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Enhancing crop productivity, cropping intensity, and employment generation through water harvesting (community/farm ponds) under Aberrated climatic conditions in Chhatarpur district of Madhya Pradesh: A case study

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Abstract

Rainfed agriculture in semi-arid regions is highly vulnerable to climate variability, especially erratic rainfall, prolonged dry spells, and frequent droughts. Chhatarpur district of Madhya Pradesh, located in the Bundelkhand region, faces serious agricultural challenges due to its heavy dependence on monsoon rainfall. This study assesses the impact of Community/Farm Ponds as rainwater harvesting structures on crop productivity, cropping intensity, farm income, and employment generation under aberrant climatic conditions. The study was conducted in Village Panchayat Salaiya, Block Rajnagar, Chhatarpur district, during 2023-2025. A total of 100 farm households were selected using a multi-stage random sampling technique, including 50 farmers with Community/Farm Ponds and 50 farmers without ponds as a control group. Primary data on cropping pattern, crop yields, income, livestock, and employment were collected through structured interviews. Descriptive statistical methods were used for data analysis. The results indicate that Community/Farm Ponds significantly improved water availability for protective irrigation during critical crop growth stages. Beneficiary farmers recorded an expansion in irrigated area and adoption of double cropping. Cropping intensity increased to 200% for farmers with ponds compared to 100% for control farmers. Crop productivity increased by 12.5% to 28.6% for major crops such as wheat, chickpea, mustard, soybean, groundnut, sesame, and paddy. Average net farm income of farmers with ponds was 20.1% higher than that of farmers without ponds. Improved water availability also supported livestock development by ensuring drinking water and green fodder throughout the year. Livestock population increased by 9.5%, while milk production increased by 14.7% among beneficiary households. Employment generation increased by 36.2% man-days per hectare due to higher labour demand during the rabi season, vegetable cultivation, and allied activities such as dairy and fish farming. The study concludes that Community/Farm Ponds are an effective climate-resilient intervention for rainfed areas. By improving water security, agricultural productivity, farm income, and employment opportunities, these structures contribute significantly to sustainable livelihoods and reduced vulnerability to climate variability.

Keywords: Cropping Intensity, Productivity, double cropped area and economics

Introduction

Chhatarpur is one of the districts of the Bundelkhand region of Madhya Pradesh, situated in the central part of India. The district lies in the central plateau of Bundelkhand and is located between 24°06' and 25°20' North latitude and 79°59' and 80°26' East longitude. The district receives the majority of its rainfall during the southwest monsoon, with nearly 90% of the annual rainfall occurring in this period, as reported by the Ministry of Water Resources.

In recent decades, however, climate change has significantly altered rainfall patterns, leading to year-to-year variability and frequent climatic aberrations. These changes have adversely affected crop area, production, and productivity. Rainfall has become increasingly erratic, characterized by either short-duration high-intensity rainfall events or prolonged dry spells, both of which severely impact agricultural performance. High-intensity rainfall over short durations results in excessive runoff and poor groundwater recharge, while extended dry spells lead to moisture

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stress during critical crop growth stages.

Consequently, crop cultivation under such conditions has become extremely challenging. Crops exhibit poor growth and development under both excess moisture and prolonged drought stress. As agriculture in the region is predominantly rainfed, failure or delay of the monsoon often leads to drought, resulting in substantial declines in agricultural production and productivity. Late onset of the monsoon, dry spells exceeding 10 days during July and August, and terminal drought conditions during September are common in rainfed areas.

As a result, productivity in rainfed ecosystems remains very low, often below 1.0 t ha⁻¹, compared to irrigated ecosystems where productivity can reach 2.5 t ha⁻¹, as reported by Biswajit *et al.* and Palanisami and Kumar (2009) [6].

Role of Rainwater Harvesting and Community/Farm Ponds

Rainwater harvesting through location-specific methods has been practiced traditionally across many villages in Chhatarpur district. Among these methods, Community and Farm Ponds are widely accepted water harvesting structures due to their smaller land requirement, reduced evaporation losses, ease of management, and direct benefits to farmers and communities.

Despite their advantages, farmers often face constraints such as inability to spare land and lack of financial resources for constructing ponds. To address these challenges, Krishi Vigyan Kendra (KVK), Chhatarpur, collaborated with Ecolife Foundation (the implementing agency) to provide technical assistance for a project implemented under the CSR initiative of Kotak Mahindra Bank Limited.

Through this collaboration, scientifically designed and field-tested interventions were implemented to promote water conservation, improve soil health, and enhance agricultural productivity in the project area. Financial support from Kotak Mahindra Bank's CSR programme, combined with technical guidance from KVK, enabled farmers to adopt improved agronomic practices, climate-resilient cropping systems, and efficient water-use methods. This integrated approach ensured that investments in water infrastructure translated into measurable improvements in crop yields, farm productivity, farmer incomes, and long-term climate resilience in this drought-prone region.

