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Study on bio-physical profile of water user associations in mula command area

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Abstract

Irrigation sector is the main consumer of available surface fresh water and more than 90.00% of total ground water draft in India. Indian government is proactively promoting user participation for effective and efficient management of irrigation water and systems. In this context this study examines the bio-physical profile of Water User Associations in Mula command area in context of their origin, structural & functional context. The present study was conducted under Mula irrigation command area with sample size of six Water User Associations (WUA's). Ex-post facto research design was used for the study. It was found that highest operational cost, irrigation fee collected, irrigation fee assessed and actual irrigated area in head reach. Highest maintenance cost, cultivable command area, total irrigable area, initial irrigated area and net irrigated area was observed in middle reach. Highest water entitlement and volume of water received was observed tail reach.

Keywords: Bio-physical, command area, profile, water user associations (WUA'S)

Introduction

The water availability of a region or nation is majorly depending on the availability of annual precipitation which is influenced by the regional hydro-meteorological and geological factors and to ensure water access and water security through the development of water infrastructure. Irrigation sector is the main consumer of available surface fresh water and more than 90.00% of total ground water draft in India. Indian government is proactively promoting user participation for effective and efficient management of irrigation water and systems. It is crucial to efficient use of available water resources for a country like India, given that India has 17% of the world's population but has only 2.4% of the land and 4% of the water resources. Moreover, the per capita availability of usable water resources, which was 5247 m³ in 1951 and it is now 1453 m³, is projected to decrease to 1170 m³ by 2050 (CWC, 2015) [2]. Agricultural sector alone consumes 80% of the ground water (Harsha, 2017) [3]. The declining trend of groundwater level in all parts of the country also indicates that the assured supply of good quality water will become a concern for country's development (Manivannan *et al.*, 2017) [6]. The overall efficiency of the flood irrigation system range between 25-40% (Amarasinghe, 2007) [1]. In order to meet the food security, income, and nutritional requirements of the anticipated population in 2050, India will need to nearly double its food production. Enhancing the groundwater table can be achieved through implementing various artificial conservation methods and boosting crop

productivity (Paul and Panigarhi, 2016) [7].

A most important factor in the effective use of water resources is the participation of farmers in the management of the operation, maintenance and collection of water charges from the areas under the control of Water User Associations (Water User Associations). A WUA is a group of farmers who live near a lateral canal and create their own non -profit cooperative organization with a set of regulations to control water delivery in their region (Lohmar *et al.*, 2003) [5]. This study focused to know the bio-physical profile of Water User Associations in context of their origin, structural & functional context.

Material Methods

Research design is the plan, structure, and strategy of investigation conceived so as to obtain answers to research questions and to control variance (Kerlinger, pp. 300) [4]. The research design followed in the present study was ex-post-facto research design. Ex post facto research is systematic empirical inquiry in which the researcher does not have direct control over independent variables because their manifestations have already occurred or because they are inherently not manipulable

The study was conducted of Water User Associations in Mula command area by using an *ex-post facto* research design to know the bio-physical profile of Water User Associations. In Mula command area, the location of Water User Associations head, middle and tail reach selected through purposive sampling. Two Water User Associations

selected from each head, middle and tail reach through stratified random sampling. To know the bio-physical profile of Water User Associations, a pre-tested structured

schedule was used to gather data on bio-physical profile. The following table 1 shows the details.

Table 1: Selection of water user associations

Location	Sr. No.	Name of Water User Associations	Area
Head reach	1.	Yashwant Water User Association	432 Ha
	2.	Shree Ram Water User Association	384 Ha
Middle reach	3.	Hanuman Water User Association	509 Ha
	4.	Sri Datt Water User Association	286.69 Ha
Tail reach	5.	Shivshankar Water User Association	164 Ha
	6.	Jagdamba Water User Association	291 Ha

Result and Discussion

To analyze the performance of Water User Associations it is important to understand the context of their origin, structural & functional context, the relevant data were collected, analyzed and the results are presented in this study.

Location & number of villages: From table 2, it can be observed that all the Water User Associations under study, except Sri Datt WUA, were established in the year 2006 under the MMISF act, 2005. Further all the Water User Associations were established on minor canals, serving villages in the range of 1-4 villages. Among all the Water User Associations, the Yashwant WUA covered maximum 4 villages followed by Shree Ram WUA (3 villages) and, Hanuman & Sri Datt WUA (2 villages each).

