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Management of water resources through participatory approach

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Abstract
Considering the importance of irrigation management and water user's participation in increasing water productivity and development of existing irrigation command area, a study were carried out to assess the present irrigation system and management of water resources for possible improvement in command area of Ghatera Babaji tank canal situated in Betwa River basin. The command area has 101 land holdings ranging from 0.23 ha to 6.32 ha belonging to 87 farmers. Cropping intensity and irrigation intensity was found to be 83.4% and 81% respectively. Productivity of wheat crop varied from 4.5 to 35.1 q ha^{-1} which converted to water productivity ranged from 0.33 to 1.55 kg m^{-3}. Water productivity for chickpea varied from 0.97 kg m^{-3} to 1.86 kg m^{-3}. More than 50 per cent farmers were agreed on conjunctive use, sprinkler irrigation, improving crops and field bunding. Out of the total 5 groups of farmers surveyed to know about adaptive behaviour it was found that the suggestions were acceptable to four group's categorized based on age, education, income and land holding in Ghatera Babaji WUA's. Depending on the soil, crop, water resources, water users and climatic conditions improvements were suggested to change irrigation method, replacement of crop varieties, better working of water user association, irrigation scheduling, drainage planning, maintenance of canal, operation of canal, and adopting full package of practices for crops.

Keywords: Adoption behaviour, Participatory appraisal, Water management, Water resource Development

Introduction
Water is a vital component of nature, which brings life in land; therefore the judicious utilization of water is needed for all types of human advancement. India is a monsoon dependent country for its water resources. Irrigation sector has been fundamental to India's economic development and poverty alleviation, since 25% of India's Gross Domestic Product (GDP) and 65% of employment are based on agriculture (MOWR GOI 2006).
Due to inadequate availability of irrigation water in the reservoir, most of the flow based minor irrigation projects suffer from poor irrigation intensity and cropping intensity. There is a need of proper crop planning especially during dry season taking into account the availability of irrigation water in the reservoir. Higher crop coverage sometimes leads to severe scarcity of irrigation water in the advanced crop growth stages thereby restricting the productivity of the crop significantly lower than the potential. The Water Users Association (WUA) formed to look after the operation and maintenance of the system and collect water tax from the farmers still have several problems. Therefore, the challenges of water resource management in minor irrigation sector calls for immediate assessment of their performance to identify the gaps and development of suitable ways and means to bring improvement.
Involvement of farmers was initiated by participatory management programs which should be extended to all projects and to all activities. It is the need of time to plan improvement in consultation with farmers or water users in the command area. Looking to the fact that in irrigation management planning farmer or water user is the most important component for improving irrigation scenario.

Materials and methods
The study was undertaken in the command area of Ghatera Babaji tank canal, a tank irrigation project located at Ganjbasoda, Vidisha district, Madhya Pradesh.

Water resources
Daily records of supply head in main canal were obtained from the Water Resources Department, Government of Madhya Pradesh.

Based on cross sectional area, slope and outlet conditions, the discharge delivered to the command area was estimated. Operating hours of selected minor and the schedule of operation of the main canal during the irrigation season were obtained to estimate the volume of water delivered to study area.

Location of different fields with respect to water courses, field channels and area irrigated was obtained from the records of the local irrigation authorities. Open wells are most important source of irrigation during Rabi season. Pumps and motor are used for lifting water for irrigation.

Tank or reservoir was designed to irrigate 65 ha command area of Ghatera Babaji. But at present 121 ha area is irrigated with 2-3 irrigation.

Irrigation in almost entire command area is done by the surface method. Irrigation water is applied by flooding from a channel located at the upper reach of a field. Farmers of Ghatera Babaji minor command area used free flooding surface irrigation method. No specific design criterion is followed in this method of water application. This method results wasteful losses and many times results in soil erosion and non-uniform application of water in a field.

Water productivity is defined as 'crop production per unit amount of water used'. Concept of water productivity in agricultural production system is focused on 'producing more food with the same water resources' or 'producing the same amount of food with less water resources'.

Water productivity = Actual Yield / actual water use

Farmers' survey

In order to assess the present irrigation system of a minor command and its diagnostic study, farmers were contacted personally to collect the desired information in data collection schedule prepared for survey.