Significance of Community/Farm Ponds in Rural Livelihoods

Rainfall remains the primary source of agricultural water in the region; however, mismanagement of rainwater has historically led to declining agricultural productivity and severe impacts on rural livelihoods. Community and Farm Ponds serve as an effective solution by collecting and storing rainwater for future use. In rural areas, these ponds are used for Irrigation of field crops, Cultivation of vegetables near homesteads, providing drinking water for livestock. The present study focuses on the positive impact of Community and Farm Ponds on rural livelihoods in Village Salaiya, District Chhatarpur. The analysis is based on two economic principles, Principle of Combining Enterprises, and Principle of Comparative Advantage, both aimed at increasing crop production and income in rural areas. The case study highlights how Community/Farm Ponds contribute to improved irrigation availability, increased crop production and profitability, Groundwater recharge, Soil erosion control. These ponds support sustainable agricultural practices and improve the standard of living, particularly in rural communities. Previous studies have also shown that short-duration drought-tolerant crops are more adversely affected by

climatic stress than long-duration crops, as the latter have greater capacity to recover during favorable conditions (Sharma and Scott, 2005) [9, 19]

Materials and Methods

The present study was conceptualized to evaluate the impact of Community/Farm Ponds constructed and renovated by Ecolife Foundation on enhancing crop productivity in rainfed regions through efficient rainwater management. Under the project, more than seven Community/Farm Ponds were constructed on community lands and individual farmers' fields, with a combined water storage capacity of 922.5 lakh litres. The study assessed changes in, Cropping patterns, Crop productivity, Farmers' income by comparing situations with and without Community/Farm Pond interventions.

Study Area

The study was conducted in Village Panchayat Salaiya, Block Rajnagar, District Chhatarpur, under the Bundelkhand region of Madhya Pradesh. The area falls within a semi-arid agro-climatic zone, characterized by low and erratic rainfall. Village Salaiya is located between 24°66' and 24°78' North latitude and 79°40' and 79°61' East longitude. The district receives an average annual rainfall of approximately 1074 mm, which is unevenly distributed. Predominant soil types include sandy, sandy loam, and medium black soils.

Agriculture is the primary occupation, with more than 75% of the population dependent on agriculture and allied activities. Major crops grown include: Kharif- black gram, green gram, sesame, Rabi- wheat, chickpea, mustard. The region receives unimodal rainfall and consists largely of medium to deep black soils with diversified cropping systems (Dupdal *et al.*, 2022) [4].

Data Source and Sampling

To analyze the impact of Community/Farm Ponds, farmers with and without ponds were selected from the same village using a multi-stage random sampling technique. A total of 100 farm households were surveyed during 2023-2025, comprising 50 farmers with Community/Farm Ponds, and 50 farmers without Community/Farm Ponds (control group). Primary data on cropping patterns, crop yields, income levels, employment status, and livestock components were collected using pre-tested interview schedules.

Statistical Analysis

Descriptive statistical tools such as frequency, percentage, and tabular analysis were used to assess the impact of Community/Farm Ponds on:

1. Cropping patterns
2. Crop productivity and returns
3. Employment generation

Among beneficiary farmers compared to control farmers.

Climatic Variability Trends in Chhatarpur District (2011-2022)

Analysis of rainfall data during 2011-2022 indicates significant climatic variability. Maximum negative rainfall deviations were observed during 2014, 2021, 2017, 2011, 2012, and 2022 (-44.2%, -23.6%, -21.04%, -18.6%, -8.5%, and -7.44%, respectively), while positive deviations occurred during 2013, 2015, 2016, and 2019 (32.78%, 18.63%, 15.6%, and 33.13%, respectively) compared to normal rainfall.

Deviations exceeding ±10% were found to be harmful to

moisture-sensitive Kharif crops. Long rainfall deficits were recorded during September 2013, 2015, 2020, and August 2022, while excessive rainfall events were observed in August 2013, 2016, and 2019. Additionally, dry spells exceeding 10 days occurred multiple times during the study period, with dry spells

exceeding 20 days recorded in 2016. These findings clearly indicate that the climate of Chhatarpur is highly vulnerable, making crop production particularly short-duration Kharif crops extremely challenging.

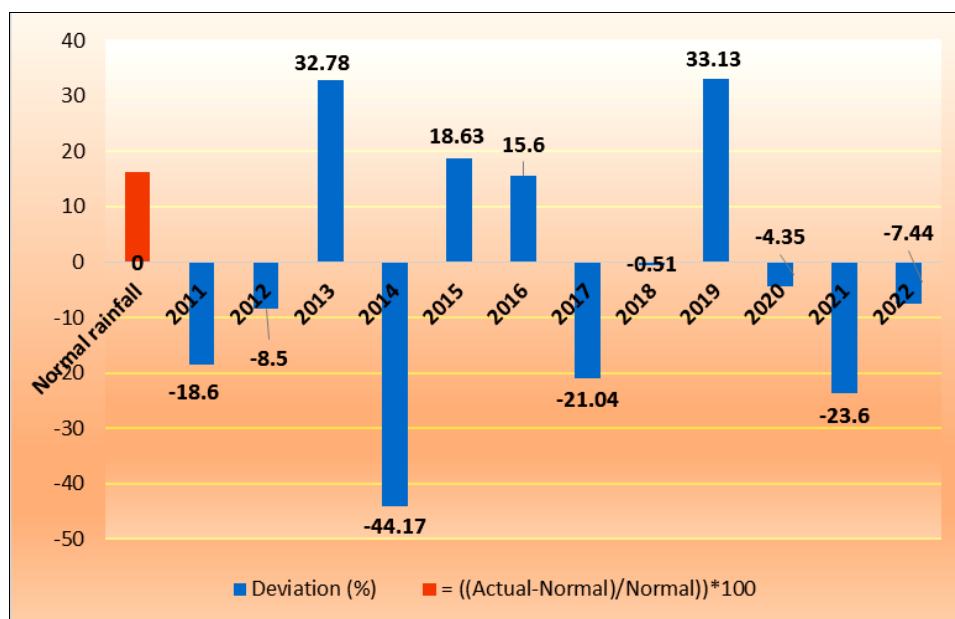


Fig 1: Annual Rainfall Deviation (%) from Normal Levels (2011-2022)

