)	Yield (q ha ⁻¹)	Water applied (mm)
1	78.6	160	57.8	190
2	73.4	140	67.6	185
3	68.7	135	61.1	190
4	71.4	120	60.2	185
5	74.6	125	63.0	190
Mean	73.34	140	60.98	188
WUE				
kg/ha mm	52.38		33.87	
Enhancing in yield = 12.36 (q ha ⁻¹) (20.26%)				
Enhancing in WUE = 18.52 kg (ha mm) ⁻¹ (35.33%)				
Saving of irrigation water				28.5%

practice. The enhanced WUE was recorded 35.33% (18.52 kg (ha mm)⁻¹ when compared to normal method

Table 4. Effect of 80% cutoff for border strip irrigation method and farmers practice on wheat crop with water saving.

No. of farmers	Pooled (2013 and 2014) data of 80% cutoff for border strip method of irrigation		Farmers practice pooled (2013 and 2014)	
	Yield (q ha ⁻¹)	Water applied (mm)	Yield (q ha ⁻¹)	Water applied (mm)
1	9.50	260	8.50	286
2	9.20	240	8.65	280
3	8.69	235	7.69	265
4	9.60	220	8.40	248
5	8.95	225	7.40	260
Mean	9.18	236	8.12	267.8
WUE				
kg/ha mm	3.88		3.02	
Enhancing in yield = 1.06 (q ha ⁻¹) (11.54%)				
Enhancing in WUE = 0.86 kg (ha mm) ⁻¹ (22.01%)				
Saving of irrigation water				13.4%

Table 5. Effect of 80% cutoff for border strip irrigation method compared with farmers practice on chick-pea crop and saving of water.

No. of farmers	Pooled (2013 and 2014) data of 80% cutoff for border strip method of irrigation		Farmers practice pooled (2013 and 2014)	
	Yield (q ha ⁻¹)	Water applied (mm)	Yield (q ha ⁻¹)	Water applied (mm)
1	19.45	270	18.50	296
2	19.82	260	18.65	270
3	18.65	255	17.69	285
4	19.39	230	18.40	258
5	18.96	235	17.40	250
Mean	19.25	250	18.12	271.8
WUE				
kg/ha mm	7.70		6.66	
Enhancing in yield = 1.13 (q ha ⁻¹) (14.67%)				
Enhancing in WUE = 1.04 kg (ha mm) ⁻¹ (13.5%)				
Saving of irrigation water				8.7%

of irrigation. The amount of irrigation water saved by alternatively alternate furrow irrigation was recorded 28.5% over the farmers method of irrigation.

The average wheat yield obtained using 80% cut off irrigation border strip method was 9.18 q/ha (Table 4). The corresponding wheat yield obtained by farmers in normal irrigation practice was 8.12 q/ha. The wheat yield was enhanced about 1.06 q/ha (11.54%) using 80% cut off irrigation border strip method compared with the normal farmers practice. The enhanced WUE was recorded 22.9% when compared to normal method of irrigation. The amount of irrigation water saved was recorded 13.4% over the farmers method of irrigation.

The average chick pea yield obtained using 80% cut off irrigation border strip method was 19.25 q/ha (Table 5). The corresponding chick pea yield obtained by farmers in normal irrigation practice was 18.12 q/ha. The chick pea yield was enhanced about 1.13 q/ha (14.67%) using 80% cut off irrigation border strip method compared with the normal farmers practice. The enhanced WUE was recorded 13.5%

when compared to normal method of irrigation. The amount of irrigation water saved was recorded 8.7% over the farmers method of irrigation. Also these results are on par with [5].

Hence, adoption of proven water saving technologies is very important and they are easily replicable under field conditions due to simplicity. This helps in boosting the economics of the region in an eco-friendly way without deteriorating the land. Also canal regulators, field channels, are to be upkeep by de-silting and clean by water users associations under the technical guideline of site engineers and scientists.

References

1. Khot AB, Prabhakar AS, Chetti MB, Janawade AD (2011) Performance of cotton to varied water supply situations and water saving techniques in vertisols. Proc Nat workshop on potassium nutrition in enhancing yield and quality of crop. 17—18 Jan. UAS, Dharwad, pp 142—143.
2. Neelakanth JK, Rajkumar S, Meti, Gundlur SS, Ashok P, Khot AB (2011) A study on assessment of water availability and to device intervention for matching water supply with agricultural production system demands. National Conference on sustainable development of water resources and environmental management, Jaipur-Rajasthan 25-26 Feb, 2011.
3. Annual Report (2013) Annual progress report of Irrigation Water Management Research Center, Belvatagi.
4. Annual Report (2014) Annual progress report of Irrigation Water Management Research Center, Belvatagi.
5. Rajkumar S, Neelakanth JK, Gundlur SS, Ashok P, Khot AB (2011) Application of water saving technologies on the farmers fields in a Participatory mode to improve the water use efficiency and crop productivity Nat Conf on sustainable development of water resources and environmental management, Jaipur-Rajasthan 25-26 Feb, 2011.