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Baseline Report of Jaldhara IV Project

A collaborative effort of Coca-Cola Foundation and S M Sehgal Foundation

Bhawna Mangla

RESEARCH MONITORING AND EVALUATION, S M SEHGAL FOUNDATION

1. About the Region

Karauli district came into existence in July 1997 as thirty second district of Rajasthan when separated from Sawai Madhopur district. The District lies between 26^0 30' – 26^0 49' North West Latitude and 76^0 35' and 77^0 26' East Longitude and at 260m altitude. Karauli district is at the height of 400 - 600 meters from sea level. The total geographical area of the district is 5043 Sq. Km. and the population is 14,58,248 as per Census 2011. The main river of state Chambal separates it from Madhya Pradesh. Karauli is located subtropical dry climate zone with average rainfall of 700 mm. Temperature touches 49.0C in summers whereas 2.0 C in winters[1]. Main source of income in the district is from the agriculture sector and per capita income is Rs. 41,180. Total cropped area is 3,28,743 in hectares. Major crops cultivated in the district are millet, mustard and wheat. Other crops cultivated but in limited areas are guar, til, cotton, pigeon pea, groundnut, and barley.

2. About the Project

The collaborative effort of Coca-Cola Foundation (funding partner) and S M Sehgal Foundation (implementing partner) aims to conserve water resources by creating series of eleven water augmentation structures in form of check dams and nala bunds across four panchayats of Nadoti block of Karauli district in Rajasthan, India. Through this intervention, a total of three non-perennial streams would be treated through a series of cascading structures. The estimated catchment area to be treated under the project is around 2300 Ha. The project duration was 2015 to 2017. However, due to various obstacles faced in implementation of the same in the earlier selected Koripura region, the project was effectively started in November, 2016 in Nadoti block.

3. About the Study

The current baseline study aims to understand the current water and agriculture scenario in the intervention region so as to measure the magnitude of the impact of water interventions on the select socio-economic indicators. Study uses both quantitative as well as qualitative data collected through structured interviews and focus group discussions with the respondent farmers.

Sampling for the study has been done at two levels. Firstly, out of total eleven rain water harvesting structures across four panchayats, one structure has been randomly selected from each panchayat. At second level, stratified purposive sampling with respect to distance from check dam has been used. Farmers who have farmlands close to check dam sites are believed to receive benefits from the project in form increased availability of ground water in years post construction of rain water harvesting structures and therefore form group of our beneficiary farmers from the intervention region . Furthermore, in order to scientifically measure the impact of the construction of check dam years later, farmers from non-intervention region are selected to ensure double difference calculation of means. Farmers from non-intervention region are selected on fulfillment of three criterion– (1) farmland more than four kilometers away from the each check dam site; (2) must be a resident of non-intervention village; (3) have similar cropping pattern. Sample size of beneficiary farmers for each site is variable for each site. For sample size of control farmers, 50% of the beneficiary farmers are targeted for each site.

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[1] http://www.karauli.rajasthan.gov.in