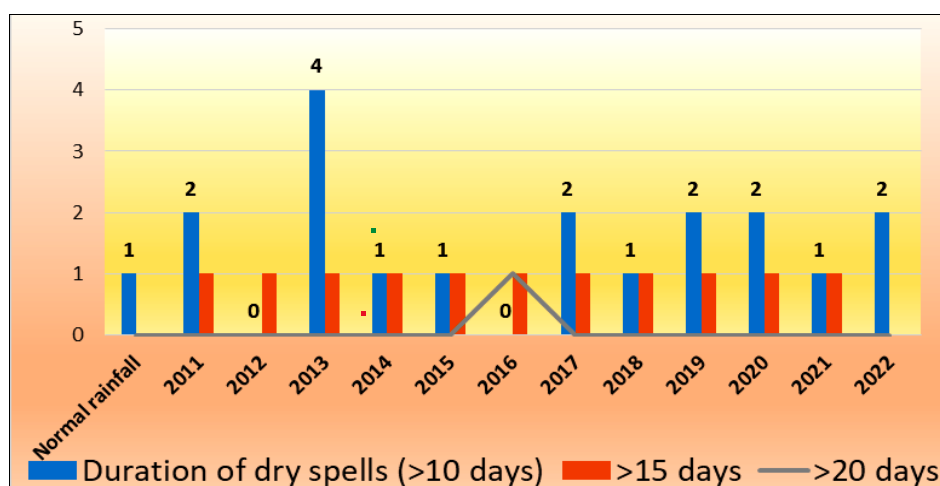


Fig 2: Duration and numbers of dry spell during 2011-2022

Results and Discussion

Community/Farm Pond and its Impact on Cropping Pattern and Cropping Intensity

The impact analysis of Community/Farm Ponds on cropping patterns indicated that the irrigated area expanded due to on-farm rainwater conservation and harvesting for protective irrigation, particularly during critical crop growth stages. Farmers with ponds had a larger percent change area under Wheat (87.5%), Groundnut (24.9%) Blackgram (24.6%) Soybean (22%) Paddy (9%) and Chickpea 7.2% as compared to without Community/Farm Ponds farmers. Besides this change the productivity of crops Wheat and Mustard (28.5%) Chickpea (25%) and 19 to 11% change productivity Sesame, Blackgram, Soybean, Paddy and Groundnut respectively under with ponds farmers as compared to without ponds farmer. Due to adoption of Community/Farm Ponds for excess runoff water harvesting,

resulting in increased water availability for life-saving irrigation and in-situ soil moisture conservation (Table 2). A 11.8% change in dual cropped area in Net cropped area was observed between farmers with Community/Farm Ponds and control farmers. The difference in net cropped area was mainly due to the increase in relative cropped area during the rabi season compared to the kharif season, leading to a difference in cropping intensity of 200% for farmers with Community/Farm Ponds compared to 100% for control farmers (Table 1), with the difference in cropping intensity between farmers with and without Community/Farm Ponds found statistically significant. From cited by by Dupdal *et al.* 2023^[3] and Dupdal *et al.* 2024^[2] revealed that Community/Farm Pond construction led to a noticeable change in cropping intensity by increasing the area under rabi crops among farmers with ponds compared to those without Community/Farm Ponds.

Role and Impact of Ecolife foundation & Kotak Mahindra Bank

Prior to the implementation of water harvesting ponds, 122 hectares of land lay Single cropped area due to erratic rainfall patterns observed over the past decade. To address this issue, Ecolife Foundation under the CSR initiative of Kotak Mahindra Bank, and with technical support from KVK scientists, constructed and renovated scientifically designed water harvesting ponds to boost crop production and productivity, and reduce fallow land by promoting efficient use of harvested water through micro-irrigation and sprinkler irrigation systems. Consequently, this initiative enabled the cultivation of double crops by adopting short-duration, drought-tolerant varieties during the Kharif season and timely sown Rabi crops, thereby enhancing cropping intensity, reducing fallow land, and improving crop productivity.

