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Impact of Lift Cum Micro Irrigation Model for developing Livelihood Opportunities in Chhattisgarh Plain

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A B S T R A C T

Water play an important role in improving crop production and productivity of crops. The production of any crop mainly suffers due to erratic and uneven distribution of rainfall, lack of irrigation facilities, non adoption of suitable varieties according to soil type, inappropriate method of cultivation, weeds and nutrient management practices and plant protection measures. Irrigation is generally believed to play an important role in improving productivity and aggregate food production. The contribution from irrigated agriculture to achieving this goal will be critical as irrigation provides a powerful management tool against the vagaries of rainfall. Given the present problem of global climate change with its attendant problem of irregular rainfall and intermittent river flow, the need to develop the irrigation potentials of the state cannot be more timely than now. Also, given the high rate of poverty particularly in the rural areas of the state, the high surface water resources and the problems of global climate change with its attendant uncertainties, this study highlight the need to develop irrigation farming in the state so as to increase food production, rural income, employment opportunity, poverty reduction and improvement in the quality of life of the people. The drip method of irrigation has the potential to completely eliminate water stress for crops even under severe water scarcity conditions. The excess supply of water through conventional method is a potential loss of water, and at times may adversely affect crop yield, quantitatively as well as qualitatively. In order to achieve these objectives a systematic review of existing literature on the topic using case studies from past successful or unsuccessful irrigation development projects has been conducted. In view of above for developing livelihood opportunities in village under the state rural livelihood mission project considering Surgi village as a Model and irrigation facilities was created for poverty alleviation and livelihood security on sustainable basis.

Introduction

Poverty is a global problem that affects citizens around the world. About 1.1 billion people earn less than one dollar per day, and they face daily risks and hardships that determine their very survival (Mandal *et al.*, 2019). The development community, including government agencies, banks and nongovernmental organizations (NGOs), seeks to improve the livelihoods of impoverished citizens through poverty reduction strategies

that address the root causes of poverty and its crippling effect on people trapped in adverse situations (Tiwari *et al.,* 2009). But after years of implementing programs to solve these issues, poverty remains a multi-dimensional problem with many faces. Out of India's total population, 269 million people survive on Rs. 27-30 a day. Chhattisgarh is the poorest state in the country with close to 40 per cent of its population being below the poverty line.

Irrigation is an important contributor to poverty alleviation, the magnitude of antipoverty impacts of irrigation varies greatly across systems. Access to irrigation has strong direct antipoverty impacts (Vanitha and Mondandass, 2014). Experience in other parts of the world shows that improving the performance of irrigation systems by improving land and water productivity of crops, diversifying cropping patterns, improving infrastructure and water distribution across locations would help in reducing poverty in the state, especially the rural areas (FICCI, 2013). Government and other agencies efforts at addressing the problems of poverty in these rural areas over the years, have been limited and largely ineffective not only due to lack of effective policies and actions but also due to lack of knowledge on the magnitude of the poverty problem, its causes and interventions that can reduce poverty more effectively (Dhawan, 2002). Water is generally believed to play an important role in improving productivity and food production. The contribution from irrigated agriculture to achieving this goal will be critical as irrigation provides a powerful management tool against the vagaries of rainfall (Biswas, 2010). Global climate change with its attendant problem of irregular rainfall and intermittent river flow, the need to develop the irrigation potentials of the state cannot be more timely than now. Also, given the high rate of poverty in the rural areas of the state, problems of global climate change with its attendant uncertainties, this study highlight the need to develop irrigation facilities in the state so as to increase food production, rural income, employment opportunity, poverty reduction and improvement in the quality of life of the people. In order to achieve these objectives a systematic study of existing literature on the topic using case studies from past successful or unsuccessful irrigation development projects has been conducted (Shah and Keller, 2014).

With increased availability of water for irrigation along with pressurized irrigation, certainly help in improvement of crops and productivity and others secondary agriculture livelihood enterprises as above. Consequently income and employment of all families residing in the villages directly as farmers and wages or share cropper to landless families enhanced (Panigrahi *et al.,* 2015). Effort to fight against poverty by developing irrigation facilities will therefore be tested in this project considering entire Surgi village as a model.

