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Farm Ponds in Northern Dry Zone of Karnataka: Impacts and Constraints

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ABSTRACT

This study ascertained the impact of water harvesting structures-farm ponds constructed under Krishi Bhagya Scheme in Northern dry zone of Karnataka during 2019 to 2021. Farmers with and without farm ponds were selected through multi-stage random sampling technique with a total sample size of 320 farmers for data collection. The impact of farm ponds on cropping pattern and crop productivity was visible due to supplementary life saving irrigation. The change in income due to farm ponds ranged from 13 to 97 per cent and net returns realized by farmers with ponds was higher than the farmers without ponds due to increased crop yield. The employment generation per farm increased for beneficiary farmers as compared to control. However, problems of sedimentation, poor design of farm ponds (absence of silt trap and proper inlet and outlet), poor site selection and lack of awareness were the major constraints experienced by farmers for long term sustainability of farm ponds.

INTRODUCTION

India is an agrarian economy wherein more than 50 per cent of work force is engaged in agriculture and allied activities. In India, rainfed agriculture constitutes nearly 60 per cent of net sown area and play important role in food grains production mainly coarse cereals, rice, pulses, oilseeds and cotton (Rama Rao et al., 2019). However, rainfed areas are characterized by low resource base, uncertain and low rainfall with prolonged dry spells and poor soil conditions with shorter growing period. In addition, irrigation potential in these areas is not being fully utilized and crop productivity achieved is considerably less as compared to irrigated agriculture. In order to improve the crop productivity and achieve doubling farmers' income, a strategy is required to harvest and utilize the full potential of natural resource base available in the rainfed regions.

The main features of rainfed agriculture are climatic hazard with lower productivity mainly found in semi-arid, arid and dry sub-humid areas. Low productivity in this region is mainly due to uncertain and ill-distributed rainfall aggravated by high runoff and evapotranspiration losses. The adequate availability of soil moisture particularly during cropping season is a major constraint and problem of soil degradation is a key factor for low productivity in rainfed regions. However, there exists an ample opportunity and scope for harvesting excess rainwater and runoff in the rainfed region in different states of the country (Wani et al., 2003). Hence, efficient utilization and management of excess rainwater is critical to achieve both water use efficiency and crop productivity. Besides, rainwater harvesting structures were highly useful in rainfed farming and had a multiplier effect on farm income (Kumar et al., 2016).

In India, Karnataka is predominantly agriculture and farming oriented state wherein nearly 65 per cent of the cultivated area is under arid condition (Dupdal et al., 2020) and state witnessed frequent droughts and floods concurrently. Keeping in view these challenges, Government of Karnataka introduced Krishi Bhagya Scheme during 2014-15 to utilize scarce rainwater efficiently through the harvested farm ponds for improving rainfed productivity. Water harvesting farm ponds have significant role in improving the crop yields and farm returns in rainfed areas under climate change conditions (Dupdal et al., 2021). On the other hand, low and uncertain rainfall and

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inefficient crop management leads to unstable and very poor crop yields (Adhikari et al., 2009). Therefore, farm ponds improve the rainfed productivity and farm income through rainwater harvesting which is used for supplementary irrigation. Further, farm pond technology helps dryland farmers to diversify cropping system and to increase their off and on-farm income (Dupdal et al., 2020). However, economic viability and long-term sustainability of farm ponds were the major concerns for the farmers in the region. Keeping in view these issues, this study attempted to analyze the farm level adoption of rainwater harvesting structures in Ballari and Vijayapura districts of Karnataka.

METHODOLOGY

The dryland districts of Ballari and Vijayapura (Bijapur) in north Karnataka were selected for the study. This region is characterized by dry semi-arid climate with low and minimum rainfall. The main focus of study was water harvesting structures that were dugout in the farmers fields under Krishi Bhagya Yojana in Northern dry zone of Karnataka. The Ballari district is located in eastern part of Karnataka, semi-arid region with low and deficit rainfall climate and lies between 15° 08'31.38 North latitude and 76° 55'26.33 East longitudes. The annual average rainfall of district is 633 mm which is not uniformly distributed over the district and predominant soil types were red and deep black soils. Vijayapura district is located in the northern part of Karnataka, low annual and unimodal rainfall with medium to deep black soils with diversified system of cropping (Dupdal et al., 2022) and lies between 15° 50' and 17° 28' North latitude and 74° 54' and 76° 28' East longitudes. The average rainfall of district is 594 mm with more than 50 percent of rainfall received during *rabi* season.