Under the leadership of Shri Amit Singh (Chief Executive Officer, Ecolife Foundation) a pivotal water management initiative was successfully implemented during 2022-25. This project resulted in the development of three new ponds and the restoration of 8 existing ponds and in Salaiya Gram Panchayat. Overall the project constructed 21 Ponds & 5 Check dams conserving 18.45 crore lts of extra water per year with the objective of harnessing excess runoff and providing crucial irrigation during prolonged dry periods. Given that water scarcity had previously affected 33 percent of the area, rendering it fallow or damaged, these interventions are anticipated to enhance crop performance, growth, development, and yield per unit area during terminal drought situations. The project's successful execution has led to an additional 160 acres being brought under cultivation and 122 hectares under double cropping within a year. Consequently, assured water availability

has been extended from February to April, significantly benefiting agricultural activities. Furthermore, the rejuvenation of existing ponds and check dams has improved water levels, availability, and discharge capacity over a longer duration in dug wells, underscoring the project's impact on water resource management. Additionally, the KVK scientist played a vital role in enhancing water use efficiency through, irrigation scheduling, and the adoption of short-duration drought-tolerant varieties via capacity development programs, method demonstrations, and group meetings, ultimately enhancing the productivity of field crops such as wheat, mustard, and chickpea by 28.5, 28.5, 25%, and Sesame, Blackgram, Groundnut, Soybean & Paddy 19.4%, 15.7%, 14.6%, 14.3% and 14.3% respectively as compared to existing farmers practices (Table 4). Besides this negative impact of less water loving crop like Mustard and fieldpea reduce area -11.8 and -14.5% respectively (Fig 4)

Strategies for Enhancing Milk Productivity

The availability of water from these ponds helps mitigate drought periods and allows for farm diversification, which directly translates to increased milk yield and farm income. Ponds ensure a consistent supply of clean drinking water for cows and buffaloes, which is increase livestock population 9.5% and milk production 14.7% as compared to control (Table 3). Proper hydration is essential for high milk production. The most significant impact comes from using pond water for supplemental or critical life-saving irrigation during dry spells. Therefore, farmers cultivate high-yield, water-efficient green fodder crops like berseem and sorghum, especially in semi-arid regions. This approach enables farmers to reduce dependence on erratic monsoons and expand the cultivation area, ensuring consistent, high-quality feed.

Table 1: Impact of Community/Farm Ponds on live stock population and their productivity

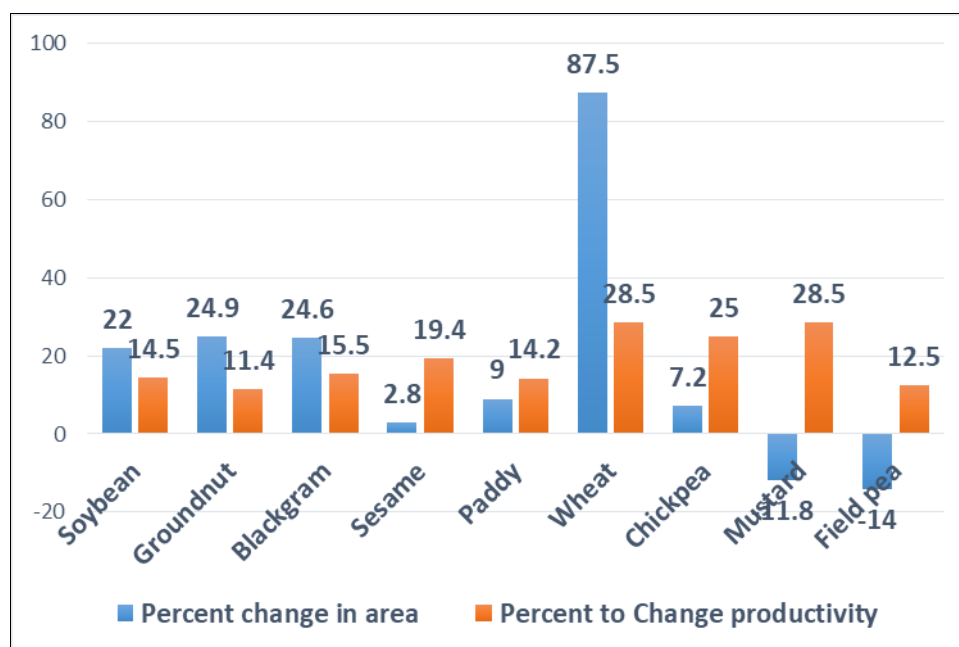
Live stock	Without Community/Farm Ponds	Total milk Production(000L)/Lactation period	With Community/Farm Ponds	Total milk Production/Lactation period	% difference in population	Percent increase Total milk Production/Lactation period
Cow	2400	1008, (280 days)	2570	1079.4	7.1	7.0
Buffalo	2050	3444, (280 days)	2200	4004	7.3	16.3
Goat	300	33.7, (150 days)	430	64.5	43.3	91.4
Grand Total	4750	4485.7	5200	5147	9.5	14.7

Table 2: Impact of Community/Farm Pond on double cropped area and cropping intensity

Crop	With Community/Farm Ponds		Without Community/Farm Ponds		Percent increase in double cropped area	Percent reduce in single cropped area	Cropping Intensity (%)
	Area(ha)	Percent to the Total area	Area(ha)	Percent of the Total cultivated area			
Village area (ha)	5924.77	-	5924.77	-	-	-	-
Cultivated area (ha)	1930.03	32.5	1930.03	32.5	-	-	-
Net Cultivated area (ha)	1930.03	32.5	1930.03	32.5	-	-	-
Double Cropped area (ha)	1028.22	53.3	1150.20	59.6	11.8 (121.98 ha)	-	200
Single Cropped area (ha)	901.81	46.7	779.83	40.4	-	13.5 (121.98 ha)	100

Table 3: Impact of Community/Farm Ponds on Cropping area and their pattern.