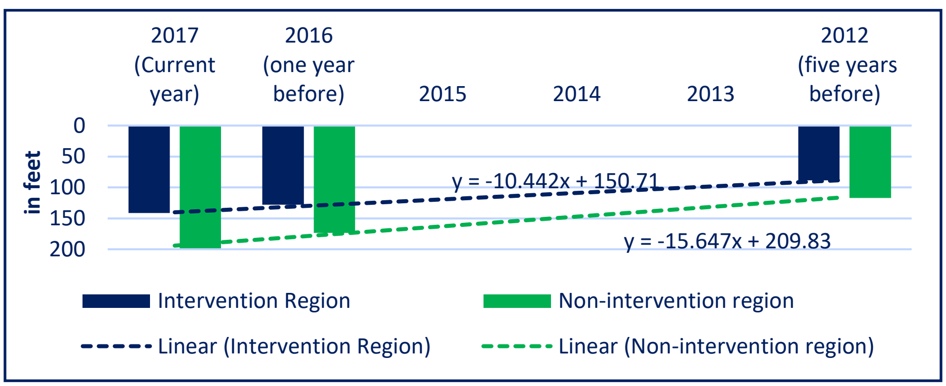
Figure 1: Log frame

Water Interventions	Outputs	Outcome	Impact Indicators
A. Construction of check dam	A1. Number of check dams constructed	A1. Decreased run-off and augmented water resource A2. Adequate availability of water for domestic and agriculture and allied purposes	A1.1. Increased groundwater levels A2.1. Increased frequency of number of irrigation A2.2 Increased agricultural productivity A2.3Increased cropping intensity A2.4 Change in cropping pattern
B. Construction of silt controlled structures	B1. Number of silt controlled structures constructed	B1. Minimized accumulation of silt in water storage area	
C. Plantation	C1. Acres of land brought under plantation	C1. Minimized soil erosion	
D. Water literacy sessions	D1. Number of literacy sessions D2. Number of community members participated in literacy sessions	D1. Water conscious communities	D1. Increased awareness on water conservation

A. Water Situation

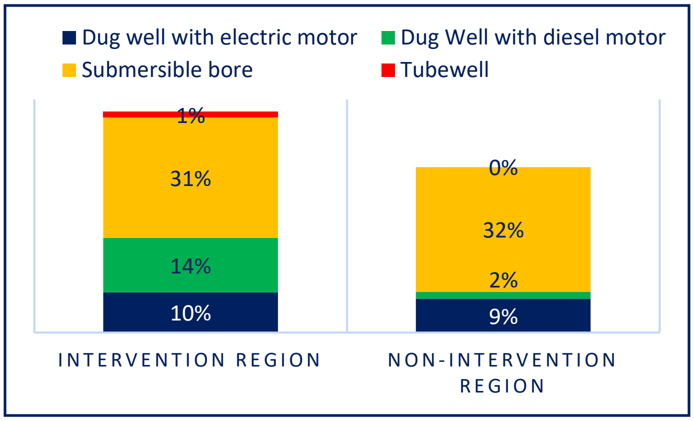
The adjoining figure (Figure 2) displays the situation of underground water table as perceived by the respondent farmers. Water levels in the study region ranges from as shallow as 40 meters to as deep as 500 meters. Water table in the region is found to be deepening over time. This is largely due to erratic and deficient monsoon coupled with continuous extraction of groundwater for irrigation and other uses. Interaction with the farmers revealed that deterioration of underground water table in last two decades is quite severe. This has led to the increase in number of exhausted sources, especially ancient old dug wells.

Figure 2: Situation of underground water (in feet) as per farmers' response



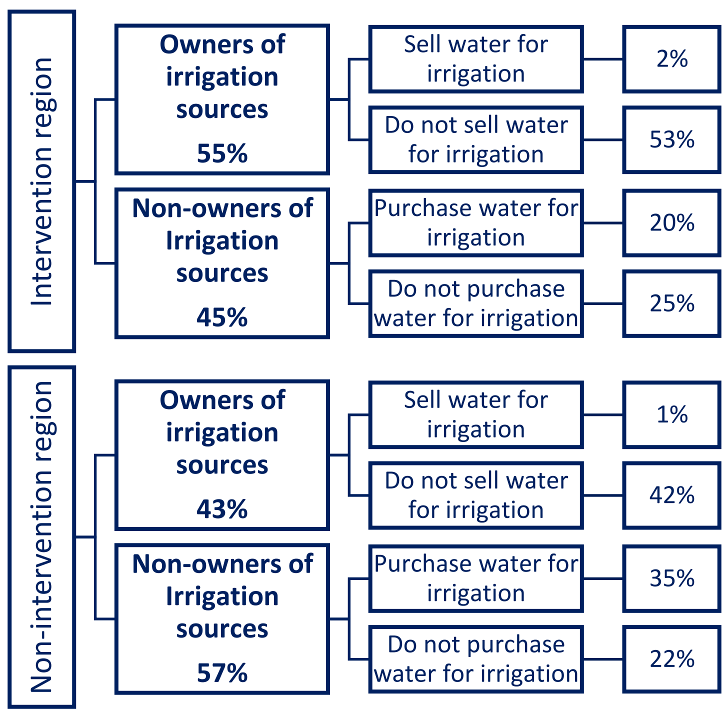
The region depends on dug wells and bore wells for irrigation. Since the existence of dug wells comes from the history, the ownership of dug wells have also been carried forward since two-three generations. Currently, most of the dug wells are owned by multiple people which has advantage of cost sharing but it also increases the wait time for their turn to irrigate the land. The situation is so grave that many farmers despite having a share in one of the irrigation resource are not able to irrigate their land timely. In one interesting case, a hamlet namely 'gyarah saje ki dhani' got its name from the dug well which was shared by 11 brothers in the past. Today, it is shared by the following two generations amounting to more than 40 households. Findings on ownership status of various irrigation sources reveals that most common source for both intervention and non-intervention region is submersible bore. Only a few of these submersible bores are found to be owned by single household, while most of them are owned by more than one household. The ownership of bore well as well ranges from single owned to owned by twenty farmers. On an average, the depth of bore is around 518 feet in intervention region and 578 feet in non-intervention region. However, there exist no case where a bore was re-excavated despite lowest depth being recorded 160 feet.

