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QUINTESSENTIAL PARADIGM OF PARTICIPATORY IRRIGATION MANAGEMENT IN GUJARAT

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ABSTRACT

Participatory irrigation management refers to the involvement of farmers (water users) in the different aspects of irrigation management such as planning, designing, construction and supervision, policy and decision making, operation and maintenance, and evaluation of irrigation system. The study aims to examine the differential impact of participatory irrigation management on the farmers of North Saurashtra of Gujarat. The major findings of the study revealed that, there was an average 17.04 per cent increased in irrigated area after formation of water users' cooperative society over the period of 2009 to 2014. The average gross return of the wheat crop was Rs. 31200 and Rs.21001 in case of farmers from functional and non-functional water users' cooperative society, respectively.

KEYWORDS: Participatory irrigation management, Resource use efficiency, Water uses' cooperative society

INTRODUCTION

"Anyone who solves the problem of water deserves not one Nobel Prize, but two - one for science and the other for peace." - John F. Kennedy. Water is an important natural resource available for mankind. Participatory Irrigation Management (PIM) has assumed great importance in India in the last decades, due to the growing difficulties faced in water resources management, and the realization that stakeholder involvement and participatory management lead to substantial improvement. Participatory irrigation management refers to the involvement of farmers (water user) in the different aspects of irrigation management such as planning, designing, construction and supervision, policy and decision making, operation and maintenance and evaluation of irrigation system. Setting up of organizations is accorded a significant attention in the participatory irrigation management programs (Chopra et al., 1990). Canals and tanks are the main sources of surface irrigation in India, while open wells and tube wells from the prime source of groundwater irrigation. Surface water provides irrigation to the extent of 42.5 million hectares, accounting for 52.76 per cent of the total irrigation and groundwater irrigates 10.12 million hectares, accounting for 12.56 per cent of total irrigation (Anonymous, 2012).

On June, 1995 the Gujarat Government passed a policy resolution for implementing participatory irrigation management in the state and signed a Memorandum of Understanding (MoU) between government administration and water users' associations for transferring the government irrigation projects to water users' associations. In November 1995 an action plan for implementing the policy resolution on participatory irrigation management was formulated. In February 1996, the Government of Gujarat has entrusted the responsibility for 13 pilot projects to the chief engineer under the irrigation department for implementing the participatory irrigation management policy of the state (Trivedi, 2012). Besides this, by 2005, as many as 44,500 check dams of various sizes have been constructed in the state through the efforts of Non-Government Organizations (NGOs), farmers' associations and the state government in various parts of the state particularly in the Central and Saurashtra region of the Gujarat state (Chaudhari et. al., 2012).

MATERIALS AND METHODS

Saurashtra has 2 major State Irrigation Project Circle, i.e. Rajkot Irrigation Circle (RIC) and Bhavnagar Irrigation Project Circle (BIPC). Since the main objective of the study is to evaluate the performance of the water users' cooperative societies in North Saurashtra of Gujarat, two Districts were selected purposely, i.e. Rajkot and Jamnagar on the basis of the highest number of water users' cooperative societies. To study the physical and financial progress of water users' cooperative societies, two water reservoir dams were selected, i.e. Aji-2 from Rajkot and Und-1 from Jamnagar based on the availability of the highest number of functional water users' cooperative societies under head, middle and tail regions of irrigation canals. A comparative study was done to study the impact of water users' cooperative societies on farmers; thirty farmers were selected randomly from each reservoir under functional water users' cooperative societies and 30 farmers from non-functional water users' cooperative societies with equal number of head, middle and tail region. Thus, the total sample size of selected farmers was 120. Primary data on year of registration, year of handing over, quantum of water agreed, canal maintenance, levy, water charges, financial status, etc. in the command area were collected from the secretaries of water users' cooperative societies by survey method with the help of schedule specifically designed for the purpose. A number of variables were used to analyze the performance of selected water users' cooperative societies in the area. These included, a) Area of water users' association b) Number of farmers involved c) Irrigated area d) Total command e) Cropping intensity f) Cropping pattern g) Physical conditions of structures h) Levy collected i) Water management practices. Command and project wise data on the targets of area irrigated, number of registered water users' cooperative societies, the number of water users' cooperative societies which have signed MoU and a number of water users' cooperative societies which have been handed over and the corresponding area irrigated was collected from WALMI, Gandhinagar, Water Resources Department, Gandhinagar and Government District Irrigation Circle. Due to the formation of water users' cooperative societies was started from 2007-2008, district wise seven year data on the number of water users' cooperative societies registered and division wise seven years data on the number of water users' cooperative societies that have been registered were collected from the Water Resources Department, Gandhinagar. Following analytical techniques were used. Primary data were collected for the Rabi season in 2012-13 by personal visit.