Crop	Without Community/Farm Ponds		With Community/Farm Ponds			
Kharif Crops	Area(ha)	Productivity kg/ha	Area(ha)	Productivity kg/ha	Percent Change in area	Percent to Change productivity
Soybean	150.1	1402	180.5	1605	22.0	14.5
Groundnut	200.5	1570	250.4	1750	24.9	11.4
Blackgram	280.4	521	305.0	602	24.6	15.5
Sesame	305.22	402	314.0	480	2.8	19.4
Paddy	92.0	2800	100.3	3200	9.0	14.2
Total Kharif area	1028.22		1150.2			
Rabi Crops						
Wheat	200.2	2800	375.3	3600	87.5	28.5
Chickpea	252.12	1200	270.15	1500	7.2	25.0
Mustard	430.5	700	379.75	900	-11.8	28.5
Field pea	145.4	1600	125.0	1800	-14.0	12.5
Total rabi area						

**Fig 3:** Percentage Change in Area and Productivity of Various Crops

Impact of Community/Farm Ponds of increase water capacity and Irrigated area: Following the launch of Community Pond /Farm Ponds, the irrigated area has increased by 122 hectares, benefiting farmers through enhanced productivity of field crops, livestock population, and their productivity, as well as improved employment opportunities due to assured water availability. Consequently, the double-cropped area and productivity have increased, resulting in farmers earning additional income per unit area. Renovating ponds significantly increases their water capacity 122.5 lakhs litters and ranges from 49 lakhs litter to 324 lakhs litter (Table 4 and

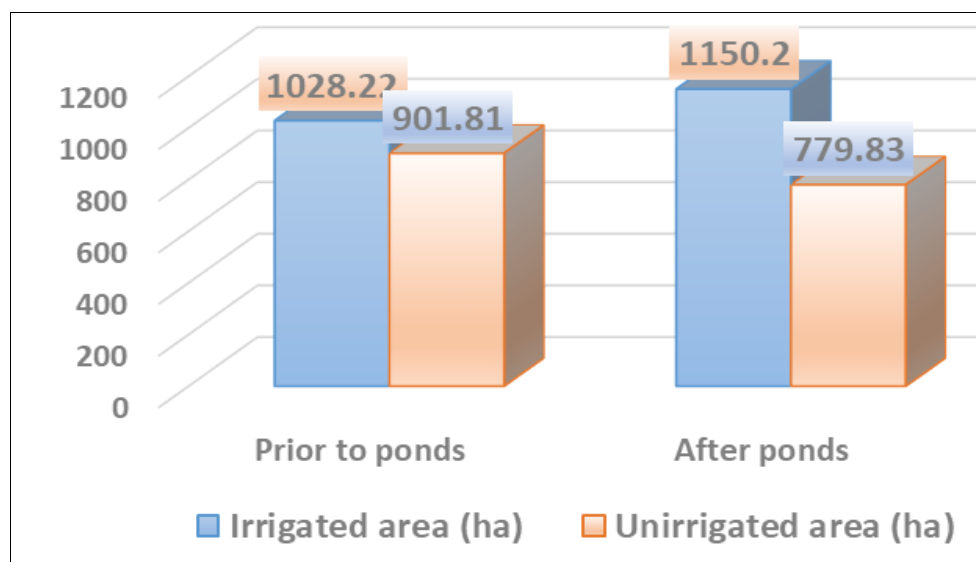
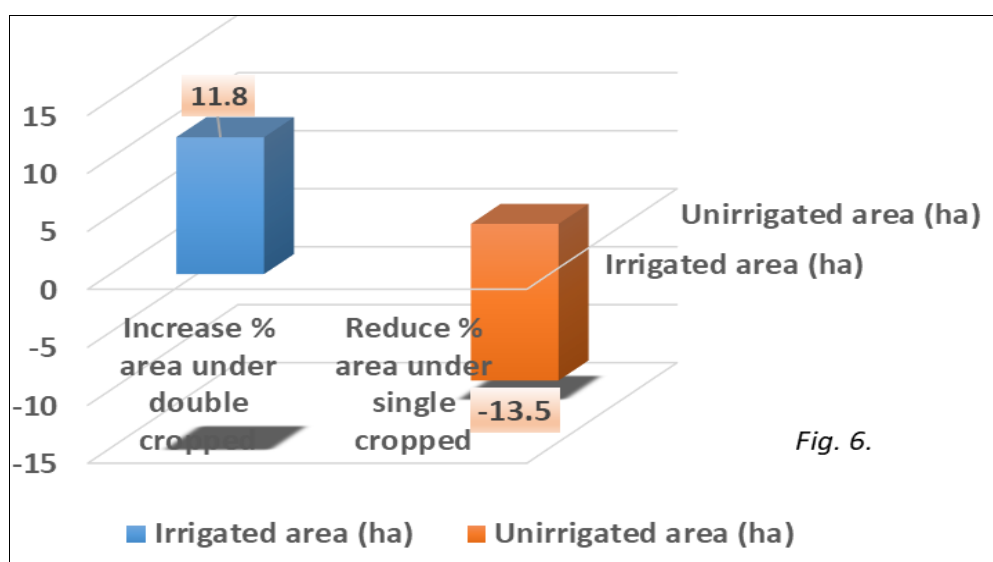
5), based on Community/Farm Pond size and catchment area and increased double cropped area 11.8% and reduce -13.5% single cropped area (Fig 5 & 6) by removing silt, deepening, and strengthening embankments and micro irrigation. This leads to better rainwater harvesting, increased groundwater recharge, improved irrigation for crops, boosting yields, and enhanced water security for communities and livestock, effectively turning seasonal dry ponds into year-round water sources. Projects often see multi-fold increases in storage, supporting agriculture and reducing dependence on external water, while reviving local ecosystems by attracting wildlife and vegetation