Operational area: It was observed that overall operational area was 18.68 km. in the study area. Highest operational area (9.5 km.) was observed in head reach followed by middle reach (6.18 km.) and tail reach (3 km.). Among the Water User Associations highest operational area was observed in Yashwant WUA (5.5 km.) followed by Shree Ram (4 km.), Hanuman (4 km.), Sri Datt (2.18 km.), Jagdamba (2 km.) and Shivshankar WUA (1 km.).

Cultivable command area: It was observed that overall cultivable command area was 2094.89 ha. in the study area. Highest cultivable command area was observed in middle reach (896 ha.) followed by head reach (743.89 ha.) and tail reach (455 ha.). Among the Water User Associations highest cultivable command area was observed in Yashwant WUA (524.72 ha.) followed by Sri Datt WUA (509 ha.), Hanuman WUA (387 ha.), Jagdamba WUA (291 ha.), Shree Ram WUA (219.17 ha.) and Shivshankar WUA (164 ha.).

Total irrigable area: It was observed that overall total irrigable area was 1675.91 ha. in the study area. Highest total irrigable area was observed in middle reach (716.8 ha.) followed by head reach (595.11 ha.) and tail reach (364 ha.). Among the Water User Associations highest total irrigable area was observed in Yashwant WUA (419.78 ha.) followed by Sri Datt WUA (407.2 ha.), Hanuman WUA (309.6 ha.), Jagdamba WUA (232.8 ha.), Shree Ram WUA (175.32 ha.) and Shivshankar WUA (131.2 ha.).

Water entitlement: It was observed that overall water entitlement was 2367.06 m³. in the study area. Highest water entitlement was observed in tail reach (957 m³) followed by middle reach (762.75 m³) and head reach

(647.31 m³). Among the Water User Associations highest water entitlement was observed in Jagdamba WUA (612 m³) followed by Yashwant (456.65 m³), Sri Datt (437.99 m³), Shivshankar (345 m³), Hanuman (324.76 m³) and Shree Ram WUA (190.66 m³).

Volume of water received: It was observed that overall volume of water received was 2903.95 m³ in the study area. Highest volume of water received was observed in tail reach (1206.2 m³) followed by middle reach (938.49 m³) and head reach (759.29 m³). Among the Water User Associations highest volume of water received was observed in Jagdamba WUA (733.67 m³) followed by Sri Datt (478.79 m³), Shivshankar (472.50 m³), Yashwant (471.74 m³), Hanuman (459.70 m³) and Shree Ram WUA (287.55 m³).

Initial irrigated area: It was observed that overall initial irrigated area was 1880 ha. in the study area. Highest initial irrigated area was observed in middle reach (785 ha.) followed by head reach (720 ha.) and tail reach (375 ha.). Among the Water User Associations highest initial irrigated area was observed in Yashwant WUA (510 ha.) followed by Sri Datt WUA (465 ha.), Hanuman WUA (320 ha.), Jagdamba WUA (245 ha.), Shree Ram WUA (210 ha.) and Shivshankar WUA (130 ha.).

Actual irrigated area: It was observed that overall actual irrigated area was 1777.66 ha. in the study area. Highest actual irrigated area was observed in head reach (665.5 ha.) followed by tail reach (592.5 ha.) and middle reach (519.66 ha.). Among the Water User Associations highest actual irrigated area was observed in Yashwant WUA (434 ha.) followed by Jagdamba WUA (317.5 ha.), Shivshankar WUA (275 ha.), Sri Datt WUA (274.16 ha.), Shree Ram WUA (245.5 ha.) and Hanuman WUA (231.5 ha.).

Net irrigated area: It was observed that overall net irrigated area was 1890.06 ha. in the study area. Highest net irrigated area was observed in middle reach (731.99 ha.) followed by head reach (721.17 ha.) and tail reach (437.5 ha.). Among the Water User Associations under study area, highest net irrigated area was observed in Yashwant WUA (508 ha.) followed by Hanuman WUA (370 ha.), Sri Datt WUA (361.39 ha.), Jagdamba WUA (290 ha.), Shree Ram WUA (213.17 ha.) and Shivshankar WUA (147.5 ha.).

Operational cost: It was observed that overall operational cost was Rs. 799239 in the study area. Highest operational cost (Rs. 301999) was observed in head reach followed by

tail reach (Rs. 284890) and middle reach (Rs. 212350). Among the Water User Associations under the study area, highest operational cost was observed in Yashwant WUA (Rs. 198666) followed by Jagdamba WUA (Rs. 156567), Shivshankar WUA (Rs. 128323), Sri Datt WUA (Rs. 127017), Shree Ram WUA (Rs. 103333) and Hanuman WUA (Rs. 85333).