Analysis of Resource Use Efficiency

In case of crop production function, the crop yield was postulated to be influenced by various factors like labour, seed, manure, chemical fertilizers, irrigation and plant protection cost. Multiple regression analysis was carried to compare the resource use efficiency in crop yield/production on farmers of functional and non-functional water users' cooperative society. The monetary values of all these inputs were considered. The resource use efficiency was studied by fitting the Cobb-Douglas production function to the farm level data of wheat crop of 2012-13. The regression equation per farm is as follows:

$$Y= a\, X1^{b1}.\, X2^{b2}.\, X3^{b3}.\, X4^{b4}.\, X5^{b5}.\, X6^{b6}.\, e^{u}$$

In logarithmic form, it assumed a log-linear equation as under

Log Y = Log a + b1 log x1 + b2 log x2 + b3 log x3 + b4 log x4 + b5 log x5 + b6 log x6 + u log e

Where,

Y = Gross return (Rs/ ha)

X1 = Seeds (Rs/ ha)

X2 = Chemical fertilizers (Rs/ ha)

X3 = Manure (Rs/ha.)

X4 = Labour (Bullock labour and Human labour) (Rs/ ha)

X5 = Plant protection chemicals (Rs/ ha)

X6 = Irrigation (Rs/ha)

a = Constant/ intercept term

u = Random variable

Similarly, b1 to b6 elasticity co-efficients of respective inputs. The co-efficient of multiple determination (R^2) was worked out to test the goodness of fit of the model.

Estimation of Marginal Value Product

Marginal value products (MVPs) of the inputs were estimated from the fitted production function. Since both the dependent and explanatory variables are in monetary terms, the first differential of the regression equation gave directly the MVP. Symbolically, it can be expressed as follows:

$MVPxi = dy/dxi = bi.\bar{y}/\bar{x}i$

Where, y is the dependent variable, and xi is an explanatory variable. The marginal value product was thus obtained by substituting the corresponding geometric mean value of y and xi in the above equation.

The allocation efficiency was evaluated by comparing MVPs of the input with their respective prices and the difference between MVP and price was tested for its statistical significance using student's 't' test. The ratio of the MVP of the factor prices indicates the direction of change that should be made in resource allocation, if the profit is to be maximized. The formula for calculating 't' is given below:

Cal. 't' =(MVPxi-Pxi)/(SE (MVPxi)

Where, SE (MVPxi) = SE (bi) (y/xi) since the value of dependent and independent variables expressed in monetary terms were taken into account,

MVPxi = Marginal value product of xi resource

Pxi = Acquisition unit price of xi resource,

SE (MVPxi) = standard error of MVPxi, and

SE (bi) = standard error of the regression coefficient associated with xi resource.

If Cal. t'< Tab. t' 0.05 (n-k-1) degrees of freedom, then it can be concluded that the difference between MVP of a resource and its acquisition unit price is statistically nonsignificant which implies that this resource is used optimally.