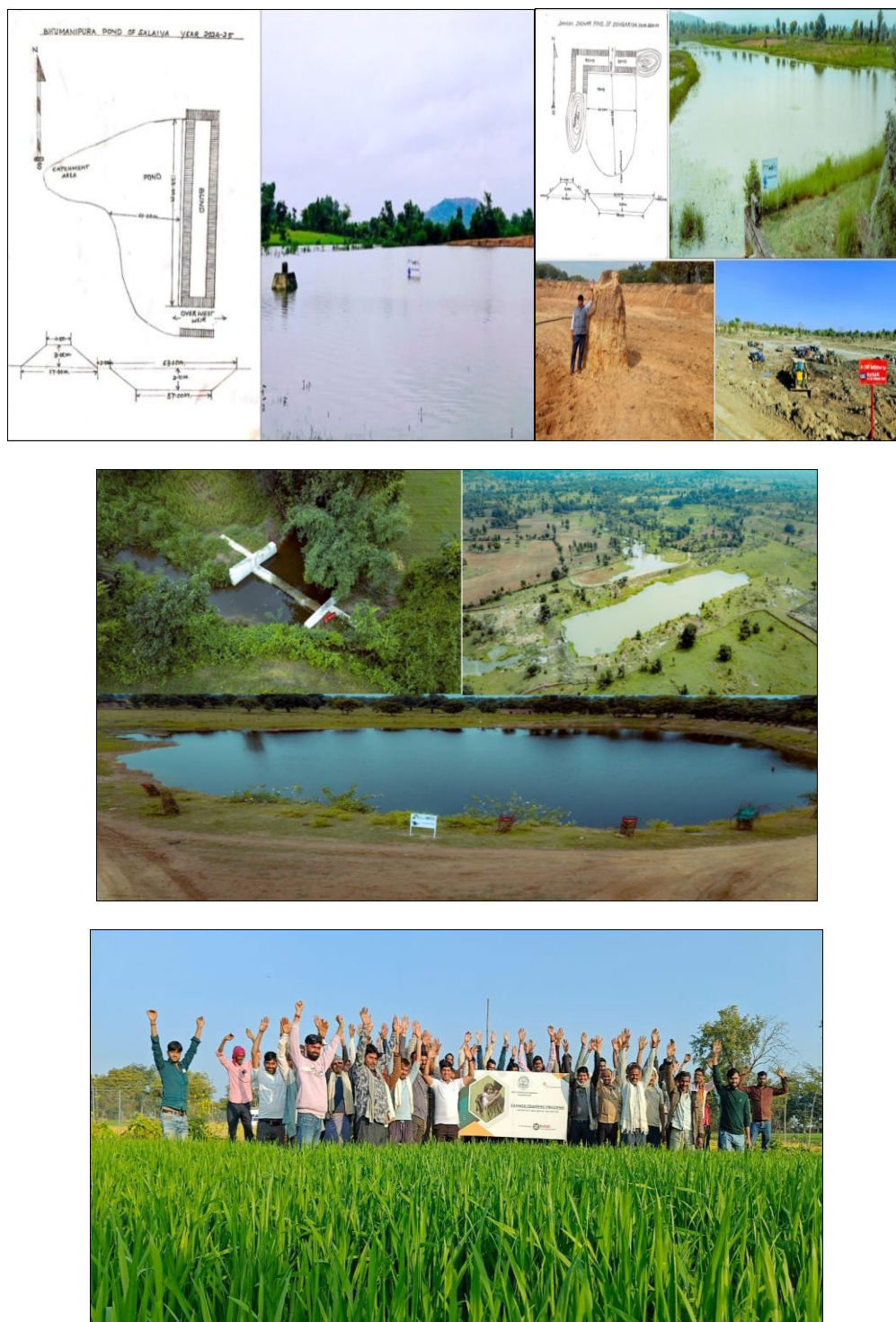
Table 4: Impact of Community/Farm Ponds of increase water capacity and Irrigated area

Sl. No.	Structure Name	Ponds dimension M ³	Increase Capacity of Water in lakh litre	Old Capacity of Water in lakh litre	Total Capacity of Water in litre
1	Moniya Pond	9058.09	64.8308	25.7501	90.5809
2	Beldabra Pond	7779.13	58.9138	18.8775	77.7913
3	Jamun Jhuwar Pond	13929.57	93.0957	46.2	139.2957
4	Pitua Nala New Pond	14400	144	0	144
5	Kajalyau Pond	19316.5	125.125	68.04	193.165
6	Munnalal Pond	6215.505	61.9971	0.15795	62.15505
7	Bhumanipurwa Pond	5000.8	49.8793	0.01287	49.89217
8	Tikra Muhalla Pond	36795.2	324.67599	43.276	367.95199
	Total		922.51769	202.31442	1124.83211

