Constraints in On-Farm Water Management

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ABSTRACT

The study was conducted in canal operated area of Patna and tubewell operated area of Vaishali District of Bihar to find the constraints of water management in crop production. Total 120 and 100 farmers were selected from canal and tubewell area respectively. Twelve constraints of water management were identified for the study. Based on total score obtained ranking of each constraint was done to know the severity of the constraint. Kendall's coefficient of concordance was used to study the degree of association among three (head, middle and tail reaches of canal command) or more sets of rankings. Spearman's rank correlation coefficient (r) was used to measure correlation between two sets of ranks. In tubewell command area, 65 per cent people have own functional tubewells, whereas only 43 per cent people in canal command owned functional tubewells out of that 57.7 per cent tubewells are in tail reaches of canal. The study revealed that costly irrigation, uneven plots, lack of irrigation implements are major water management constraints in tubewell commands; whereas uneven bunds, scattered plots, problems due to neighboring plots are top three water management constraints in canal commands.

Key words : *Constraints; Water management; Canal; Tubewell.*

Water resources occupy an important place among other natural resources as it is the basis of life of human beings and all other life forms on this planet. The National Water Policy of India adopted in 1987 recognizes that water is a scarce and precious national resource to be planned, developed and conserved as such and on an integrated and environmentally sound basis. India has made considerable progress in increasing the production of agricultural commodity but the sustainability of agricultural development food, security and poverty reduction strategies are being questioned due to an impending water crisis. Agricultural sector accounts for more than 80 per cent of total water used in India. However, only around 40 per cent of the net sown area is reportedly endowed with water for irrigation. Moreover, with the growing population, per capita availability of water is continuously going down and is likely to go below the scarcity level within few decades. Most of the farmers, especially in canal command have been found applying more irrigation water than the optimum level due to lack of adequate knowledge and under the impression that water alone can replace the requirement of other critical inputs. On the other hand, due to lack of clear-cut policy directions, large and resourceful farmers are installing higher capacity tube-wells and extracting more water than their requirements to cultivate water-exhaustive crops like sugarcane, which are more remunerative. But, it is leading to the failure of shallow tubewells of resource-poor farmers (Srivastava et al, 2009).

Water is a scarce resource, but most crucial to crop production. Irrigation water can be sourced through rainfall, canal and ground water. Rainfall is unpredictable and sometimes also erratic. Every patch of agricultural land is not blessed with canal water. Even certainty of getting canal water is sometimes questionable in the event of scanty rainfall. Under such circumstances, the ground water is only assured source of irrigation which should be conjunctively utilized to save crops and increase productivity. But obtaining ground water in adequate quantity is not that easy. It needs some investment and many resource poor farmers are simply unable to invest in ground water extraction device i.e. pumpset. They have to purchase water from ground water seller to save their crops. Fragmented land holding also discourage farmers to own tubewll in every plot. Improper water management leads to over utilization of water, scarcity of water for others, proneness to pest infestation and yield reduction and sometime causes social conflict. In spite of several efforts, like command area development programmes, drought prone area programme, watershed development programme, Participatory Irrigation Management (PIM), extension efforts of the concerned departments, due to one or more reasons and sometime subsidized rates of energy and irrigation water, water is not properly utilized for agricultural production. These facts call for re-investigating water management constraints afresh and hence the study was conducted to find the constraints of water management in both tubewell and canal operated area.

METHODOLOGY

Study was conducted in canal operated area of Patna and tubewell operated area of Vaishali District of Bihar. In canal command, 20 farmers each from head, middle and tail reach of Adampur and RPC-V distributary of Patna main canal were selected for the study. Thus, total 120 farmers were selected for the

study in canal command. In Vaishali district, 50 farmers each from Vaishali and Jandaha blocks who were using tubewell for irrigation were selected randomly. Thus, total of 100 farmers were selected for study in tubewell command. Data were collected from selected farmers with the help of interview schedules developed for the purpose. Focus group discussions were undertaken in canal as well as in tubewell command and interactions were made with farmers, water resource department officials and other stakeholders in order to get first hand information. This helped in identification of different constraints related to water management and finalization of interview schedule for the study. Accordingly, 12 constraints to water management were identified for the study. To know the severity of those identified constraints, responses were administered on three point continuum namely "Strongly agree" "Agree" and "Disagree" with score of 2, 1 and 0 respectively. Similarly, frequency of contact of the information sources was divided into three continuums namely "Always" "Sometimes" and "Never" with corresponding score of 2, 1 and 0 respectively. Based on total score obtained ranking of each item was done. If two or more values happen to be equal, then the average of the ranks which should have been assigned to such values had they been all different, was taken and the same rank (equal to the said average) was given to concerning values. Kendall's coefficient of concordance (W) was used to study the degree of association among three (head, middle and tail reaches of canal command) or more sets of rankings. Spearman's rank correlation coefficient (r) was used to measure correlation between two sets of ranks.