RESULTS AND DISCUSSIONS

Changes in Irrigation Area

It was noticed from Table 1 that the increased in areas of irrigation in the command area was low even after the formation of water users' cooperative society in the middle and tail region as compared to head the region. Head region had the highest of 24.67 per cent increased in irrigation area in command region as compared to other regions and the middle regions had the lowest increased in irrigation area. This was because in the middle region on average money spent on operations and maintenance work was lower in each society. In head region, irrigated area was increased because of 33.33 percent of the societies were regularly attended to operation and maintenance work which lead to increased in areas of irrigation. These findings are also similar to the findings of (Bhatt, 2013) and (Ghosh and Kumar, 2012) who reported water availability to members had improved after the formation of the water users' association.

Table1: Changes in Irrigation Area after the Formation of Water Users' Cooperative Society

Region	Area irrigated by canal (ha.)		
	Before	After	Percent change
Head	184.36	229.84	24.67
Middle	125.28	145.38	16.04
Tail	336.21	391.21	16.36
Total	654.85	766.43	17.04

Production Elasticities and Resource Use in Wheat Crop

The geometric means of inputs used and output per farm in wheat production, as well as the result of regression analysis and ratio of marginal value product to marginal factor cost are presented in Table 2 and Table 3, respectively. The values of geometric means of all the inputs were higher in the case of functional farmers' groups except manure. Remarkable differences in geometric means of irrigation and labour between two groups of farmers were observed.

Table 2: Geometric Means of Value of Inputs and Output in Wheat Production

Sr. No.	Variables	Geometric mean	
		Functional	Non-functional
1	Seed	2561.12	1986.55
2	Manure	1335.35	1415.53
3	Chemical fertilizers	3886.75	3341.151
4	Plant protection chemical	382.00	333.67
5	Irrigation	4461.13	1671.60
6	Labour	12301.20	7753.83
7	Gross income	62364.33	40930.73

The results of regression analysis revealed that the variance explained in the gross income from wheat production by explanatory variable included in the production function ($\bar{R}^2$) of functional farmers was 84.84 per cent, whereas, it was 59.42 per cent in respect of non-functional farmers. The high value of the adjusted R square ($\bar{R}^2$) indicated the fitness of Cobb-Douglas production function in analysis of wheat crop. Positive and significant impact of seed, manure, chemical fertilizers, labour and irrigation were noticed in the case of farmers of functional and non-functional water users' cooperative societies.

Table 3: Production Elasticities of Resources Used in Wheat Production

Sr.No.	Variables	Functional WUCS		Non Functional WUCS	
		Production Elasticities	MVP: MFC	Production Elasticities	MVP: MFC
1	Intercept	8.0468 (0.2290)**	-	7.5966 (0.3870)**	-
2	Seeds	0.0408 (0.0185)*	0.9926	0.0694 (0.0269)*	1.4295
3	Manure	0.0284 (0.0118)*	1.3270	0.0514 (0.0171)**	1.4856
4	Chemical fertilizers	0.0475 (0.0118)**	0.7626	0.0552 (0.0254)*	0.6763
5	Labour	0.1410 (0.0134)**	0.7147	0.1463 (0.0290)**	0.7722
6	Plant protection chemical	0.0048 (0.0051)	0.7763	0.0091 (0.0105)	1.1115
7	Irrigation	0.0858 (0.0199)**	1.1991	0.0421 (0.0131)**	1.0318
	Multiple R	0.9294		0.7971	
	R Square	0.8638	-	0.6355	-
	Adjusted R Square	0.8484		0.5942	
	F value	56.04	-	15.40	-
	Total cost	31177.1	-	19930.9	-
	Gross returns	62377.3	-	40932.2	-
	Net returns	31200.2	-	21001.3	-

Figures in parentheses indicate Standard Error, R^2= Co-efficient of multiple determination, MVP: Marginal Value Product, MFC: Marginal Factor Cost, * Significant at 5 per cent level of significance, ** Significant at 1 per cent level of significance

Plant protection, chemical was statistically non-significant in case of both groups. Return to scale, that is, response of output to a proportionate change in all the input simultaneously, in Cobb-Douglas production function can be estimated directly by adding the regression coefficients of all the variables. In wheat crop except plant protection, the coefficients of all other variables were found to be significant and all the variables had a positive influence on the output. This shows that with the increase in the use of these resources the output would also increase.

