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WATER PRODUCTIVITY ASSESSMENT IN GOVINDGARH COMMAND AREA

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Abstract

Irrigation water management is facing organization changes worldwide. Beginning in the 1980's, there have been a large scale programs to turn over irrigation management from Government Agencies to organized Water User Associations in a number of countries such as Philippines, Indonesia, Columbia and Maxico. This study is aimed to assess the water productivity in wheat crop taken by govindgarh tank command area in Rewa district. In this command area eight miner and head reach highest discharge was obtained in Govindgarh minor (0.572 m^3/s) and lowest discharge was in Amin and Hardisankar minor which is 0.246 m^3/s. It decreases by 62.76%, 67.48% and 80.49% in tail reach. The water productivity of wheat crop in Govindgarh command area is ranging from 0.46 to 1.43 kg/m^3 in head reach, 0.55 to 1.50 kg/m^3 in middle reach and 0.54 to 2.39 kg/m^3 in tail reach. In this command area tail reach water productivity of wheat crop is more in all three reaches.

Keyword:- Water Productivity, Command area, Discharge.

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Introduction

Irrigation has played an important role in increasing world's agricultural production in the last 50 years.For irrigating field crops, available water resources are being used for various crops but the utilization of this resources is quite low. As far as source wise irrigated area is concerned about 25.7 % area is irrigated through canal water, 40.6% through ground water (tube wells and other wells), and 3.4 % through tank and remaining area through other sources. In recent years community management of water resources is believed to have significant potential in addressing the stagnating agricultural productivity in thecommand areas of major irrigation projects.Each of them was developed at different times as per demand for irrigation as well as technologies developed for storing, transporting and lifting of water. It is necessary to achieve maximum returns per unit of water used from cropping activities. Real changes in irrigation water use can be achieved through improving the productivity of existing available water resources. Therefore, institutional interventions to improve irrigation water management are pre-requisite for increasing the productivity of limited water resources. A WUA is a group of farmer along a lateral canal who establish their own cooperative non-profit organization with a set of rules to manage water deliveries within their area (Lohmar *et al., 2003*). Madhya Pradesh was second state to complete elections to 1470 WUAs in April 2000 and to 90 Distributories Committees in February 2001. WUA's main aim is to increase water productivity in command

area development (Hooja, 2005). Water productivity can be expressed in physical or economic terms. Physical productivity is quantity of product in kg per m³ of water used and economic productivity is income in Rupees derived by use of unit volume of water (m³) (Molden *et al.*, 2003). WUA's constituted in the year 2008 in the state of Madhya Pradesh for different irrigation projects are working to achieve the productivity improvement of water applied.

MATERIAL AND METHODS:-

Study Area

The area selected for the present study is command area under Govindgarh tankirrigation project at their location in Rewa district Madhya Pradesh.Govindgarh WUA command area (1840 ha) in Rewa district is 24º38`15`` to 24º41`24`` N latitude and 81º28`0`` to 81º28`43`` E longitude. In this WUA total numbers of minors are eight. The climate of the study area is subtropical monsonic characterized by an oppressive hot summer, high humidity and chilly winter. Total number of farmers is more in small category farmers as compare to other category farmers and small farmers category more area covered in all WUAs.

Farmer's survey

Representative farmers from within the WUA command area as well as in the immediate vicinity were selected under different categories namely marginal, small, medium and large. Farmers were selected using stratified random sampling technique. Three farmers in each of four categories were selected in head, middle and tail reach of minors. Thus total 36 farmers were surveyed in each WUA area. The selected farmers were interviewed and the information on their agricultural practices, land use, crops grown, irrigation sources, irrigation practices were obtained. This information was tabulated and analyzed to determine the status of canal water use.

Field Observation

Field observations were recorded to determine the discharge of minor and field channel in different minors at different reach. Discharge of minors was estimates by velocity area method. Cross sectional area, velocity of flow and depth of flow were measured in the minors and canal. Cross sectional area was measured at three locations and averaged for head, middle and tail reach of each minor. Depth of flow was measured directly by depth gauge in the stream. Velocity of flow was measured with the help of current meter in main canal and minors, where as float area method was applied in field channels.