Materials and Methods

The village Surgi belongs to district Rajnandgaon have been selected in order to bringing about socio-economic transformations of the farmer of the village in sustainable manners. The village is spread in 659.2 ha of area having 3361 farmers families which includes 72% marginal, 19% small and 8 % of large farmers. The four important groups of soil *i.e.* Bhata (10 ha), Matasi (15 ha), Dorsa (138 ha) and Kanhar (366 ha) exist in the village (DCOC, 2011).The village is in general facing the acute water shortage especially during summer season. The most of agriculture production depend on rainfed, however crops in variably suffers due to stress during prolonged rainfall periods. Village is situated in the bank of Kharkhatariver, this river is main source of irrigation by which

about only 70 hectares of area is being irrigated. The negligible area is being irrigated through tube well and ponds (Table 1).

Agriculture is prime source for livelihood of the farmers. The rice is main crop grown during the rainy season in the village while during summer season too rice is being grown by the farmers in river bank areas. During *rabi* season, pea, Chickpea, lentil and linseed are the compatible crops grown by the farmers under rainfed condition. The crop production is mainly suffers due to erratic and uneven distribution of rainfall, lack of irrigation facilities, non adoption of suitable varieties according to soil type, inappropriate method of cultivation, weeds & nutrient management practices and plant protection measures(Kumar and Ladha, 2011).

Rabi season excepting rice, rabi crops are grown in dorsa and matasi land under rainfed situation suffers due to low plant population and finally poor productivity.

The seeding implements are also very less in the village affects for proper germination of *rabi* crops (Thakur *et al.,* 2010). The marginal farmers and landless labours are present in huge numbers in the village however allied enterprises i.e. animal husbandry and vegetable production might help to boost the economic situation of the farmers.

For this Interlinking of village ponds carried out and create infrastructure for filling them by lifting of water from river located near to Surgi village. Up-and-out-scaling of crop production technologies taken up for increasing productivity and double cropped area. Promotion of integrated farming system models for increasing income and employment opportunities of small, marginal and landless farmers also taken up for income and employment generation (Govindan and Grace, 2012).

The main features of community lift cum micro irrigation in Surgi

The main features of community lift cum micro irrigation in Surgiare firstly formed farmers group and named as Aadarsh Krishak Samuhin which 48 farmers and 75 acre land involved. Then Lifting of water from anicut of kharkhara river and transport the water with 200 mm PVC pipe upto 2100 m at tulsitalab. Air release valve were fitted at 300 m distance total 8 in numbers. The PVC pipe was fitted at the depth of 3 feet in soil in 2 ft wide and 2100 m long channel. The gradient from river to tulsitalab was 7 meter. For lifting of water from river two 05hp electric pump fitted with provision of one extra motor in case of higher water demand. Each pump is in the name of one farmer in order to take advantage of electricity subsidies. Each electric pump also have one non return valve (NRV) therefore water delivery at the destination start with 2 minutes after start of both motors. One lamp fringe is fitted with three branches for fitting of 03 pumps. Discharge measured at the destination (tulsitalab) is 35-40 liter per second. Pond capacity is 9062 m^3 at 1.5 m depth that will be filled through water harvesting during rainy season. Whereas, the maximum of 18500 m^3 (2.8 m depth) can be filled using two above electric pumps. This capacity can be achieved in 10-12 days (12 hrs of lifting per day) which is sufficient to irrigate > 80 acres using drip irrigation. Each group are likely be install one 03 hp electric pump for drip irrigation to the farmers of the same group. Fitting of main line (> 4000 m) for drip is completed by all the groups and 4 group completed sub main line for fitting of laterals with control valve. Complete set of drip system fitted but will be used after kharif rice. The drip system was installed in 75 acre area in Surgi village.

This is only scheme in the state that (i) completed by involvement of farmers (2) with

> 12% farmers share in construction (3) having combination of lift irrigation, water harvesting and drip irrigation (4) solely operate & maintain by farmers (5) with contribution of Rs. 1000 per acre per season as irrigation charge (6) having Bank Account in the name of Aadarsh Krishak Samuh for revenue collection and finance management.