$$W = \frac{S}{\frac{1}{12}K^2(N^3-N)}$$; where k = no. of sets of ranking; N = no. of constraints ranked

$$S = (R_i - R_j)^2$$

$$\text{Spearman's } r = 1 - \left\{\frac{6\ d_i^2}{n(n^2-1)}\right.$$; where n = no. of paired observation

d = difference between ranks for each pair of observations

RESULTS AND DISCUSSION

1. Socio-economic profile of the respondents :

Majority of respondents live in joint family, literate, middle aged and have small and marginal holdings. Small and marginal farmers constitute 81% and 75% of the sample size in tubewell and canal area respectively (Table 1). In tubewell area, 22% and 10% farmers have leased-in and leased-out of land respectively. In canal command, percentage of leased-in land and leased-out of land are 14.2 and 11.8 respectively. Every farmer has cattle or buffalo in canal command, whereas eighty four per cent farmers have cattle or buffalo in tubewell area. Thirty four per cent respondents have taken training in agricultural fields and 13% have undergone more than one training. In tubewell command area, 65% people have own functional tubewell, whereas only 43% people in canal command owned functional tubewell; out of that 57.7% tubewells are in tail reaches of both distributaries (RPC- V and Adampur distributary).

Table 1
Socio-personal characteristics of the farmers

Socio-Personal characteristics		Canal command (%) N=120	Tube well (%) (N=100)
Age (Years)	30-40	02.50	21.00
	41-50	14.16	21.00
	51 60	57.50	28.00
	61 70	24.16	21.00
	>70	01.67	09.00
Educational status	Post-graduate	00.80	01.00
	Graduate	12.50	09.00
	Intermediate (10 + 2)	31.70	10.00
	Matriculation (10)	35.00	27.00
	Primary	14.20	24.00
	Adult literacy	03.30	19.00
	Illiterate	02.50	10.00
Family type	Nuclear	23.00	42.00
	Joint	77.00	58.00

Table Cont.

Land holding size (Acre)	0-2.5	12.50	41.00
	2.6-5.0	62.50	40.00
	5.1-10	23.30	17.00
	>10	01.60	02.00
Training under-taken	No training	89.20	66.00
	More than one Training	03.30	13.00
	1 - day training	06.60	26.00
	3-6 days	02.50	00.00
	7 - days training	00.00	12.00
	> 7days	00.00	09.00
Leased in land (Acre)	No	85.80	78.00
	<1	04.20	10.00
	1-2	09.10	09.00
	>2	00.80	03.00
Leased out land (Acre)	No	88.20	90.00
	<1	01.60	02.00
	1-2	06.00	05.00
	>2	04.20	03.00
Own tubewell	Own tubewell	43.00	65.00

1. Information sources : Total 14 information sources related to agricultural activities were identified and respondents were asked to tell its frequency of contact to get desired information. Based on the total score of each information source ranking was done separately for canal and tubewell command area. It is evident from the Table 2 that neighbourers / friends and radio are two most preferred source's of agricultural information for the farmers of canal and tubewell areas. Newspaper and mobile / telephone are third

Table 2
Sources of agricultural information in canal and tubewell command and its ranking

Sr.no.	Information sources	Score (ranking) of information sources in canal command	Score (ranking) of information sources in tubewell command	Rank difference	Spearman's rank correlation
1	Newspaper	168 (3)	102 (4)	1	0.704396*
2	Television	107 (6)	91 (6.5)	0.5	
3	Radio	200 (2)	114 (2)	0	
4	Magazine	80 (8)	60 (9)	1	
5	Farmers' Fair	104 (7)	70 (8)	1	
6	Farmer's Club	9 (13)	19 (13)	0	
7	Demonstration	27 (12)	35 (12)	0	
8	Neighbourer/progressive farmers / friends	201 (1)	160 (1)	0	
9	Input dealers	124 (5)	91 (6.5)	1.5	
10	Mobile/telephone	33 (11)	109 (3)	8	
11	Internet	01 (14)	4 (14)	0	
12	Agril Institutes	77 (9)	97 (5)	4	
13	Govt. Departments	145 (4)	43 (11)	7	
14	NGO	52 (10)	48 (10)	0	