Maintenance cost: It was observed that overall maintenance cost was Rs. 185519 in the study area. Highest maintenance cost (Rs. 66843) was observed in middle reach Water User Associations followed by head reach (Rs. 60676) and tail reach (Rs. 58000). Among the Water User Associations highest maintenance cost was observed in Yashwant WUA (Rs. 45000) followed by Sri Datt WUA (Rs. 41283), Jagdamba WUA (Rs. 35000), Hanuman WUA (Rs. 25560), Shivshankar WUA (Rs. 23000) and Shree Ram WUA (Rs. 15676).

Length of canal: It was observed that overall length of minor canal was 18.68 km. in the study area. Highest length of minor canal (9.5 km.) was observed in head reach followed by middle reach (6.18 km.) and tail reach (3 km.). Among the Water User Associations highest length of minor canal was observed in Yashwant WUA (5.5 km.) followed by Shree Ram (4 km.), Hanuman (4 km.), Sri Datt (2.18 km.), Jagdamba (2 km.) and Shivshankar WUA (1 km.).

Number of irrigation system structure: It was observed that overall number of irrigation system structure was 17 in the study area. Highest number of irrigation system structure (7) was observed in head reach followed by middle reach (7) and tail reach (3). Among the Water User Associations highest number of irrigation system structure was observed in Hanuman WUA (7) followed by Yashwant (4), Shree Ram (3) and Shivshankar WUA (3).

Table 2: Bio-physical Profile of Water User Associations (WUA's)

Sr. No.	Characteristics		Water User Associations									Overall
			Head reach			Middle reach			Tail reach			
			Yashwant WUA	Shree Ram WUA	Total	Hanuman WUA	Sri Datt WUA	Total	Shiv shankar WUA	Jagdamba WUA	Total	
1.	Establishment year		2006	2006	-	2006	1989	-	2006	2006	-	-
2.	WUA location	Reach	Head	Head	-	Middle	Middle	-	Tail	Tail	-	Middle
		Canal	Minor	Minor	-	Minor	Minor	-	Minor	Minor	-	Minor
3.	No. of village		4	3	7	2	2	4	1	1	2	13
4.	Operational area		5.5	4	9.5	4	2.18	6.18	1	2	3	18.68
5.	Cultivable command area		524.72	219.17	743.89	387	509	896	164	291	455	2094.89
6.	Total irrigable area (TIA=CCA*0.8)		419.78	175.34	595.11	309.6	407.2	716.8	131.2	232.8	364	1675.91
7.	Water entitlement		456.65	190.66	647.31	324.76	437.99	762.75	345	612	957	2367.06
8.	Water supplied to WUA		471.74	287.55	759.29	459.70	478.79	938.49	472.50	733.67	1206.2	2903.95
9.	Irrigated area at the beginning of WUA		510	210	720	320	465	785	130	245	375	1880
10.	Actual irrigated area		434	231.5	665.5	245.5	274.16	519.66	275	317.5	592.5	1777.66
11.	Net irrigated area		508	213.17	721.17	370	361.39	731.39	147.5	290	437.5	1890.06
12.	Operational cost		198666	103333	301999	85333	127017	212350	128323	156567	284890	799239
13.	Maintenance cost		45000	15676	60676	25560	41283	66843	23000	35000	58000	185519
14.	Physical system											
	Length of minor canal		5.5	4	9.5	4	2.18	6.18	1	2	3	18.68
	No. of irrigation system structure		4	3	7	7	0	7	3	0	3	17
	No. of outlet	Repaired	17	5	22	6	13	19	1	3	4	45
		Un-repaired	5	0	5	6	0	6	2	0	2	13
	Total		22	5	27	12	13	25	3	3	6	58
15.	Method of water distribution											
	Method	Tail to head	1	1	2	1	1	2	1	1	2	6
		Head to tail	0	0	0	0	0	0	0	0	0	0
	Basis	Volumetric	1	1	2	1	1	2	1	1	2	6
		Area	0	0	0	0	0	0	0	0	0	0
	Nature	Rotational	0	0	0	0	0	0	0	0	0	0
		Demand	1	1	2	1	1	2	1	1	2	6
16.	Method of water fee assessment											
	a) Volumetric		0	0	0	0	0	0	0	0	0	0
	b) Area		1	1	2	1	1	2	1	1	2	6
17.	Water User Associations, general body membership											
	Men		360	157	517	432	448	880	181	355	536	1933
	Women		125	80	205	179	138	317	77	100	177	699
	Total		485	237	722	611	586	1197	258	455	713	2632
18.	Water User Associations, management committee membership											
	Men		9	6	15	7	6	13	6	6	12	40
	Women		3	3	6	2	3	5	3	3	6	17
	Total		12	9	21	9	9	18	9	9	18	57