This study was conceptualized based on *Krishi Bhagya* Scheme implemented by Government of Karnataka to enhance the productivity of rainfed farming through efficient rainwater management. Since inception of the scheme more than one lakh farm ponds were constructed in the farmer fields to harvest excess run-off for providing assured life saving irrigation for sustainable production in rainfed areas. In addition to farm pond, diesel pump set of 5HP capacity along with pipes were provided to famers in a subsided rate for promoting micro-irrigation and to increase water use efficiency. Therefore, the present study measured the change in cropping pattern, crop productivity and income of farmers with and without farm ponds. Multi stage random sampling technique was employed to select farmers for data collection. A total of 320 farm household data was collected through pre-tested interview schedule during 2019-2021. Out of 320 respondents, 160 were farmers with farm ponds and 160 were farmers without farm ponds for comparative study. Under each district, one taluk and two villages were selected for primary data collection. The selected taluk were Ballari taluk in Ballari district and Vijayapura taluk in Vijayapura district and selected villages were K. Veerapura and Joladarasi in Ballari taluk and Nagatan and Hunsyal in Vijayapura taluk. Data pertaining to crops, cropping pattern, crop yields along with farm income were collected from both beneficiary and control farmers. Further, data related to employment due to farm ponds and constraints experienced etc. were collected from beneficiary farmers. The descriptive statistics and 't' test were used to study the farm ponds impact on cropping pattern, crop productivity and returns, and employment accrued by the beneficiary farmers. Further, study was also conducted for assessing the major constraints experienced by farmers in sustainability of farm ponds.

RESULTS AND DISCUSSION

Farm ponds and its impact on cropping pattern and cropping intensity

Results on impact of farm ponds on cropping pattern revealed that additional area was brought under irrigation due to rainwater harvesting through farm ponds for supplementary life saving irrigation particularly during post rainy season. After construction of farm ponds and improved soil moisture, beneficiary farmers in Ballari district increased area under coriander (14.6 ha) and chickpea (27.1 ha) as compared to non-beneficiary farmers (3.6 ha) and (20.5 ha) (Table 1). In Vijayapura district, beneficiary farmers has increased area under maize (12.7 ha) due to life saving irrigation through farm ponds. The change in gross cropped area was mainly attributed to relative increase in crop area under *rabi* season as compared to *kharif* season. As a result, the cropping intensity increased to 161 per cent and 144 per cent in Ballari and Vijayapura districts respectively for farmers with farm ponds.

Farm ponds and its impact on crop yields and income

Rainwater harvesting through farm ponds and supplementary life saving irrigation brought significant changes in the crop yields of beneficiary farmers (Table 2). The crop yields increased significantly for chickpea (47%) and coriander (41%) with help of life saving irrigation through farm ponds under rainfed situations. Increase in yields of chickpea and coriander during *rabi* season was mainly attributed to better conservation of residual soil moisture in the post rainy season due to construction of ponds. Further, increase in crop yields was also attributed to field bunds that were constructed to conserve soil moisture over control condition. The additional income generated by beneficiary farmers due to increase in crop yields was Rs. 11,272 ha^{-1} and Rs. 10,888 ha^{-1} for chickpea and coriander respectively. The findings of a study have a similarity with results reported by Kumar et al., (2017) & Rajendra & Dolli, (2021). The gain in income due to farm ponds ranged from 13 to 97 per cent. The net returns realized by farmers with farm ponds were higher as compared to farmers without farm ponds and these were mainly due to increased crop yields with ponds. Dupdal et al., (2021) reported that farm ponds with supplementary irrigation enhanced crop productivity up to 25-30 per cent particularly during drought period. Malik et al., (2013) in their study conducted in Madhya Pradesh reported that increase in crop yields and income was mainly due to farm ponds. Kumari et al., (2014) & Moulasab et al., (2018) reported 17 to 53 per cent increase in yields of prominent crops due to farm ponds constructed under Krishi Bhagya Yojana.