** Significant at 1 per cent level, Figures in parentheses indicate ranking*

most preferred sources of information for farmers of canal and tubewell area respectively. Spearman's rank correlation of information sources between people of canal and tubewell area was significant that indicates that preferential source of information for people of canal and tubewell area are almost similar.

1. Constraints in water management : Uneven bund, problem due to neighboring plots and scattered plots are top three constraints of head and middle reaches of canal command. In tail reach of canal command, scattered plots, non availability of water on time and required quantity, and problem due to neighboring plots are major constraints to water management (Table 3). It is also evident from Table 3 that Kendall's Coefficient of Concordance of different constraints identified by the farmers of head, middle and tail reaches of canal command is significant, which means that the state of opinion of farmers of head, middle and tail reaches regarding constraints are almost the same. Hence in canal command area almost similar water management strategies will confiscate identified constraints in different reaches of the canal but strategies for timeliness of water supply should be evolved in tail reach of the canal command to overcome the major water management constraint in the tail reach.

The study also revealed that costly irrigation, uneven plots, lack of irrigation implements are top three major water management constraints in tubewell commands whereas uneven bunds, scattered plots, problems due to neighboring plots are top three major water management constraints in canal commands (Table 4). Spearman's rank correlation of identified constraints by people of canal and tubewell area was non-significant that indicates that severity of the constraints faced by the people of tubewell and canal command are different and hence different water management strategies should be adopted for canal and tuewell command areas.

Water application methods in crops : Table 5 revealed that farmers apply irrigation water either through field-to-field or through field channel or through portable pipes or in combination with any of the three. The study further discovered that majority of farmers apply field–to-field irrigation in rice as well as in wheat in canal command. Because cost of irrigation in canal command is based on the area and not on the basis of volumetric use, farmers practice flooding method to irrigate their crops and irrigation water pass through one field to another and sometime irrigation is

Table 3

Relationship with rank position of different constraints of water management in different reaches of canal command

Sr. No.	Constraints	Severity of constraints and ranking					
		Score (Ranking) in head reach (N=40)	Score (Ranking) in middle reach (N=40)	Score (Ranking) in tail reach (N=40)	Sum of Ranks(R_j)	$(R_s - R_j)^2$	Kendall's Coefficient of Concordance (W)
1	Costly irrigation	4 (12)	03 (12)	07 (12)	36	272.25	
2	Uneven plots	28 (11)	29 (11)	19 (11)	33	182.25	
3	Lack of irrigation implements	43(6)	46 (6.5)	38 (7)	19.5	0	
4	Remote sources of irrigation	45 (4)	49 (5)	34 (9)	18	2.25	
5	Scattered plot	60 (3)	61 (2.5)	63 (1)	6.5	169	
6	Smaller field size	32 (10)	42 (8)	32 (10)	28	72.25	
7	Non availability of water on time	39 (9)	50 (4)	61 (2)	15	20.25	$W = 0.8014^{*}$
8	Problem due to neighboring plots	63 (2)	61 (2.5)	60 (3.5)	8	132.25	
9	Nonavailablility of water in required quantity	41 (8)	46 (6.5)	60 (3.5)	18	2.25	
10	Lack of knowledge about method of irrigation	43 (6)	36 (10)	36 (8)	24	20.25	
11	Uneven bund	70 (1)	63 (1)	58 (5)	7	156.25	
12	Lack of knowledge about when and in which stage to irrigate	43(6)	40 (9)	40 (6)	21	2.25	
					$(R_j - R_j)^2$	1031.5	