Table 2.1Average cross section details, flow depth and velocity in Govindgarh WUA.

Govindhgarh WUA	Bottom width, m	side slope (H:V)	Top width, m	Depth of flow, m	Velocity of flow, m/s
Head	0.30	1:1.5	1.14	0.43	1.15
Middle	0.30	1:1.5	1.12	0.37	0.90
Tail	0.30	1:1.5	0.99	0.34	0.49

The details regarding the area of cross section, depth of flow and velocity in minors and field channel obtained from the measurement along with the location are presented in Table 2.1 Bottom width of minors is 0.3 and side slope are 1:1.5, depth of flow change from 0.34 to 0.43 m. Accordingly velocity is recorded as 0.49 to 1.15 m/s in various minors.

Estimation of Water Productivity:-

Agricultural production performance indicators included crop yield, area harvested and land holding pattern. Indicators are easier to compute from generally available data than the indictors of water delivery performance.

This indicator relates to the performance of irrigated agriculture and performance of agricultural economics of water productivity.Waterproductivity of WUA's is determined by quantity of water used, yield. Water productivity is quantity of product in kg per m³ of water used in field.(Molden *et al* , 2003).

$$\text{Water Productivity} = \frac{Y}{Wq}$$

Where, Y = Yield per kg/ha as per surveyed

Wq = Quantity of water use per m^3/haas per farmerssurvey and field observation.

RESULTS AND DISCUSSION:-

Discharge measurement:-

The discharge measurement is show in Table 3.1. In head reach highest discharge was obtained in Govindgarh minor (0.572 m^3/s) which decrease by 62.76% in tail reach (0.213 m^3/s). The lowest discharge was in Amin and Hardisankar minor which is 0.246 m^3/s. It decreases by 67.48% and 80.49% in tail reach (0.08 m^3/s and 0.048 m^3/s respectively).Table 4.3 shows number of

minor and their length, Mohini minor with a length of 2.45 km and Nakta minor with lowest length of 0.90km.

Table 3.1Field observation in different minors under Govindgarh WUA

Name of Minor	Canal length (km)	Measured Discharge (m^3/s) at different reaches		
		Head	Middle	Tail
Govindgarh	0.87	0.572	0.324	0.213
Parsiya	1.25	0.467	0.365	0.174
Kapurhai	1.21	0.434	0.312	0.151
Nakta	0.90	0.331	0.276	0.106
Mohani	2.45	0.325	0.244	0.078
Amin	1.46	0.246	0.163	0.080
Dhobet	1.22	0.255	0.124	0.062
Hardi Sankar	1.31	0.246	0.138	0.048

Water productivity:-

Table 3.2 shows water productivity of wheat crop in different reaches in different category.In shead reach highest water productivity was found in medium farmer is 1.48 kg/m^3 and lowest in marginal farmer is 0.46 kg/m^3. Water productivity in middle reach highest in small farmer is 1.50 $kg/m^3$and lowest in marginal farmer is 0.55 kg/m^3.

Reach	Farmer Category	Water Productivity (kg/m^3)		
Head	Marginal	0.64	0.54	0.46
	Small	1.24	1.19	0.56
	Medium	1.48	1.36	0.59
	Large	0.70	0.62	1.13
Middle	Marginal	0.55	0.90	1.11
	Small	1.28	1.46	1.50
	Medium	0.88	1.26	0.99
	Large	1.38	1.33	1.20
Tail	Marginal	0.54	0.67	0.68
	Small	0.89	1.23	1.09
	Medium	2.39	1.47	1.93
	Large	1.63	1.83	1.90

In tail reach maximum water productivity in medium farmer and minimum in marginal farmer. Average of all four category farmers medium category farmers (1.37 kg/m^3) maximum water productivity and minimum in marginal category farmers (0.67 kg/m^3). Tail reach farmers highest water productivity (1.35 kg/m^3) and head reach farmers lowest water productivity (0.87 kg/m^3) because of head reach farmers improper irrigation scheduling and timing so wastage of water by head reach farmers.

