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Performance of Groundwater Irrigation System as Perceived by Farmers in West Bengal

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ABSTRACT

In spite of being the most fundamental stakeholder, farmers often receive least attention for assessment of irrigation performance. Present study assessed the performance of groundwater irrigation systems being managed by water user associations (WUAs) in Burdwan (East) district of West Bengal from the perspectives of farmers during the year 2019. A random sample of 120 famers under four groundwater irrigation systems perceived that most of the parameters of irrigation performance in term of irrigation service utility at a higher level with mean perception score ≥4.0 except for the certainty of water delivery (2.67) leading to overall mean perception score 4.12 in kharif season. Farmers perceived similarly in rabi season with overall mean perception score 4.15; however, the overall perception of farmers regarding irrigation in summer season was relatively low (3.78). Overall irrigation performances under the jurisdiction of WUAs was perceived very good by all the farmers for all three seasons with index values more than 93 per cent. The farmers' participation in irrigation management has helped in better water management that advocates for promoting participatory irrigation management through WUAs in all the minor irrigation systems to overcome low irrigation efficiency and other management constraints being faced in irrigated areas.

INTRODUCTION

Irrigation has played a crucial role to bring green revolution and self-sufficiency in food production in India (Chambers, 1988). The large production gains were a result of agricultural intensification in which irrigation played a critical role (Madramootoo & Fyles, 2010). With the rapidly growing population and expanding agriculture, water resources for agricultural purposes are becoming scarcer in most parts of India. Therefore, the importance of groundwater development is increasing rapidly on account of inherent weaknesses (maintenance and operational inefficiencies) in the canal (surface water) irrigation system (Ghosh et al., 2019). Even though the irrigation has made profound impacts on agrarian dynamism, the same has yet to be visible in eastern India, where it is needed having abundant water resources to sustain intensive irrigation. Performance of irrigation and agriculture has been better in Northern region of India, while eastern region has been lagging behind in spite of rich water resources and average annual rainfall of more than 1000 mm (Srivastava et al., 2014).

In spite of being the most fundamental stakeholder, the farmers often receive the least attention for assessment of performance of water delivery system. A set of criteria for constraints and performance evaluation of irrigation system needs to be considered from farmers' point of view (Chambers, 1998). The bottleneck for good performance of any irrigation scheme is often found in the water delivery system. In most of the cases evaluation of performance of irrigation water delivery system is done on the basis quantitative (flow data) at various levels and points of the irrigation

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system. It is important to consider irrigation as a service provided to farmers (Naik et al., 2019).

Of the eastern Indian states, West Bengal has a relatively better irrigation situation (Ghosh et al., 2017). West Bengal is endowed with 7.5 per cent of the water resources of the country and is relatively rich in water resources among the eastern Indian states. Rainfall is the main source of water in West Bengal with an annual average of about 1700 mm. Out of this 76 per cent falls in four months during the monsoon and the rest in the non-monsoon period. During the 12th Five-Year Plan (2012–2017), an initiative has been taken up by the government of West Bengal to include the concept of participatory irrigation management (PIM) through implementation of the West Bengal Accelerated Development of Minor Irrigation Project, leading to a formation of around additional 848 WUAs covering 25,499 ha command area and 50,265 beneûciaries by the end of July 2015 with the aim of improving the irrigation and agricultural scenario in the minor irrigation commands of the state. On this backdrop, present study was undertaken to evaluate the performance of groundwater irrigation systems being managed by WUAs from the perspectives of farmers.

METHODOLOGY

The study was conducted in randomly selected Burdwan district of West Bengal. Out of 23 blocks in Burdwan (East) district, two blocks i.e., Ausgram I and Ausgram II were randomly selected, where from four groundwater irrigation systems, two each from each block were selected. Random samples of 30 farmers represented from each groundwater lift irrigation command areas were chosen. Thus, overall, 120 farmers were selected as respondents in present study.