Establishment and operating cost

Establishment cost of the model was 78.42 lakh out of which 28 % is shared by the farmers and convergence and remaining from the project fund. Annual electricity charges would be Rs. 319265 for operating 5 hp 2 pumps and 3hp 7 pumps for 8 hours daily. Subsidies of Rs 273600 would be given by electricity bill. Thus net payment of Rs. 45665 will be the actual bill for payment. Additional amount of nearly Rs. 54920 will be required for maintenance of the system inclusive aftercare. Revenue of Rs. 2.25 lakh will be collected annually in three seasons that will be sufficient for operation and maintenance of the system inclusive risk management. Fish and duckery reared in the pond will also share sufficient fund for maintenance of the system (CWC, 2010).

Results and Discussion

Impact of the created water resources lift cum micro irrigation model

Productivity of kharif rice

Line sowing of high yielding rice varieties was done in the entire area. Weed management was done using pre and post emergence herbicide in paddy. Productivity of the crop remarkably improved with availability of water and adoption of improved technology (Thakur, 2013).

Use of bund

Arhar was sown on entire rice bunds whereas mango, guava, apple ber and banana were planted on pond bunds. Use of rice bund gave additional income to the farmers.

Table.1 General information of the selected village for developing livelihood security and poverty alleviation through development of irrigation and adoption of farming systems

Particulars	Surgi	Particulars	Surgi	Particulars	Surgi
Geographical Area	659	**Farmers Family**		**Agriculture Implements**	
Revenue land		Marginal (<1 ha)	426	Tractor	17
Waste Land (ha)	6	Small (1-2 ha)	115	Thresher	7
Forest area		Medium and big (>2 ha)	49	Power tiller	1
Grass Land	58	**Total**	**590**	Seed drill	1
Net Sown area (ha)	529	Population	3361	Hand Sprayer	100
Double Cropped area(ha)	246	**Type of Soils**		Foot Sprayer	25
Irrigated area (ha)	78	Bhata	10	Hand How	5
Per cent irrigated area	14.7	Matasi	15	Ripper	1
Irrigation source (No.)		Dorsa	138	Diesel Pump	-
Tube well	3	Kanhar	366	Winnowing Fan	-
Well	1	**Total**	**529**	Conoweeder	-
Pond	15			Seed Treating drum	-
River	1			Sprinkler	-

Table.2 Cropping during 2017-18 in three cropping seasons and economic returns from entire area (75 acres) over rainfed rice before establishment of the model

Crops	Area (ha)	Production (q)	Return from entire area (Rs in lakh)		Yield (q/ha)	Return (Rs./ha in lakh)	
			Gross return	Net return		Gross return	Net return
	Before the start of project : 2016-17						
Rainfed rice	30.09	709.50	13.13	7.22	23.58	0.44	0.24
	After the start of project : 2017-18						
Kharif irrigated rice	30.09	1235.00	22.85	12.57	41.04	0.76	0.42
Rabi season							
Lathyrus	4.80	20.55	0.82	0.54	4.28	0.17	0.11
Tomato	1.05	117.15	1.17	0.64	111.36	1.11	0.61
Brinjal	0.74	82.00	0.98	0.54	110.81	1.33	0.73
Coriander	0.97	70.00	0.84	0.46	72.31	0.87	0.48
Ladies finger	0.83	61.00	0.85	0.47	73.32	1.03	0.56
Bottle guard	1.37	88.80	0.71	0.39	64.91	0.52	0.29
Pumpkin	1.76	106.00	0.85	0.47	60.23	0.48	0.27
Potato	0.20	8.50	0.10	0.06	42.50	0.51	0.28
Bitter gourd	0.10	4.30	0.11	0.06	43.00	1.08	0.59
Mustard	5.58	47.70	1.76	0.57	8.54	.32	0.17
Maize	5.68	246.00	3.57	1.96	43.34	0.63	0.35
Wheat	0.60	14.00	.24	0.13	23.33	0.40	0.22
Lentil	3.08	29.35	1.17	0.69	9.53	0.38	0.22
Cowpea	0.46	36.70	0.92	0.50	79.78	1.99	1.10
Arhar on bund	2.40	33.00	1.82	1.0	13.75	0.76	0.42
Sesame	0.40	2.10	0.16	0.09	5.25	0.39	0.23
Onion	0.07	7.50	0.15	0.08	104.17	2.08	1.15
Total	30.09	974.65	16.23	8.56	-	-	-
Summer season							
Lady finger	0.40	28.80	0.43	0.24	72	1.08	0.59
Bottle gourd	0.20	11.80	0.11	0.06	59	0.53	0.29
Bitter gourd	0.20	17.70	0.44	0.24	88.500	2.21	1.22
Cucumber	0.40	30.50	0.24	0.13	76.25	0.61	0.34
Urid	0.40	3.50	0.19	0.11	8.75	0.48	0.26
Moong	0.40	2.50	0.14	0.08	6.25	0.34	0.19
Ridge gaurd	0.16	9.58	0.09	0.05	59.88	0.54	0.30
Total	2.16	1495.38	1.64	0.90	44.35	0.83	0.46
Grand Total	62.34	3705.03	40.72	22.53		2.41	1.33