Number of outlets

It was observed that overall total number of outlets was 58 in the study area. Highest number of outlets (27) was observed in head reach followed by middle reach (25) and

tail reach (6). Among the Water User Associations highest number of outlets was observed in Yashwant (22) followed by Sri Datt (13), Hanuman (12), Shree Ram (5), Jagdamba (3) and Shivshankar WUA (3).

Number of repaired outlets: It was observed that overall total number of repaired outlets was 45 in the study area. Highest number of repaired outlets (22) was observed in head reach followed by middle reach (19) and tail reach (4). Among the Water User Associations highest number of outlets was observed in Yashwant (17) followed by Sri Datt (13), Hanuman (6), Shree Ram (5) and Jagdamba (3) and Shivshankar WUA (1).

Number of un-repaired outlets: It was observed that overall total number of un-repaired outlets was 13 in the study area. Highest number of un-repaired outlets (6) was observed in head reach followed by middle reach (5) and tail reach (2). Among the Water User Associations highest number of outlets was observed in Hanuman (6) followed by Yashwant (5), and Shivshankar WUA (2).

Method of water distribution: The method of water distribution was common in all Water User Associations. They were following method of water distribution tail to head, nature of water distribution rotational and area basis distribution of water. Method of fee assessment was on area basis also common in all Water User Associations.

Method of water fee assessment: The method of water fee assessment from members of Water User Associations also used similar method for assessment. In all the Water User Associations water fee assessment was based on area. It was not a good method of water fee assessment in Water User Associations because different water users used different cropping patterns. So, different crops had diverse water requirements for good growth and development.

Number of members in general body membership: It was observed that total number of members in general body membership was 2632 in the study area. Highest number of members (1197) was observed in middle reach followed by head reach (722) and tail reach (713). Among the Water User Associations highest number of members was observed in Hanuman (611) followed by Sri Datt (586), Yashwant WUA (485) Jagdamba (455), Shivshankar (258) and Shree Ram WUA (237).

Number of members in management committee: It was observed that total number of members in management committee membership was 57 in the study area. Highest number of members (21) was observed in head reach followed by middle reach (18) and tail reach (18). Among the Water User Associations highest number of members was observed in Yashwant WUA (12) followed by Shree Ram (9), Hanuman (9), Sri Datt (9), Jagdamba (9) and Shivshankar WUA (9).

Conclusion

It was concluded that highest operational cost was observed in head reach. Among the Water User Associations highest operational cost is observed in Yashwant WUA. Highest maintenance cost was observed in middle reach. Among the Water User Associations highest maintenance cost is observed in Yashwant WUA. Highest irrigation fee collected was observed in head reach. Among the Water User Associations highest irrigation fee collected is

observed in Yashwant WUA. Highest irrigation fee assessed was observed in head reach. Among the Water User Associations highest irrigation fee assessed is observed in Yashwant WUA. Highest cultivable command area was observed in middle reach. Among the Water User Associations highest cultivable command area is observed in Yashwant WUA. Highest total irrigable area was observed in middle reach. Among the Water User Associations highest total irrigable area is observed in Yashwant WUA. Highest initial irrigated area was observed in middle reach. Among the Water User Associations highest initial irrigated area is observed in Yashwant WUA. Highest actual irrigated area was observed in head reach. Among the Water User Associations highest actual irrigated area is observed in Yashwant WUA. Highest net irrigated area was observed in middle reach. Among the Water User Associations highest net irrigated area is observed in Yashwant WUA. Highest water entitlement was observed in tail reach. Among the Water User Associations highest water entitlement is observed in Jagdamba WUA. Highest volume of water received was observed tail reach. Among the Water User Associations highest volume of water received is observed in Jagdamba WUA.

Future Scope

The study can help future researchers and scholars to get an overview of different terminologies in the study of the Water User Associations and how it helps to assess the performance of Water User Associations in various context.

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