The irrigation service utility was measured based on 10 dimensions, viz., sufficiency of water, duration of supply of irrigation water, condition of point of delivery of water, frequency of water supply, certainty of delivery of water, stream size of water, timeliness of water supply, equity of water supply, functioning of irrigation system below the outlet level, and irrigation performance under the jurisdiction of WUA. Farmers' responses on each of the above-mentioned dimensions were taken on a 5-point continuum scale (very poor: 1, poor: 2, average: 3, good: 4 and very good: 5) with the help of a structured interview schedule. Thereafter, mean scores of the 10 dimensions were calculated to derive overall perception of each farmer on irrigation service utility followed by mean of all sampled farmers to arrive at overall irrigation service utility scores separately for kharif, rabi and summer seasons. The irrigation service utility in terms of afore-said dimensions were further reduced to three categories, viz., tractability, convenience and predictability. Tractability refers to the ease with which farmers can control and satisfactorily apply water to their land. It was measured by quantity of water supply/ adequacy/ sufficiency (no. of irrigations requested and those actually received), point of water delivery (distance of field from the outlet), stream size, and control mechanism to regulate the flow in outlet. Convenience refers to the timing of water delivery as preferred by farmers to enable them to plan their activities. It was determined through timeliness of irrigation (no. of irrigations requested and those received on time), duration of water supply, and frequency of getting water (interval between two irrigations). Predictability relates to the farmer's degree of confidence with respect to water supply service, or how much information is available to farmers about the water delivery schedule and the degree of uncertainty associated with this information. Predictability was measured on the basis of certainty of water availability, equity of water supply, and irrigation performance under aegis of WUA (having knowledge of water supply roster/ advance water supply roster, management decisions/ farming operations influenced by water supply). Index values of each dimension were calculated as ratio of farmers' mean perception score (1 to 5) and maximum possible score expressed in percentage.

RESULTS AND DISCUSSION

Groundwater lift irrigation service utility from the farmers' perspectives was assessed for all three seasons, viz., kharif, rabi and summer, respectively. Evidently from Table 1, farmers in groundwater irrigation command area perceived most of the parameters highly favourable with mean perception score ≥4.0 except the certainty of water delivery (2.67) leading to overall mean perception score 4.12 in the kharif season. Farmers perceived most of the parameters similarly for rabi season resulted to overall mean perception score 4.15. However, the overall perception of farmers regarding groundwater irrigation service in summer was relatively

Table 1. Irrigation performance as perceived by the farmers in groundwater irrigation command area

S.No.	Particulars	Kharif Mean (SD)	Rabi Mean (SD)	Summer Mean (SD)
1.	Sufficiency of water	4.08 (0.60)	4.02 (0.52)	3.43 (0.57)
2.	Duration of supply of irrigation water	4.08 (0.56)	3.96 (0.49)	3.44 (0.57)
3.	Condition of point of water delivery	4.04 (0.52)	3.97 (0.45)	3.44 (0.55)
4.	Frequency of water supply	4.09 (0.37)	4.98 (0.16)	4.98 (0.16)
5.	Certainty of delivery of water	2.67 (1.06)	2.48 (0.84)	2.81 (0.61)
6.	Stream size of water	4.00 (0.53)	3.93 (0.50)	3.43 (0.61)
7.	Timeliness of water supply	4.80 (0.46)	4.78 (0.47)	4.11 (0.71)
8.	Equity of water supply	4.54 (0.52)	4.53 (0.52)	4.01 (0.58)
9.	Functioning of irrigation system below outlet level	4.08 (0.50)	4.02 (0.43)	3.48 (0.57)
10.	Irrigation performance under jurisdiction of WUA	4.82 (0.39)	4.81 (0.40)	4.67 (0.50)
	Overall Performance	4.12 (0.37)	4.15 (0.30)	3.78 (0.34)
	Irrigation Performance Index	82.42%	82.92%	75.63%

low (3.78) as five parameters like sufficiency of water, duration of water supply, condition of point of water delivery, stream size of water and functioning of irrigation system below the outlet level were perceived relatively low with mean perception score less than 3.50. The perception of the farmers on certainty of water supply was poor with mean score of 2.81. This parameter was perceived poorly by most of the farmers in all three seasons. Therefore, overall groundwater irrigation was found best in rabi season followed by kharif and summer season with irrigation performance index value of about 83, 82 and 76 per cent, respectively.