Table 5: Area under Irrigated and unirrigated

Type of area	Prior to ponds	After ponds	Increase% area under double cropped	Reduce% area under single cropped
Irrigated area (ha)	1028.22	1150.20	11.8	
Unirrigated area (ha)	901.81	779.83		-13.5

**Fig 4:** Impact of Ponds on Irrigated and Unirrigated Areas (ha)**Fig. 6.****Fig 5:** Increase in Double-Cropped Area and Decrease in Single-Cropped Area due to Farm Ponds



Impact of Community/Farm Ponds on Crop Yields and Farm Income

The study's findings on the impact of Community/Farm Ponds for rainwater harvesting and supplemental irrigation revealed notable differences in crop yields and net income among farmers with Community/Farm Ponds, as illustrated in Table 4 and Figure 1. Specifically, crop yields showed significant variations, particularly in wheat, mustard, and chickpea by 28.5, 28.5, 25%, and Sesame, Blackgram, Groundnut, Soybean & Paddy 19.4%, 15.7%, 14.6%, 14.3% and 14.3% respectively as compared to existing farmers practices to cultivation without irrigation under rainfed conditions. Significant difference in yields between farmers with Community/Farm Ponds and control farmers. The yield disparity among farmers with ponds can be attributed

primarily to increased protective irrigation during critical crop growth stages and improved soil moisture. Additionally, field bunds constructed in farmers' fields contributed to increased soil moisture and reduced field cracking in areas with Community/Farm Ponds. The results demonstrated that the yield differences translated to additional income of Wheat (Rs.19400/ha), Chickpea (Rs/ha16950), Groundnut (Rs/ha16705) Mustard (Rs/ha11900) Fieldpea (Rs/ha11300) and rest of crops additional income less than (Rs/ha. 11000) as compared to control (Table 4). These findings are consistent with previous research by Kumar *et al.*, Raizada *et al.*, Gireesh *et al.*, and Kumar *et al.* The percentage difference in farmers' income with Community/Farm Ponds ranged from 12.5% to 28.6% for various crops compared to control farmers, resulting

in a average net income 20.1% higher than that of farmers without Community/Farm Ponds (Fig 7). These results align with the study by Rao *et al* 2019,^[7] which reported income gains due to improved crop yields, changes in cropping patterns towards high-value crops, increased cropping intensity, and expansion of cultivated area where ponds were located. Furthermore, this study's findings are supported by Dupdal *et al.* 2022,^[2] who reported that Community/Farm Pond interventions enhanced crop productivity by 12.5-28.5% (Table 2) due to harvested rainwater providing protective irrigations during dry spells and drought. Similar results on increasing crop productivity and net returns with Community/Farm Pond irrigation were reported by Rao *et al.* 2019^[7] and Reddy *et al.* 2018. The study's results also corroborate with Kumaret *al* 2016., who found that tank rejuvenation improved the livelihood of 50-70% of small and marginal farmers through increased crop yields.

Community/Farm Pond and its impact on employment generation among beneficiary farmers

The adoption of Community/Farm Ponds resulted in a notable difference in employment generation, with Community/Farm Pond adopters recording 28.8 percent and 58 man-days per ha farm compared to 45 man-days per ha farm for non-adopters in kharif season and 45.7 percent and 51man-days per ha farm

compared to 31 man-days per ha farm for non-adopters in Rabi season (Table 5). Over all 36.2 5 more employment generation under Community/Farm Ponds as compared to without Community/Farm Ponds. The disparity in man-days between beneficiary farmers and control farmers was primarily due to increased labor requirements during the rabi season. Harvesting excess runoff water and utilizing it for supplemental irrigation through Community/Farm Ponds expanded the irrigated area, thereby generating more employment opportunities on farms with ponds. These findings are consistent with the study by Kumar *et al.*, which reported that Community/Farm Ponds facilitate cropping system diversification and increased crop yields, ultimately enhancing employment opportunities by promoting integrated cropping and farming systems, which diversify income streams and create year-round work, and through government schemes that encourage high-value and off-season crops and field crops. The water availability from ponds enables the cultivation of high-value crops (tomato, chilli, and brinjal) and the extension of farming into the dry (rabi) season (wheat, chickpea, and mustard), which significantly increases labour demand and productivity per hectare. The availability of water and improved fodder production supports dairy, poultry, and goat/sheep farming, providing alternative income and employment sources.

Table 6: Impact of Community/Farm Ponds on employment among beneficiary farmers (Man days/ha)

Particular	Without Community/Farm Ponds	With Community/Farm Ponds	Percent difference of man days/ha
	Man days/ha	Man days/ha	
Kharif	45	58	28.8
Rabi	35	51	45.7
Total	80	109	36.2

Impact of Ecolife Foundation

This study examined the impact of their work on increasing cultivated area, double cropping area, income, and employment generation, ultimately enhancing the standard of living for farmers, livestock health, and human well-being. Consequently, farmers expressed high satisfaction, having secured their basic needs and those of their families. Otherwise, approximately

36.2% of farmers would have migrated in search of employment opportunities after six months, given the limited job opportunities in the crop period. The struggle to meet daily needs such as tuition fees, clothing, and other essentials would have led to difficulties for their family members. Additionally, farmers observed improvements in their livestock productivity, health, and reduced mortality rates.