The resource use efficiency in terms of the ratio of marginal value product for the marginal factor cost presented in Table 3 clearly indicate that seed (0.99), chemical fertilizers (0.76), labour (0.71) and plant protection, chemical (0.77) were over utilized, since the ratio of marginal value product to marginal factor cost was less than one in wheat cultivated by farmers of functional water users' cooperative societies. While on the other hand, the ratio of the marginal value product to marginal factor cost in seed (1.42), manure (1.48), plant protection, chemical (1.11) and irrigation (1.03) were more than one in wheat cultivated by farmers of non- functional water users' cooperative societies, that means all these inputs were underutilized.

Positive impact of participatory irrigation management was observed through the highest net return on wheat production in the case of farmers of functional water users' cooperative society (Rs. 31,200.2) as compare to farmers of non- functional water users' cooperative society (Rs, 21,001.3).

Constraints in Working of Water Users' Cooperative Society

An opinion survey was conducted for different stakeholders in participatory irrigation management to know the constraints in the management. The results has been presented in Table 4 show that in the opinion of the farmers members, inadequate maintenance rank first followed by lack of members cooperation, untimely water release from dam, lack of training, inadequate water supply in the canal and high cost of maintenance etc. Other related issues were conflict among members about timing of water from the farmers of tail area, lack of awareness and problems in deciding water distribution rules etc. These findings are more or less similar with Smith and Sohani (1997), Oza (1998), Parthasarathy and Jharna (2003), Parthasarathy (2004), Douglas and Vermillion (2004) and Arun et.al (2012). They also observed training and awareness programs which were essential for successful participatory irrigation management.

Table 4: Constraints in the Participatory Irrigation Management

Sr. No.	Constrains	Score	Rank
1	Inadequate maintenance	3.62	I
2	Lack of members cooperation	3.56	II
3	Untimely water release from dam	3.55	III
4	Lack of training	3.54	IV
5	Inadequate water supply in the canal	3.52	V
6	High cost of maintenance	3.51	VI
7	Conflict among members about timing of water	2.94	VII
8	Complaint from farmer of tail area	2.85	VIII
9	Lack of awareness about participatory Irrigation management	2.72	IX
10	Problems in deciding water distribution rules	2.51	X
11	Illiteracy of farmer	2.4	XI
12	Officials apathy towards handing over	1.97	XII
13	Lack of political will	1.95	XIII

Suggestions for Effective Working of Participatory Irrigation Management

The personal survey on suggestions for successful participatory irrigation management was carried out and the opinions are presented in Table 5. It was observed that the majority of the farmers (76.67%) opined that close canal system applied in participatory irrigation management and minimizing the role of civil contractors in participatory irrigation management should be implemented. Similar suggestions were observed from the secretary of water users' cooperative society. Modification of the open canal system to close canal was suggested by 76.67 per cent of farmers and 55.56 per cent of secretaries. Close canal system needed very low maintenance as compared to open canal system that leads higher efficiency to water distribution up to the tail command area. These findings were supported by the Raju (2006) in their study, he suggested that modern technology and management of the canal system would be needed to enhance the life span, less prone to damage and longer durability.

Table 5: Suggestions for Effective Working of Participatory Irrigation Management

Sr. No.	Suggestions	Farmers	Secretaries
1	Changes in institutions dealing with PIM	24.17	0.00
2	Changes in nomenclature of posts	14.83	16.67
3	Changes in PIM model	8.33	22.22
4	Close to canal system applied in PIM	76.67	55.56
5	Investment on research and training	67.50	50.00
6	Maintenance of canal	66.67	38.89
7	Minimizing the role of civil contractors	76.67	55.56
8	Reasonable pricing of water	44.17	44.44
9	Stop political interference	16.67	22.22

The Secretaries (50%) and farmers / members (67.50%) suggested that the investment in research and training could help not only the secretaries and presidents of water users' cooperative society but farmers also. These findings are more or less similar with Sun (2000). He has reported positive impact of participatory irrigation management training for farmers in Maryland, U.S.A.