Figure 3: Ownership of irrigation sources (in percentage of respondent farmers)



The adjoining figure (Figure 4) highlights the dearth of water available for irrigation. Though more than half of the farmers own source of irrigation either partially or completely, only 2% of the total farmers sell water for irrigation. Since majority of the farmers are found to be sharing irrigation sources, there is little left for further selling. Therefore, the prime reason for not selling water is reported to be insufficient availability of water for their own use (99%), so selling water is out of question. Farmers who purchase water struggle immensely to get water at cost of INR 100-150 per hour. The availability of purchased water for irrigation is very uncertain. This is because farmers who are willing to sell water to others will sell only after irrigating their own field. The consequences of this are (1) no cultivation in rabi season; (2) cultivating rabi crops without water; and (3) cultivating rabi crops with delayed irrigation. The situation is even worse when farmers are forced to cultivate commercial crops like mustard without water. This makes farming a less remunerative for the inhabitants.

Figure 4: Situation of water trade for irrigation



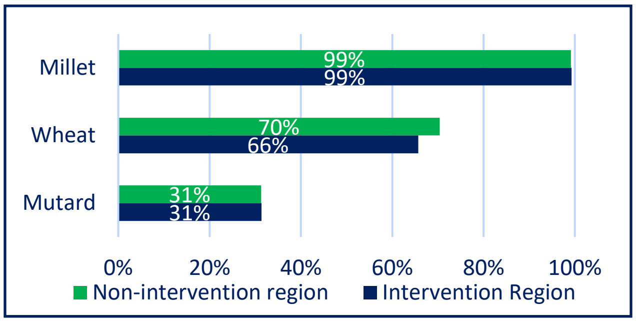
B. Agriculture Situation

The major crops grown in the study region are millet, wheat, and mustard. The details of land under cultivation is explained in the table below (table 1). The average size of cultivable land owned by the respondents is 2.12 acres for intervention region[2] and 1.73 for non-intervention region. The cropping intensity is 1.5 in intervention region and 1.7 in non-intervention region. Data reveals that approximately one-fourth farmers in the intervention region and one-fifth farmers in the non-intervention cultivates only in one season.

TABLE 1: LAND UNDER CULTIVATION (IN ACRES)

	Intervention Region	Non-intervention region
Net Sown Area	571.41	185.16
Net Irrigated Area	380.94	150.78
Gross Cropped Area	882.19	313.44

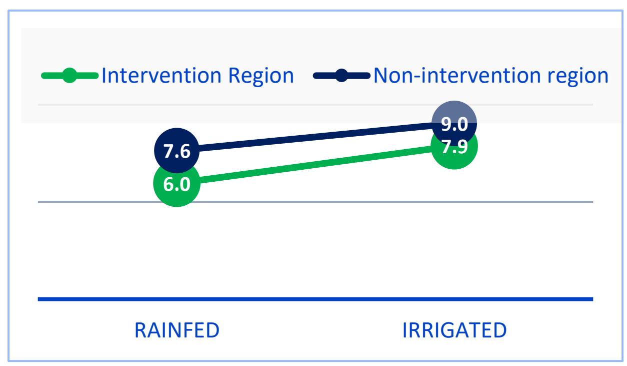
FIGURE 5: MAJOR CROP CULTIVATED (IN PERCENTAGE OF FARMERS)



Farming in the study region is limited to three crops primarily- millet in kharif; and wheat and mustard during rabi season. Most of the cultivation is rain-fed even for the crops cultivated for cash remuneration. The water scarcity and non-availability of water for irrigation is the prime reason for limited diversification in agriculture scenario in the region.