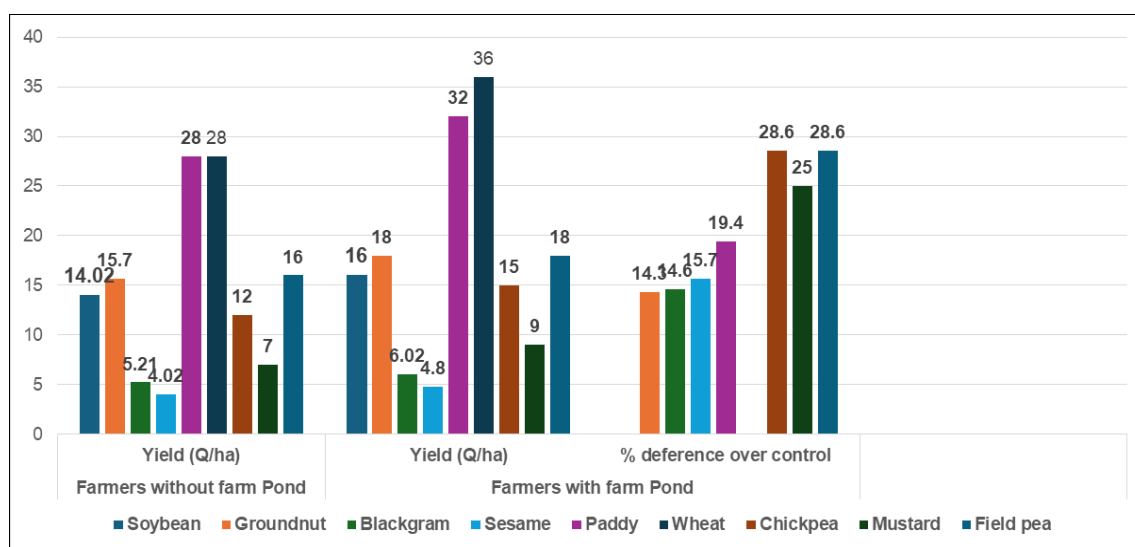


Fig 6: Impact of fram Ponds on crop yields q/ha and Farm Income %

Table 7: Impact of Community/Farm Ponds on Crop Yields and Farm Income

Season/Crop	Farmers without Community/Farm Pond					Farmers with Community/Farm Pond					Additional income to farmers with Community/Farm Ponds	% deference over control
	Yield (Q/ha)	COC (Rs/ha)	Gross return (Rs/ha)	Net return (Rs./ha)	B:C Ratio	Yield (Q/ha)	COC (Rs/ha)	Gross return (Rs/ha)	Net return (Rs./ha)	B:C Ratio		
Kharif												
Soybean	14.02	33315	74592	41277	2.2	16.0	33315	85248	51933	2.6	10656	14.3
Groundnut	15.70	38389	114029	75640	3.0	18.0	38389	130734	92345	3.4	16705	14.6
Blackgram	5.21	22591	40560	17969	1.8	6.02	22591	46956	24365	2.1	6396	15.7
Sesame	4.02	21400	39580	18180	1.8	4.8	21400	47260	25860	2.2	7680	19.4
Paddy	28.00	47994	66332	18338	1.4	32.0	47994	75808	27814	1.6	9476	14.3
Rabi												
Wheat	28.00	32905	67900	34995	2.1	36.0	32905	87300	54395	2.7	19400	28.6
Chickpea	12.00	28854	67800	38946	2.3	15.0	28854	84750	55896	2.9	16950	25.0
Mustard	7.00	24400	41650	17250	1.7	9.0	24400	53550	29150	2.2	11900	28.6
Field pea	16.00	26385	90400	64015	3.4	18.0	26385	101700	75315	3.9	11300	12.5
												20.11 %

Conclusion

Sustainable agricultural production in rainfed regions faces significant challenges under climate change, primarily due to unpredictable and erratic rainfall, frequent droughts, prolonged dry spells, and crop failures. However, these challenges can be mitigated through the adoption of Community/Farm Ponds at the farm level for rainwater harvesting and efficient utilization and management of excess runoff water to increase rainfed productivity. This approach enables farmers to diversify their cropping systems and integrate different farming systems with agriculture, such as dairy farming, to enhance on-farm and off-farm income in rainfed areas. It also promotes efficient utilization and management of natural resources in these regions. The study results clearly indicate differences in cropping patterns, cropping intensity, and crop yields following the adoption of Community/Farm Ponds. The area under irrigation increased due to on-farm rainwater conservation and harvesting, which was utilized for supplemental life-saving irrigation. Notably, there were differences in crop yields and farm income for farmers with Community/Farm Ponds compared to those without, attributed to protective life-saving irrigation during critical crop growth stages facilitated by Community/Farm Ponds. Furthermore, the results revealed that the percentage gain in income for farmers with Community/Farm Ponds ranged from 12.5% to 28.6% compared to control farmers, with net income being higher for farmers with Community/Farm Ponds. Employment generation in terms of man-days was also higher for farmers with ponds than for control farmers, primarily due to an increase in man-days during the rabi season compared to the kharif season. The adoption of Community/Farm Ponds led to an increase in livelihood opportunities, such as dairy farming through livestock rearing, as Community/Farm Ponds served as a reliable source of drinking water and green fodder for livestock even during drought periods.

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