CONCLUSIONS

The variants of participatory irrigation management were in vogue in different parts of India with partial success here and there. Due to the continued effort of irrigation department, NGOs and various institutes, participatory irrigation management was starting to adapt by farmers. However, PIM needs a simultaneous legislative initiative with full involvement of grass-root NGOs. Without capacity enhancement of WUAs, the full benefit of an expanding irrigation infrastructure cannot be achieved. It was noticed that water availability to members had improved after the formation of the water users' association. Also, Positive impact of participatory irrigation management was observed through the highest net return on wheat production in the case of farmers of functional water users' cooperative society (Rs. 31,200.2) as compare to farmers of non- functional water users' cooperative society (Rs, 21,001.3). However, inadequate maintenance, lack of member's cooperation, untimely water release from the dam, lack of training, inadequate water supply in the canal and high cost of maintenance etc. are the main constraints faced by members of water users' cooperative society. These problems should be solved as early as possible for greater positive impact of PIM.

REFERENCES

1. Chopra, K., Kadekod, G. K. and Murthy, M. N. (1990), *Participatory Development, People and Common Property Resources.* Sage Publication, New Delhi.

2. Anonymous. (2012), National Water Policy, Ministry of Water Resources, New Delhi.

3. Trivedi, K. B. (2012), Participatory Irrigation Management as Tools for Improving Water Use Efficiency- Success story of Implementation of PIM in Gujarat State. *In*: India, Water Week 2012 – Water, Energy and Food Security: Call for Solutions, 10-14 April 2012, New Delhi. pp.122-128.

4. Chaudhari, J.C.; Patel, K.P.; Patel, D.K and Chuhan, S.U. (2012), Participatory irrigation management practice in Gujarat. *In*: India, Water Week 2012 – Water, Energy and Food Security: Call for Solutions, 10-14 April 2012, New Delhi. pp. 88-94.

5. Bhatt; S. V. (2013), How does participatory irrigation management work? A study of selected water users' associations in Anand district of Gujarat, western India. *Water Policy*. 15(2): 223-242.

6. Ghosh, Souvik and Kumar, Ashwani. (2012), How participatory irrigation management reform influences agriculture performance. *Current Science,* 103 (4) 359-360.

7. Smith, L. E. D. and Sohani. (1997), A Participatory irrigation management: a case study of ability to pay. Economics management and demand International Commission on Irrigation and Drainage *At:* Proceeding 18th European Regional Conference 'Water an economic good', Oxford, pp. 210-218.

8. Oza, A. (1998), NGOs and institutional reforms: A case study of irrigation sector reforms in Gujarat, India. *In:* International workshop on Community Based Natural Resource Management (CBNRM) Washington DC, United State. May 10-14, 1998.

9. Parthasarathy, R. and Jharna Pathak, (2003), The guiding visible hand of participatory approaches to irrigation management. Working Paper, Institute of Rural Management, Anand. 141: 24.
10. Parthasarathy, R. (2004), Objects and accomplishments of participatory irrigation management programme in India: an open pair of scissors. Working Paper Gujarat Institute of Development Research, Ahmedabad. 146: 41.
11. Douglas, L. and Vermillion. 2004. Irrigation, collective action and property rights. *International Food Policy Research Institute*. 11(1): 6.
12. Arun, G.; Singh, Dharamraj.; Kumar, Shiv and Kumar, Anil. 2012. Canal Irrigation Management through Water Users Associations and its Impact on Efficiency, Equity and Reliability in Water Use in Tamil Nadu. *Agricultural Economics Research Review (Conference Number*). 25: 409-419..
13. Raju, K. V. (2006), Participatory Irrigation Management in Bihar Status and Issues. Available at http://www.isec.ac.in/Draft02-Bihar-PIM-090406.PDF Accessed 28/05/2016.
14. Sun, P. P. C. (2000). *Policy Issues in Managing Irrigation and Drainage.* Extension Bulletin Food and Fertilizer Technology Center. 490: 7.