Fish and duck rearing

Fish fingerling (12000 Nos.) and 90 ducklings were reared in the pond. Round the year water availability in the pond supported very good productivity of fish and duck.

This income was helpful in strengthening of the system including fencing of entire area in near future. Productivity of the crops remarkably improved with availability of water and adoption of improved technology.

Rabi and summer season

Mustard, maize, wheat, lentil, lathyrus and vegetables were grown with improved seed and production technology in the drip irrigation during rabi season. During summer season mung, urid and vegetables were grown with improved seed and production technology in drip system.

Drip fertigation and poly mulch were used for production in all types of crops. Productivity of the crops remarkably improved with availability of water and adoption of improved technology (Parthasarathi *et al.,* 2013). Farmers have reported the main reasons for higher yield of these crops due to drip method of irrigation (Narayanamoorthy *et al.,* 2018).

Crop yields

Rainfed rice productivity was 23.6 q/ha with Rs. 0.24 Lakh ha net income before start of the project. Rice yield increased from 23.6 to 41.04 q/ha owing to adoption of improved line sowing technology with herbicide under irrigated condition after completion of project. It was possible to grown *rabi* and summer crops after availability of irrigation (Table 2).

Cropping intensity

The cropping intensity of the area increased from 100 to 210 in one year. It is possible to further increase it after second year onwards after familiarization of the farm community with high tech vegetable cultivation (Chauhan *et al.,* 2013).

Economic benefits of the model

Before start of the scheme, rainfed rice was grown during rainy season that usually suffers due to drought stresses and farmers were harvesting satisfactory yield in most of the year. In favorable years, some farmers were also growing relay cropping of lathyrus that produced poor yields (Narayanamoorthy *et al.,* 2018). Net income from rice was about Rs. 7.22 lakh from the 30 ha area. After completion of the project, line sown rice was save from drought stress during 2017 by providing supplemental irrigation. During rabi and summer season mustard, lentil, wheat and vegetables were grown with improved seed and production technology using drip irrigation. Net income from irrigated rice were Rs. 12.57 lakh from 30 ha area. Whereas by growing rabi crops including vegetables and summer crops, farmers obtained Rs. 9.96 lakh from entire area of 30 ha area of the ml indicating 3.12 times more income in a year as a result of establishment of community lift cum drip irrigation model compared to traditional rainfed rice farming (Table 2).

Rice is the staple food for half of the world's population and rice farming is a livelihood for millions of farmers in Asia**.** Rice is generally grown under the rainfed condition in most of the parts of the India and water deficit in soil either during vegetative or reproductive stage of rice affects rooting pattern, growth and yield of rice. Supplemental irrigation at critical stage helps in increase in potential yield of rice. Drip method of irrigation can be a viable option in achieving the mission of 'more crop per drop' vegetable crops during rabi and summer season. So it is concluded from the study that the development of such irrigation model can be viable option in

achieving the mission more crop per drop of water and doubling the farmers income on sustainable basis.

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