Millet is the most widely grown crop in kharif season in the study region. Millet is mostly a rain-fed crop except for 9% farmers in intervention region and 4% farmers in non-intervention region who irrigate once. During kharif season, most of the wells and bore wells dry up owing to hot weather conditions and scanty rainfall. Therefore, very few farmers have functional irrigation sources and rest of them depend on rainfall only for cultivating millet. The average yield for the district is 7.7 quintals per acre (Rajasthan agriculture statistics, 2016-17) which is same for the non-intervention study region. However, yield of millet for intervention region is only 6.1 quintals per acre. Despite majority of farmers practice rain-fed cultivation of millet, the yield is significantly higher by 1.4 quintals per acre and 1.9 quintals per acre for the ones who irrigate their land in intervention and non-intervention region respectively[3]. If on an average, 1.5 quintals is aggregated for all the acres not irrigated, the loss is computed to be 1357.5 quintals for the respondent families. In addition, almost 30% farmers in both the regions cultivate millet for commercial value as well. The average cost of cultivating millet in one acre plot is found to be ₹ 3946 and ₹4621 in intervention and non-intervention region respectively. Thus, the findings for the study region in Karauli is indicative of the low productivity of millet owing to dependence on rainwater in absence of sufficient availability of water for irrigation.

FIGURE 6: YIELD (QUINTALS PER ACRE) OF MILLET WITH AND WITHOUT IRRIGATION

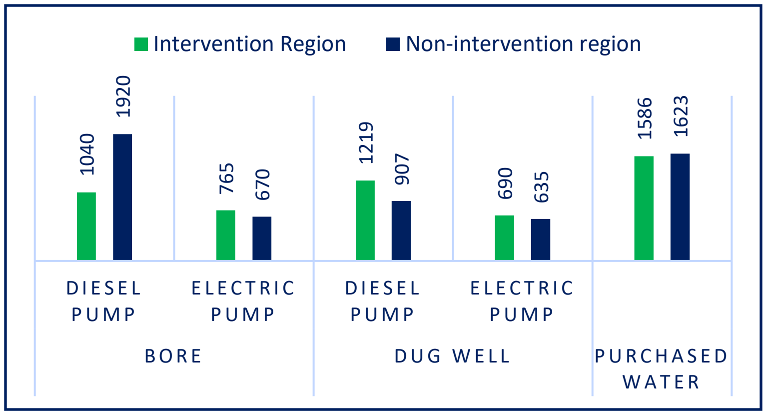


[2] The land details for the intervention region are only taken within one kilometer radius from the prospective check dam site and not beyond that.

[3] The one-way ANOVA test depicts that the difference in means is significant at 2% level of significance.

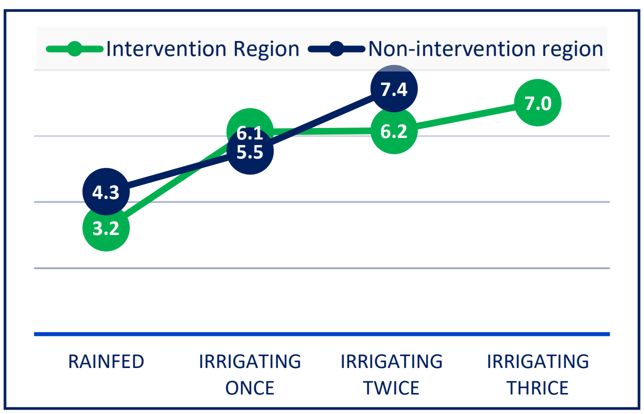
During rabi season, wheat is grown by majority of farmers mainly for subsistence[4] buy the respondent farmers in the study region. Almost all except three farmers[5] from intervention villages provided irrigation five times on an average. The Karl Pearson's coefficient of correlation between yield and number of times irrigated is positive (0.32) and significant (at 2% level of significance). This clearly indicates the potential of increase in productivity with increased irrigation and especially for the farmers who are irrigating less than four times. The data reveals that yield in the intervention region is 15.7 quintals per acre while in non-intervention region is 16.8 quintals per acre[6]. With respect to irrigation, the cost is highly variable especially in case of diesel operated pump sets extracting water from bore [7] or dug well. The coefficient of variation[8] for the former source is 68% and 55% for the latter. This is because the annual electricity bill of operating electric pump is distributed equally among the owners of bore of dug well. Since the ownership of these resources ranges from 5% to 100%, the bill share differs considerably among its users. On the other hand, cost of fuel in diesel operated pumps are borne by the users themselves and the ownership do not have any role in cost division. The diesel cost varies on the horsepower of the pump, depth of the source and level of water available since the amount of diesel required per hour varies from one to two liters and similarly number of hours per acre irrigation affecting the final cost of irrigation. The least variation is observed in purchased water where price of water ranges from ₹100-150 per hour to ₹1000 per acre per irrigation.