Information regarding present irrigation system of minor command area, land holding, income, age group, education, location of farm etc. was collected through personal contact. To identify the factor responsible for performance of the users, farmers were categorized based on income ranging less than 50,000, 51,000–90,000 and more than 90,000 Rs./annum. Based on the age group, farmers were categorized between the age group of young age (up to 39 years), middle age (40-52 year) and old age (53-65 year). Five education categories were considered as illiterate, primary, middle, high school and graduation level. Based on location of field they were kept into head, middle and tail reach of canal. Analysis was made for marginal, small, medium and large farmers, (<1 ha, 1-2 ha, 2-4 ha and >4 ha) separately.

Farmers' response for suggested technical intervention

To collect sufficient factual and reliable information about the farmer-managed irrigation systems, an inventory checklist and schedule were prepared. The data collection schedule was designed to probe for a brief historical background of the system, characteristics & performance of the physical systems as well as the farmers' organizations, agricultural services and production. This involved preparation of schedule for farmers' response contacting selected farmers in minor command and compiling data for further analysis for relationship of these factors for agreeing and disagreeing on the possible improvements suggested after analysis.

Results and discussion

Water availability

Average discharge measured in head, middle and tail reach of Ghatera Babaji tank outlet main canal was 0.066 to 0.013 m sec^{-3}. Table 1presents the total volume of water available.

Water productivity

Fig 1 shows water productivity of wheat and chickpea in head, middle and tail reach in main canal of Ghatera Babaji WUA. In wheat highest water productivity was found in tail reach of 0.97 kg m^{-3} and lowest in middle reach are 0.86 kg m^{-3}. Highest water productivity of chickpea was also found in tail reach1.58 kg m^{-3} and lowest in head reach 0.97 kg m^{-3}.

Problems identified in the command area

- Out of 71 surveyed farmers, 65 used free flooding method which increases water loss.
- Irrigation efficiency is poor as low as 35% in present irrigation method.
- By use of free flooding method soil erosion problem has created.
- Absence of water distribution from field to field.
- Unlined water course responsible for losses of precious water resource.
- Moderate and seasonal problem in *kharif* season due to lack of drainage system which causes water logging problem.

Total area under 87 farmer's was102 ha. The area in head reach was 28 ha, middle reach 32 ha and in tail reach 42 ha. Total no. of holdings were101 in which 27 in head, 34 in middle and 40 in tail reach. Out of total 87 farmers 26 were in head, 32 in middle and 29 were in tail reach. Farmers' survey was conducted to collect data of land holdings of 71 farmers out of 87 farmers. Variation of productivity was analyzed by taking different groups based on size of holdings, age, income, and education of farmers. Survey was conducted to cover the opinion of all the farmers. Data on this aspect are given in table 2.

Improved irrigation management and technical interventions proposed were discussed with farmers for getting their response. 71 sample farmers or water users out of the 87 farmers of command area of Ghatera Babaji tank canal were surveyed to discuss about technical interventions. A schedule was prepared considering the points made for improvement and information was collected through personal survey of individual farmer. The responses of farmers were recorded in the form of agreement or disagreement with the suggested improvement. Table 3 presents the percentage of farmers accepted the proposals.

Maximum number of farmers responded to question number 15 in positive manner and minimum for question number 9. The farmers' agreement on living of canal might be due to obvious impact of it on reducing seepage losses and saving the fields due to water logging. Poor response in drainage planning could be due to less awareness of farmers about benefits of drainage and also technological gap in traditional and improved practices as per scientific requirement. This indicates the need of capacity building of farmers. All the suggested improvements are summarised and presented in table 4. Table 5 shows that the resultant impact expected in the GBT project after adoption of improvements.

Table 1: Water availability in different reach of main canal under Ghatera Babaji Tank command.

Reach	Volume available (m^3)
Head	261360
Middle	162160
Tail	51480
Total	475200

Table 2: Water users and holdings at different reach.

S. N.	Reach	Total farmers			Sample farmers		
		Area (ha)	Farmers holding (ha)	No. of farmers	Area (ha)	Farmers holding (ha)	No. of farmers
1	Head	28	27	26	25	21	22
2	Middle	32	34	32	30	32	24
3	Tail	42	40	29	40	29	25
4	Total	102	101	87	95	82	71

Table 3: Response of water users in adoption of improved irrigation management technology.