It is noted from Figure 1 that tractability in terms of sufficiency of water, point of water delivery, stream size and functioning of irrigation below the outlet was perceived better (>80%) in kharif season followed by rabi and summer season. Water was perceived sufficient by farmers both in kharif and rabi season (index value 81.67% and 80.33%). Rice was a predominant and main crop in kharif season, while potato and mustard were major crops in rabi season. Water was more needed for rice crop rather than other crops. That's why farmers under WUA could easily cultivate rice crop due to sufficient amount of water in kharif season. However, in kharif season, rainwater used to take a vital role in rice cultivation apart from irrigation water. Contrastingly, potato and mustard crops were grown with groundwater irrigation only. In summer season, water was not sufficient (index value 68.64%) in comparison to that in kharif and rabi season; however, it was sufficient for 67.5 per cent farmers to grow *boro* rice in selected groundwater irrigation command areas. The condition of point of delivery in command area was perceived very good in kharif season (index 80.83%) and rabi season (index 79.33%); however, it was relatively low in summer season (index 68.89%). It is revealed that stream size of water in groundwater irrigated area was very much sufficient in kharif season (index 80%) followed by rabi season (index 78.67%). But in summer season stream size of water was perceived relatively less (index 68.64%) in groundwater irrigation as perceived by the farmers cultivating in the command areas. Irrigation system below the output level in irrigated area was perceived favourably in kharif (index 81.67%) and rabi season (index 80.33%) but in summer season index value of 69.63 per cent indicated lower perception of the farmers regarding functioning of groundwater irrigation system below the outlet level.

Contrasting to the tractability, overall convenience of water supply is better in rabi season followed by kharif and summer season (Figure 2). Farmers used to get water at the time of need for irrigating the crops both in kharif (index 96%) and rabi (index 95.67%) season. But in summer season timeliness of water supply (index 82.22%) was relatively lowly perceived by the farmers as compared to kharif and rabi season due to problem of irregular electric supply. It is observed that duration of water supply in groundwater command area was perceived much better in kharif season (index 81.67%) followed by rabi season (index 79.17%). But in summer season duration of water supply (index 69.89%) was relatively low due to electricity problem of these areas as revealed by the farmers during interview. Frequency of water supply in groundwater command area was perceived high in summer season (index 99.51%) and rabi season (index 99.50%). But in kharif season frequency was relatively less that may be attributed to the fact of