** Significant at 1 per cent level, Figure in parentheses indicate ranking*

Table 4
Severity of constraints in canal and tubewell command

Sr. No.	Constraints	Severity of constraints & ranking		
		Score (Ranking) in Canal Command (N=120)	Score (Ranking) in T Command (N=100)	Difference between ranks (d
1	Costly irrigation	14 (12)	175 (1)	11
2	Uneven plots	76 (11)	169 (2)	9
3	Lack of irrigation implements	127 (7)	153 (3)	4
4	Remote sources of irrigation	128 (6)	150 (4)	2
5	Scattered plot	188 (2)	141 (5)	3
6	Smaller field size	106 (10)	129 (6.5)	3.5
7	Non availability of water on time	150 (4)	129 (6.5)	2.5
8	Problem due to neighbouring plot	184 (3)	122 (8)	5
9	Non availability of water in required quantity	147 (5)	121 (9)	4
10	Lack of kaowledge about method of irrigation	115 (9)	108 (10)	1
11	Uneven bund	191 (1)	66 (11)	10
12	Lack of kaowledge about when and in which stage to irrigate	123 (8)	59 (12)	4

Figures in parentheses indicate ranking

also automatically given in one's plot even if it is not desired. Wasteful use of canal water has created the problems of water logging in head and middle reaches of canal command areas, whereas tail end farmers continue to suffer due to lack of access to this water. The situation is further aggravated by low irrigation system efficiency (NAAS, 2005). Irrigation through tubewell is very costly and it is number one constraint (Table 4) in tubewell command and hence majority of farmers use portable pipes to irrigate wheat and rice crops to save water and energy. In absence of water for irrigation in canal command, for life saving irrigation few farmers use pumps and portable pipes to irrigate their crops. Some farmers also use field channels in tubewell as well as in canal command to irrigate their crops (Table 5).

CONCLUSION

Water is very crucial to crop production, in spite of several efforts due to one or more reasons and sometime subsidized rates of energy and irrigation water. it is not properly utilized for agricultural production. Hence prudent use of available water, therefore, is crucial for sustenance of life. The study revealed that costly irrigation, uneven plots, lack of irrigation implements are major water management constraints in tubewell commands whereas uneven bunds, scattered plots, problems due to neighboring plots are top three major water management constraints in canal commands. In tubewell command, use of water saving technologies, like use of pressurized irrigation methods, growing community nursery, use of fuel efficient pumps, establishment of community wells etc can reduce severity of constraints to some extent. Study

Table 5
Water application methods in canal and tubewell command

Sr. No.	Method of water application in crops	Distribution of farmers in Canal Command (N=120)		Distribution of farmers in Tubewell Command (N=100)	
		Rice	Wheat	Rice	Wheat
1	Field - to -field	47 (39.16)	46 (38.33)	1	2
2	Field channel	05 (04.16)	10 (08.33)	7	10
3	Use of portable pipe	03 (02.50)	17 (14.16)	79	86
4	Field –to –field and field channels	41 (34.16)	24 (20.00)	-	-
5	Field –to –field and portable Pipe	17 (14.16)	17(14.16)		
6	Portable Pipe and field channel	01 (00.88)	01 (00.88)	10	2
7	All the three methods (1,2 and 3)	01 (00.88)	-	-	-
8	Others methods	02 (01.66)	01(00.88)	-	-
9	No response	02 (01.66)	04 (03.33)	3	0

Figures in parentheses indicate percentage

revealed that uneven bunds at farmers' fields is the first ranked is the most serious problem for on- farm water management in the canal command area. The problem of narrow, small bund and uneven bunds occurs mainly due to small size of the plots, objections by neighboring plot owners and involvement of human labour in the construction of bunds. Are also important. These problems can be solved by creating large scale awareness about participatory on-farm water management, along with initiatives by the government agencies and suitable incentives at initial stage through Command Area Development programmes (CAD). Neighbourers/friends, radio, newspaper and mobile/telephone are preferred sources of information by farmers of canal and tubewell area. Hence, these information sources should be effectively used in forming policies for on-farm water management.

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REFERENCES

1. Ministry of Water Resources, Govt. of India, ***National Water Policy, 1987***
2. NAAS (2005). Emerging issues in water management-The question of ownership. ***Policy Paper No. 32***, National Academy of Agricultural Sciences, New Delhi
3. Srivastava, S.K., Kumar, Ranjit, Singh, R.P. (2009). Extent of ground water extraction and irrigation efficiency on farms under different water market regimes in central Uttar Pradesh, ***Agricultural Economics Research Review, 22(1) :*** 87-97