S. N.	Proposed improved technology	No. of farmers accepting the proposal	% of farmers responded positively
1	Border Irrigation method	53	74.64
2	Sprinkler irrigation method	42	59.15
3	Replacement of crop varieties	62	87.32
4	Cooperation with water user association	55	77.46
5	Attending training program	62	87.32
6	Conjunctive use of water	38	53.52
7	Suggested irrigation schedule	63	88.73
8	Growing low water requirement crops	57	80.28
9	Drainage planning	30	42.25
10	Adoption of improved technology	45	63.38
11	Operation and maintenance of canal	56	78.87
12	Use of fertilizer at equal proportion	57	80.28
13	Construction of bund at field level	40	56.33
14	Lining of canal	70	100.0
15	Repaired sluice gate and earth dam	67	94.36
16	Satisfaction with irrigation charges	66	92.95
17	Adoption of crop rotation	49	69.00

Table 4: Possible improvements proposed in GBT project.

S. N.	Constraints		Existing	Target
1	Reduction in water requirement, cm		55	40-45
2	Including more crops for irrigation		Wheat, gram, vegetables	Soybean, mustard, lentil, wheat, gram, vegetables
3	Use of efficient Irrigation method		Flooding	Pipe flow, sprinkler, border
4	Time of irrigation, days		22, 21, 20	21, 21, 18
5	Change in Variety	Wheat	GW-322, Lok-1	GW-3020,
		Gram	JG- 315, JG-64	JG-16
6	Use of NPK N:P_2O_5:K_2O		80:40:0	120:60:40
7	Conjunctive use of water GW : SW		0.1 :1.00	0.3:1.00
8	Operation and maintenance of canal		Nil	100%
9	Reduction in seepage through lining of canal, m^3/ M m^2		29.02	6 – 8
10	Participation in operation, maintenance and scheduling of irrigation		Nil	100%
11	Recovery of irrigation charges,		89%	100%

Table 5: Expected impacts of improvements.

S. N.	Constraints		Existing	Target
1	Increase in area irrigated (ha)		120.9	155
2	Reduced depth of water application (cm)		9	6
3	Improvement in water productivity, kg m^{-3}	Wheat	0.89	1.16
		Gram	1.18	3.43
4	Increased yield levels (q ha^{-1})	Wheat	22.6	40-45
		Soybean	10.9	20-25
5	Enhanced yield due to water management (q ha^{-1})	Wheat	41.5	48-50
		Gram	17.9	20-24
		Soybean	16.6	24-28
6	Improvement in yield levels obtained with full package of practice, (q ha^{-1})	Wheat	43.6	50-52
		Gram	18.8	22-26
		Soybean	15.7	20-25

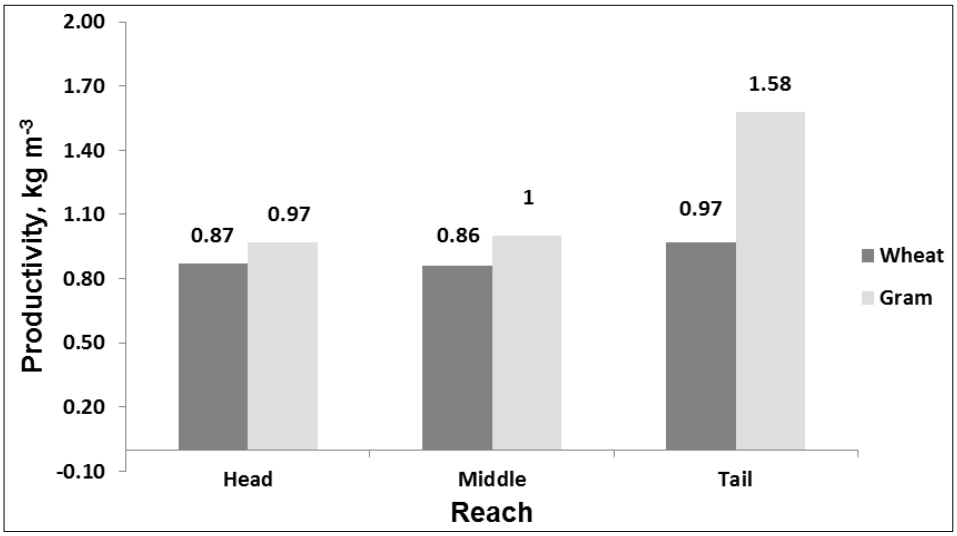

Fig 1: Water productivity of wheat and chickpea crop at different reach of main canal.

Conclusion

Based on the diagnostic analysis of GBT irrigation project, possibility of improvements and adoptability of farmers following conclusions were drawn.