Fig. 3.1 the trend line shows that all reaches of canal the yield level decrease as the water utilization increases in x- axis. A fact that can be observed in the figure that water utilization in overall three reaches is minimum around 1045 m^3/ha in tail reach, 2489 m^3/ha in middle reach and 3656 m^3/ha in head reach. Which again show that head reach has got over utilization of water. The respective yield in minimum water utilization in tail, middle and head reach are 2500 kg/ha, 2000kg/ha and 2500 kg/ha respectively, it shows that the yield is increasing from tail to head reach but it is not able to compensate the head reach water productivity level due to higher water utilization with less increase in yield. Therefore it can concluded that there is need of improving water management in head reach. Also improved water availability in tail end may further improve yield level and water productivity level to appreciable limit.

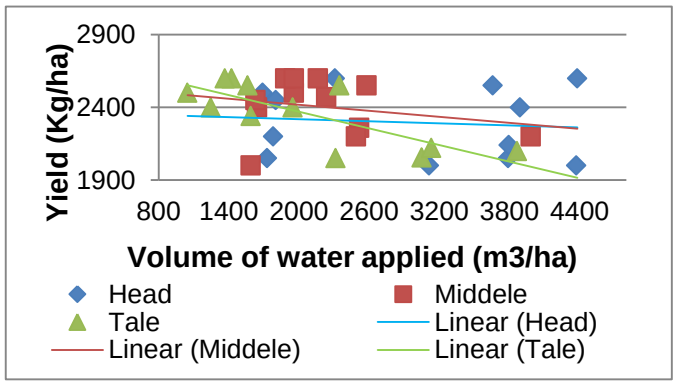

Fig. 3.1 Variation of wheat yields with water utilization.

Analysis of variation of water productivity:-

Water productivity as obtained with wheat crop varies with respect to canal reach and also with the categories of farmer's i.e. marginal, small, medium and large farmer. It also attains different value as per water management, canal management and water distribution works under taken by canal reaches. Wheat productivity data were used to find out the impact of all these variation statistically.

In this analysis, ANOVA used is randomized complete block design with many observation units. Water productivity of wheat crop in different reaches was assessed for four categories of farmers. In Govindgarh command area mean of water productivity obtained under three replications of wheat crop in different categories of farmers is presented in Table 3.3.Average water productivity in Govindgarh command area has been found to

almost same in medium and large category i.e. 1.37 kg/m^3 and 1.3 kg/m^{3}and the minimum water productivity in marginal category was 0.68 kg/m^3. Overall range is 0.55 kg/m^3 to 1.93 kg/m^3. Calculated value of F statistics for experimental error is 6.901 which is greater then the corresponding table value $F_{5\%\ (6,24)}$ = 2.5082 as shown in Table 3.4. It indicates that the experimental error of the data for Govindgarh command area is found statistically significant. Calculated value F_c for category is 1.885 which is less than the corresponding tabulated value $F_{5\%\ (3,\ 6)}$ = 4.7571. Variation of water productivity in different category is non-significant.

Table 3.3 Mean water productivity of wheat (kg/m^3)

Farmer category	Water productivity in kg/m^3			
	Head reach	Middle reach	Tail reach	Average
Marginal	0.55	0.83	0.63	0.67
Small	0.99	1.41	1.07	1.16
Medium	1.14	1.04	1.93	1.37
Large	0.81	1.30	1.79	1.30
Mean	0.87	1.15	1.35	

Table 3.4 Analysis of variation for Govindgarh command area.

Source of variation	df	ss	ms	fc	$F_{5\%}$	Significance
Reach	2	1.63	0.814	1.739	6.1631	NS
Category	3	2.65	0.882	1.885	4.7571	NS
Experimental error	6	2.808	0.468	6.901	2.5082	S
Sampling error	24	1.628	0.068			
Total number	35	8.71				

Conclusions:-

Govindgarh Command area velocity is decreases so discharge is decreases in head to tail reach in main canal and minors but mean of water productivity is increases in head to tail reach and average of water productivity is more in medium and large category farmer as compare to other farmer category. Govindgarh command area is statistically significant and variation of water productivity in different category is non-significant.

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