FIGURE 8: IRRIGATION COSTS (₹ PER ACRE PER IRRIGATION) INCURRED IN WHEAT CULTIVATION



The second most popular crop cultivated in rabi season in the study region is mustard. Mustard is grown for commercial value where one to two quintals is kept aside for home consumption and rest is sold in the market. Despite mustard being a commercially viable crop, around 8% and 26% farmers are cultivating it without irrigation in intervention and non-intervention region. On an average, irrigating mustard field once increases yield by 2.1 quintals per acre as against no irrigation[9]. Yield of mustard is found to be significantly higher for

FIGURE 7: YIELD (QUINTALS PER ACRE) OF MUSTARD IN DIFFERENT IRRIGATION CONDITIONS



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[4] 79% farmers in intervention region and 70% in non-intervention region cultivate wheat for self-consumption.

[5] These three farmers are no included in the analysis for wheat cultivation since they couldn't harvest wheat owing to damage because of no irrigation.

[6] According to estimates provided by Rajasthan agriculture statistics for the year 2016-17, average yield of wheat for the district is 16.2 quintals per acre.

[7] Only one farmer reported to be using diesel operated pump on a bore well, he reported high cost of extraction

[8] The coefficient of variation represents the ratio of the standard deviation to the mean, and it is a useful statistic for comparing the degree of variation from one data series to another, even if the means are drastically different from one another.

[9] According to estimates provided by Rajasthan agriculture statistics for the year 2016-17, average yield of mustard for the district is 7.2 quintals per acre.

more number of irrigations provided[10]. Dearth of water for irrigation is forcing farmers to cultivate a commercial crop with no or inadequate water leading to huge amount of losses in terms of production and thereby remuneration from agriculture. The average cost of irrigation is ₹945 and ₹1062 for irrigating one acre of land once. Irrigation cost is highly variable[11] in case of mustard as well with maximum variation observed in electric operated irrigation source due to the same reasons discussed in case of wheat. Additionally, average cost of cultivating one acre of mustard plot is ₹8773 and ₹8130 in intervention and non-intervention region respectively. The revenue raised from mustard production holds lot of significance for small and marginal farmers since millet and wheat is used for self-consumption and income form mustard helps to meet other household needs. The lower yields owing to irrigation water scarcity is limiting the scope of income generated from a remunerative oilseed like mustard.

C. Awareness on water conservation

With the pressure on underground water resources owing to continuous extraction of water for irrigation, drinking and other purposes; it is imperative that efforts should be taken to efficiently use and conserve the available water. This becomes even more crucial in area like Karauli which lies in semi-arid climatic zone affected by erratic rainfall. 97% respondent farmers in intervention region and 100% farmers in non-intervention region reported that groundwater has been depleting over the last five years. On exploring reasons perceived by them for the observed depletion, erratic rainfall was reported by all (Figure 9). Very few farmers reported other possible man-made factors responsible for the current water emergency situation. The rural inhabitants could not associate the changes in natural precipitation with unsustainable human practices that causes the former. Furthermore, construction of rain water harvesting structures tops the list of possible mitigating efforts reported by the farmers (Figure 10). In addition to this, farmers perceive that plantation could also help in arresting the depletion process. Again, mitigating efforts at individual level which largely involves behavioural change was recognized by very few framers as possible contribution to improve water situation in the region.