Farm ponds and its impact on employment generation among farmers with farm ponds

The farm ponds impact on emplyoment generation revealed that number of man days per farm incresed for farmers with ponds

Table 1. Impact of farm ponds on cropping pattern and cropping intensity

Ballari district					Vijayapura district				
Crop	With farm ponds		Without farm ponds		Crop	With farm ponds		Without farm ponds	
	Area (ha)	Percent to total area	Area (ha)	Percent to total area		Area (ha)	Percent to total area	Area (ha)	Percent to total area
Redgram	13.4	10.5	11.2	10.9	Redgram	11.7	10.6	7.1	8.6
Cotton	5.3	4.1	6.2	6.1	Groundnut	4.3	3.8	3.4	4.1
Sorghum	9.9	7.7	8.1	7.9	Sunflower	8.1	7.2	8.0	9.7
Sunflower	7.4	5.8	5.3	5.1	Pearl millet	5.8	5.2	6.6	8.0
Fallow land	21.4	16.8	20.4	19.9	Sorghum	7.9	7.1	9.3	11.2
Total kharif area	57.3	45.2	51.4	50.1	Maize	6.9	6.2	7.8	9.5
Chickpea	27.1	21.3	20.5	20.0	Fallow land	16.3	14.6	10.5	12.7
Safflower	6.9	5.4	4.8	4.6	*Total Kharif area*	61.1	55	52.9	63.8
Coriander	14.6	11.4	3.6	3.5	Chickpea	11.6	10.4	7.8	9.4
Sorghum	12.2	9.6	8.1	7.9	Safflower	7.0	6.3	2.8	3.4
Foxtail millet	5.3	4.1	5.5	5.4	Sorghum	8.2	7.4	4.4	5.3
Fallow land	3.4	2.6	8.5	8.3	Sunflower	7.1	6.3	2.5	3.1
Total Rabi area	69.4	54.8	51.1	49.8	Maize	12.7	11.4	3.7	4.5
GCA	126.7	100	102.5	100	Fallow land	3.3	2.9	8.6	10.4
NCA	78.6		71.8		*Total Rabi area*	50.0	45	30.0	36.2
CI (%)	161		143		GCA	111.2	100	83.0	100
					NCA	77.5		63.5	
					CI (%)	144		131	

Table 2. Farm ponds and its impact on crop productivity and farm income

Crop	Farmers with farm ponds				Farmers without farm ponds				Additional income (Rs ha^{-1})	Percent change
	COC (Rs ha^{-1})	Yield (q ha^{-1})	Net returns (Rs ha^{-1})	BCR	COC (Rs ha^{-1})	Yield (q ha^{-1})	Net returns (Rs ha^{-1})	BCR		
Redgram	38244	13.7	34631	1.9	36740	11.5	25522	1.6	9109	36
Cotton	34450	10.2	19716	1.5	32058	8.5	12992	1.4	6724	52
Maize	26316	29.5	15054	1.5	24212	25.7	11768	1.4	3286	28
Sorghum	21040	14.7	15710	1.7	20844	11.8	8656	1.4	7054	81
Sunflower	29960	11.5	39040	2.3	27210	10.3	34590	2.2	4450	13
Chickpea	23471	14.4	27069	2.1	19135	9.8	15797	1.8	11272	71
Foxtail millet	19742	11	9958	1.5	17879	8.5	5071	1.2	4887	96
Coriander	21844	5.8	22106	2.0	20057	4.1	11218	1.5	10888	97

(130 man days farm^{-1}) as compared to farmers without ponds (93 man days farm^{-1}) (Table 3). The increase in man day per farm for beneficiary farmers was mainy attributed to increase in man day works during *rabi* season as compared to *kharif* season. Farm pond with rainwater harvesting and irrigation leads to increased area under crops as well as crop yields which call for more labour demand and employment opportunities created in the farm as compared control condition. The farm pond leads diversification of cropping system and increase in crop yields helped in improving employment level (Kumar et al., 2016).