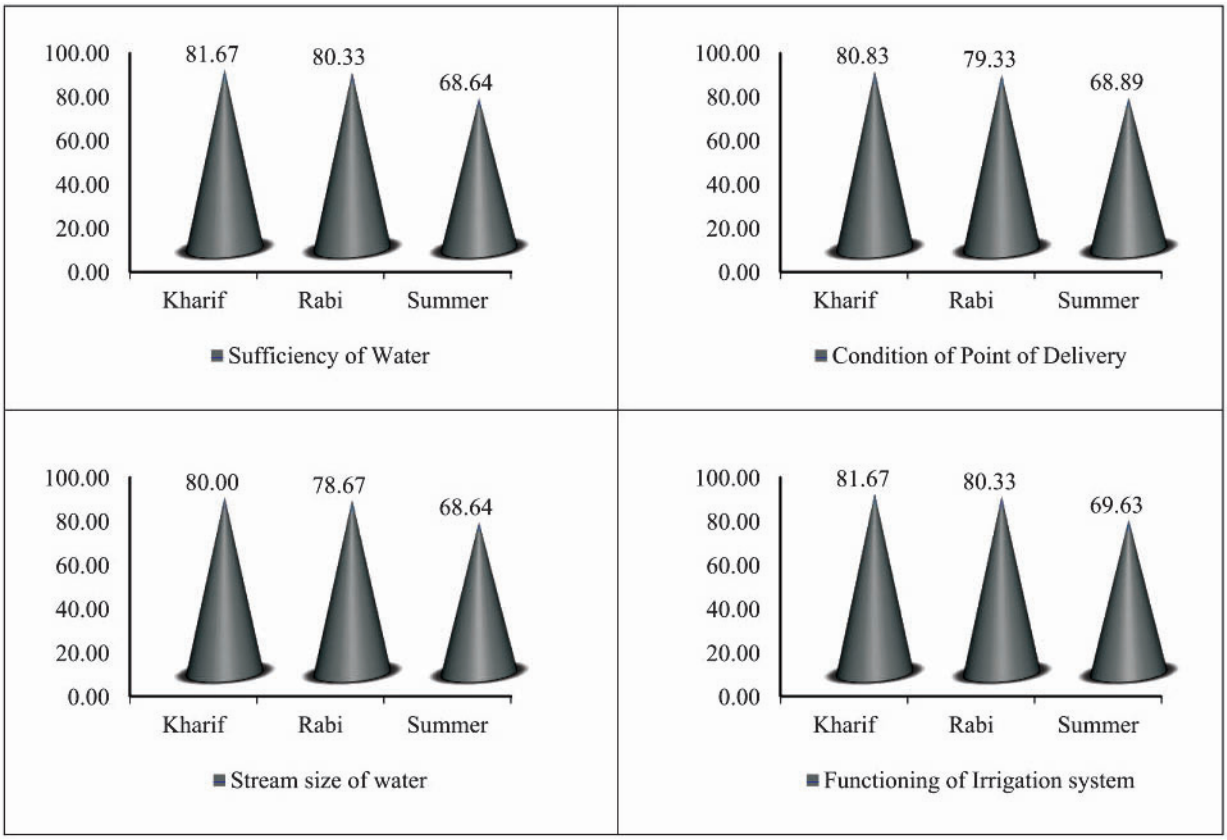

Figure 1. Tractability of water supply as perceived by farmers in groundwater irrigated area