Figure 10: Perceived reasons for depletion of ground water resources

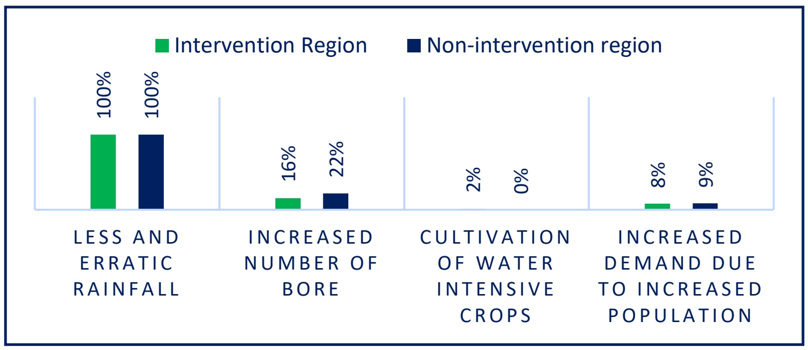
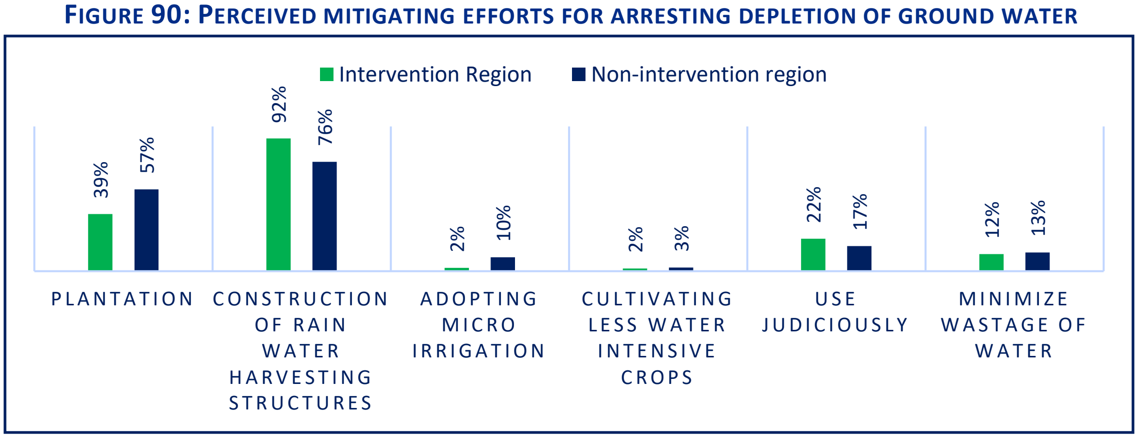


Figure 90: Perceived mitigating efforts for arresting depletion of ground water



[10] This is established by one-way ANOVA analysis of differences in means which is significant at 2% level of significance.

[11] The coefficient of variation calculated for average irrigation cost is 34% in intervention region and 32% in non-intervention region.

4. Conclusion

The study concludes that the intervention region is subjected to extreme water scarcity, especially for irrigation affecting the agriculture, the primary source of income. Owing to poor cropping intensity and lower yield, agriculture is less remunerative. The ground water levels have been going down with continuous extraction and adversity of climate change causing insufficient precipitation. The farmers of the region are finding it hard to cultivate more than one crop in a year and even if they cultivate most of it is rain-fed. Very few irrigation sources are available in the region which is mostly existent in sharing basis. Due to sharing of the irrigation water source, the water available for resource-poor farmers is negligible. At times, even the shared owners are not able to provide timely irrigation due to long waiting queue of the fellow share partners. The yield of major crops- millet, wheat and mustard is affected significantly with number of irrigation cycles provided. Therefore, there lies huge potential for increase in agriculture productivity with mere availability of irrigation water. With the planned interventions of creating water harvesting structures in the region, it is expected that underground water levels will increase and help increase the availability of irrigation water for farmers. Therefore, increasing the cropping as well as irrigation intensity to increase agricultural yield and returns from the same.