Constraints experienced by farmers in long term sustainability of farm ponds

The sedimentation and siltation of farm ponds was the major constraint for sustainability of farm ponds (Table 4). The farm ponds were constructed in black soil without lining and stone pitching and hence farmers faced the problem of silt deposition in the ponds. Further, the small and marginal farmers were not in position to desilt the sediment deposited in the ponds due to which storage capacity of ponds reduces in the long run.

Another important constraint was improper and poor designing of ponds i.e. absence of silt trap, proper inlet and outlet, poor site selection which led to soil erosion and accumulation of silt in the ponds. Lack of maintenance of ponds due to insufficient awareness and absence of fencing and grass sodding were the other major constraints. There is significant difference between awareness about different components of ecosystem services (Rejula et al., 2017). The absence of proper fencing may lead to incidence of livestock and human falling and sometimes incidence of deaths as were reported in the recent past. Therefore, sustainability of farm ponds requires proper site selection and scientific designing of ponds. Further, training and awareness for better utilization and management and regular monitoring and post corrections from implementing agency was crucial for long term sustainability of

Table 3. Impact of farm ponds on employment among beneficairy farmers (Man days/farm)

Particulars	With farm ponds	Without farm ponds	% difference	t-value
Kharif	90	85	6	0.3
Rabi	40	08	400	10.8**
Total	130	93	40	2.7**

Note: ** 1 per cent level of significance.

Table 4. Constraints faced by farming community in sustainability of farm ponds

S.No.	Particulars	Mean Garrett Score	Rank
1.	Problem of sedimentation	86.44	I
2.	Improper and poor designing of farm ponds (absence of silt trap, proper inlet and outlet)	73.55	II
3.	Poor site selection	68.23	III
4.	Lack of maintenance of farm pond due to insufficient awareness	62.19	IV
5.	Absence of fencing and grass sodding	55.88	V
6.	Economic unfeasibility of farm ponds due to diesel pump sets	48.36	VI
7.	Lack of post corrections and regular monitoring of ponds by Agril. Department	46.15	VII
8.	Inadequate rainfall and frequent drought prevailed	41.06	VIII
9.	Negative externality due to higher rates of evaporation during post rainy season	34.32	IX
10.	Economic unfeasibility of ponds due to small holding size	21.77	X

Source: Author calculation based on field survey data.

farm ponds. Srinivasa Rao et al., (2017) reported that lack of awareness, small holding size, higher investments at initial level, seepage and loss due to evaporation and reasonable profit in normal years are problems in large scale adoption of farm ponds in rainfed ecosystem of India. Gupta et al., (2021) opined need for synergy and convergence among researchers, administrations, line departments, NGOs, extension system were felt as the facilitative factors for diffusing Contemorary water management innovations. Dupdal et al., (2021) reported that non-availability of information towards climate change was major problem in adoption of adaptation practices. Ahmed et al., (2015) reported that absence of fences and roof cover, siltation of sediments, limited training of stakeholders during implementation of the programme and wrong site selection were the major problems encountered by farmers in utilization of rainwater harvesting technology in Derra district of Central Ethiopia. The inadequate management of conservation practices by the farmers due to poor knowledge and awareness (Oraon et al., 2020; Kumar et al., 2021).

CONCLUSION

Farm ponds constructed under Krishi Bhagya Scheme enhanced the crop productivity and income of the farmers in the rainfed areas of SAT of Karnataka. The farm ponds changed the cropping pattern, increased cropping intensity and crop productivity when crops were supplemented with life saving irrigation from the farm ponds. The income with irrigation to the crops from farm ponds ranged from 13 percent in sunflower to 97 percent in coriander crops. The employment generation also increased with adoption of farm ponds. This study also revealed the sedimentation of farm ponds, faulty design of farm ponds, poor site selection and lack of maintenance of ponds were the major constraints experienced by farmers for sustainability of farm ponds in the region. The training to the farmers on the management of farm ponds is crucial for efficient utilization of farm ponds in the region for their sustainability.

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