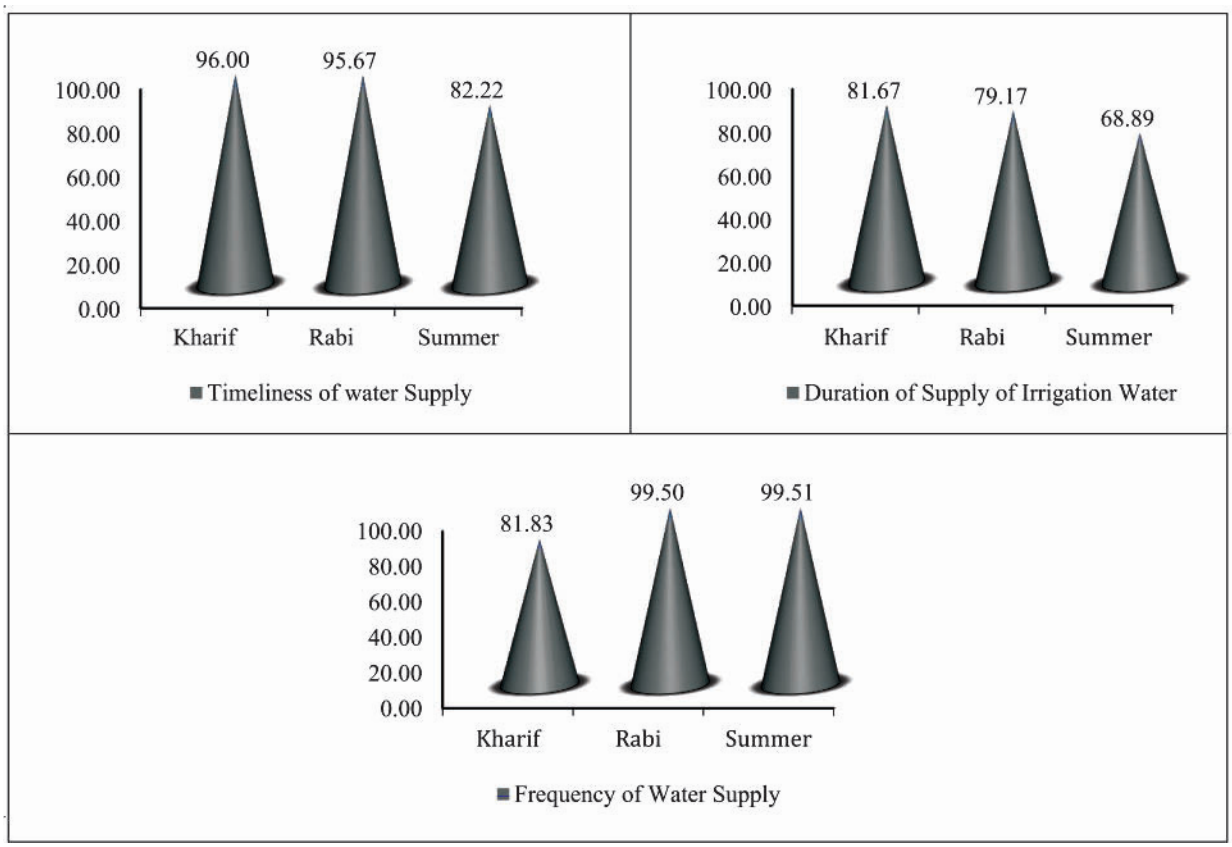

Figure 2. Convenience of water supply as perceived by farmers in groundwater irrigated area

occurrence of rainfall that used to help cultivating the crops. Therefore, interval between two irrigations might be lengthened.

The predictability and prior knowledge of irrigation schedules helped farmers to undertake timely crop management decisions. Figure 3 depicts farmers' perception on predictability of irrigation system. Certainty of water delivery in groundwater command area was perceived by the farmers highly in summer season (56.30%) followed by kharif (53.33%) and rabi (49.50%) season at critical growth stage of the crops. Among all the parameters being perceived by the farmers, the certainty of water delivery was judged lowly that need to be addressed by the WUAs managing irrigation system to make the irrigation service further effective. It is observed that all the farmers used to get the same quantity of water from the groundwater irrigation source in kharif (index 90.83%) and rabi (index 90.50%) season to irrigate a particular crop during the irrigation period. But in summer season, the index value with respect to equity in water supply was decreased (80.25%). Irrigation performance under the jurisdiction of WUA was perceived very good by all the farmers for all three seasons with index values more than 93 per cent. Farmers perceived this parameter favourably as they used to have knowledge of water supply roster/ advance water supply roster, enabling them to take management decisions/ farming operations influenced by water supply.

Present study emphasized the performance of groundwater irrigation system transferred to WUAs under PIM programme. Groundwater irrigation is often reported to be preferred by the farmers as compared to surface (canal) irrigation in terms of irrigation efficiency (Ali et al., 2018). Narayanamoorthy (2011) mentioned that due to insufficient supply of canal water, the dependence of farmers on groundwater for irrigating the crops had increased many folds during the last decade; groundwater irrigation command showed better poverty reduction as compared to canal irrigation. Cheap and un-metered electricity, slow development of surface irrigation, and poor management of canal systems further encouraged groundwater irrigation (Ali et al., 2017; Shah et al., 2009). Over the last two decades, 84 per cent of the total addition to net irrigated area came from groundwater, and only 16 percent from canals. Fourth Minor Irrigation Census (2006-07) indicated that about a quarter of the total groundwater extraction devices (GEDs) have become nonfunctional over a period of time that has led to poor utilization of irrigation potential. Moreover, many of the non-functional GEDs have not been working because of mainly less discharge rate and mechanical breakdown. Poor infrastructure and unfavourable geological conditions are reasons for poor groundwater irrigation condition in eastern Indian states (Srivastava et al., 2014) that prompted implementation of PIM through WUAs. Ghosh et al., (2005) assessed the utility of irrigation water supply in a major canal irrigation in Khurda district of Odisha, which revealed that farmers' level of satisfaction with the factors in an increasing order was predictability, convenience and tractability. The most important factor is found to be predictability followed by tractability and convenience. Mishra et al., (2011) reported that farmers perceived adequacy of irrigation water and overall performance of minor irrigation system relatively better. Ghosh et al., (2016) in their study