1. The overall irrigation efficiency of 35% needs to be improved to enhance water productivity of wheat from 0.89 to 1.16 kg m^{-3} and for chickpea from 1.18 to 3.43 kg m^{-3}.
2. Improved irrigation method namely border and sprinkler are to be adopted to improve application efficiency from 66% to 80%.
3. Total water availability in canal at head, middle and tail reach was found to be 261360 m^3, 162160 m^3 and 51480 m^3, respectively. This was higher than the well water availability.
4. Farmers need capacity building program to educate them for adopting complete package of practices of crop including variety, seed, seed treatment, fertilizer, weeding, irrigation scheduling and proper water management to enhance level of average yields from 22.6 to 40 q ha^{-1} for wheat and 10 to 20 q $ha^{-1}$for soybean crop.
5. Out of 17 questions, more than 75% farmers responded positively on 11 improvements. Least response was obtained for drainage planning. More than 50% farmers were agreed on conjunctive use, sprinkler irrigation, improving crops and field bunding.

References

1. Albaji M, Hemadi J. Investigation of different irrigation systems based on the parametric evaluation approach on the Dasht Bozorg plain. Transactions of the Royal Society of South Africa. 2011; 66(3). DOI: 10.
2. Biswas AK. Monitoring and evaluation of an irrigation system. Water Resources Development. 1984; 2(1):3-25.
3. Bos MG, Nugteren. Definition on irrigation efficiencies. International institute for land reclaimination and improvement *ILRI publication*. 4th edition, 1990, 125p.
4. Chandran MK, Varadan KM, Valsan T. Evaluation of farmers' participation under command area development programme in Kerala. J Tropical Agric. 2001; 39(1):38-41;1(3/4):36.
5. FAO. A Framework for Land Evaluation. Soil Bulletin No. 32. FAO, Rome, Italy, 1976, 72. http://www.fao.org/docrep/x5310e/x5310e00. htm
6. Goldsmith H, Makin IW. A comparison of two methodologies for assessment of irrigation performance under the Warabandi system. Overseas Development Unit, Hydraulic Research, Wallingford, UK. 1991; 5(1):19-29.
7. Hart WE, Peri G, Skogerboe GV. Irrigation performance: an evaluation. Journal of Irrigation and Drainage Engineering. 1979; 105(3):275.
8. Hooja R. Below the Third Tier Water User Association in India, 2005. Forum of Federation - *www.forumfed.org*
9. Junghare YN. Factor influencing the adoption of farm practices. Indian Journal of Social Work. 1962; 23(3):291-296.
10. Kaushal RK, Tyagi NK, Sewa Ram, Bhirud S. Diagnostic analysis of tertiary canal water delivery system and approaches to improved management. Division of Agricultural Engineering, Central Soil Salinity Research Institute, Karnal, Haryana 132001. Indian Journal of Agricultural Engineering. 1992; 2(1):47-53.
11. Kazbekov J, Abdullaev I, Manthrithilake H, Qureshi A, Jumaboev K. Evaluating planning and delivery performance of Water User Association (WUAs) in Osh Province, Kyrgyzstan. Agricultural Water Management, 2009.
12. Khan MA. Study on tribal farmers of dantewara block of bastar district, M.P. with reference to adoption of selected agricultural technologies M.Sc. (Ag.) unpublished thesis, IGKVV, Raipur, 1996.
13. Kumbhare NV, Singh K. Adoption behaviour and constraints in wheat and paddy production technologies. Indian Research Journal Ext. Education. 2011; 11(3).
14. Puranik RP. Water User Association in Madhya Pradesh. In: National Workshop on Enhancing Water Productivity in Canal Command, Jabalpur 2628 December. C.A.E., J.N.K.V.V., Jabalpur (M.P.), 2008, 121-132p.
15. Reddy JM. Management of gravity flow irrigation systems, In Irrigation Management in developing countries: Current Issues and Approaches. West View Press Colorado, 1986, 95.
16. Sharma PBS, Rao VV. Evaluation of irrigation water management scheme - A case study. Agricultural Water Management. 1997; 32(2):181-195.
17. Singh M. Farmers attitude towards adoption of recommended technology to increase productivity under

dry land area. Indian Research Journal of Extension Education Special Issue (volume+), 2012.
18. Svendson M, Leslie S. Farmer's perspective on irrigation performance. Irrigation and Drainage Systems. 1990; 4(4):385-402.
19. Trivedi K, Singh OP. Impact of quality and reliability of irrigation in field and farm level water production of crops. International Water Management. 2004; 89:1162-1182.
20. Yakubov M. Assessing irrigation performance from the farmers' perspective: A Qualitative study. Irrigation and Drainage Systems, 2011. DOI: 10.1002/ ird.649.