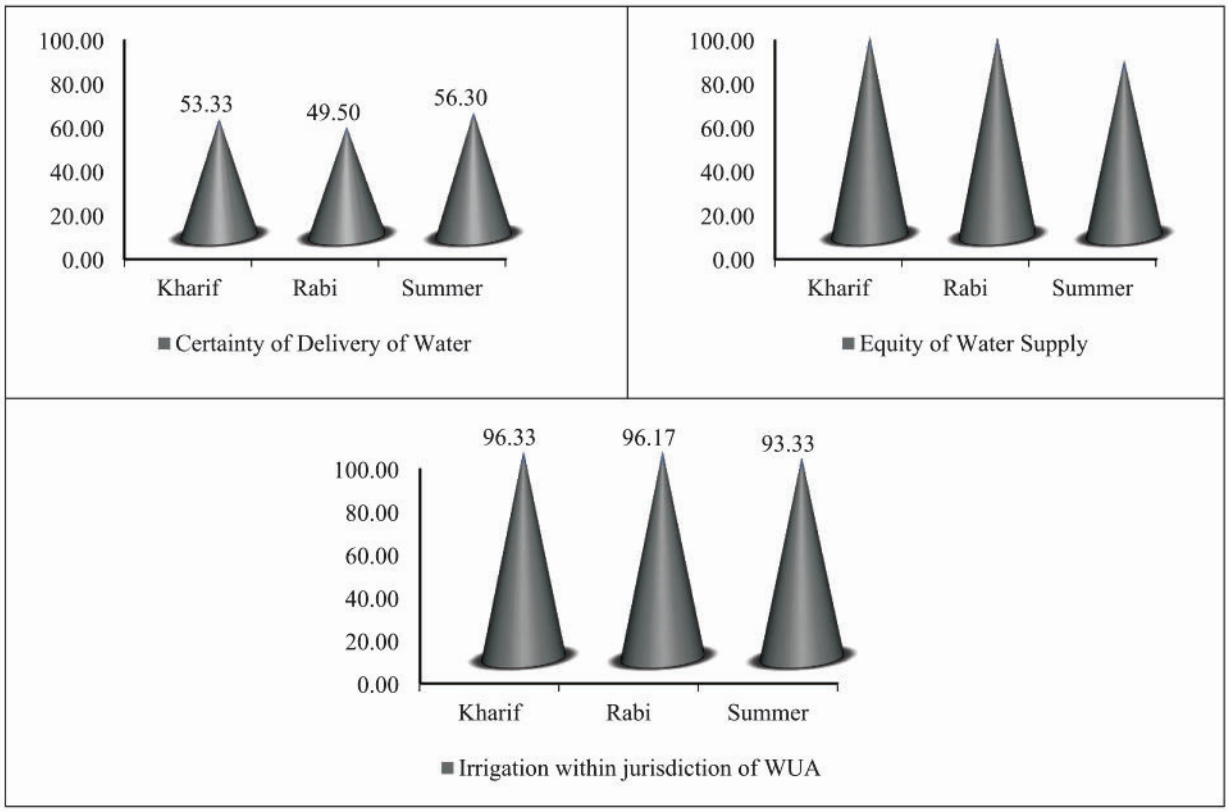

Figure 3. Predictability of water supply as perceived by farmers in groundwater irrigated area

on assessment of PIM in Kuanria Medium Irrigation Project in Nayagarh district of Odisha reported that the irrigation performance found better in kharif season as compared to rabi season in most of the WUA's jurisdiction areas, which is contrasting to the findings of present study. Groundwater irrigation is mostly prevailing in Indo-Gangetic plains, where rice-wheat cropping system is dominant and major user of irrigation raising the concern of sustainability and food security (Gautam et al., 2021; Kaur & Sharma, 2022), thus needed due attention for efficient use of groundwater through proper crop planning and irrigation management under aegis of WUAs. Findings of present study have unraveled the importance of groundwater irrigation as productive irrigation during rabi and summer season besides protective irrigation in kharif season.

CONCLUSION

Farmers in groundwater irrigation command area perceived most of the parameters of irrigation performance in term of irrigation service utility favourably except the certainty of water delivery leading to overall perceived irrigation service utility very good in both kharif and rabi season. Farmers perceived groundwater irrigation service in summer relatively low but better than average. Overall irrigation performances under the jurisdiction of WUA is perceived very good by all the farmers for all three seasons that warrants speedy implementation of PIM through WUAs in all minor irrigation projects to alleviate the often-reported constraints of irrigation inefficiency and management of irrigation infrastructure. Pluralistic extension approach involving WUAs, irrigation department and state department of agriculture would improve the agricultural scenario through improved irrigation performance.

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