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Short Communication

Socio-economic upliftment of farmers through model irrigated village approach in East Champaran (Bihar), India: A case study

Arvind Kumar Singh
Krishi Vigyan Kendra, Piprakothi, East Champaran, Dr Rajendra Prasad Central Agricultural University, Pusa, Samastipur (Bihar), India
Jitendra Rajput
Division of Agricultural Engineering, ICAR-Indian Agricultural Research Institute, Pusa, New Delhi, India
Ashish Rai*
Krishi Vigyan Kendra, Parsauni, East Champaran, Dr Rajendra Prasad Central Agricultural University, Pusa, Samastipur (Bihar), India
Anshu Gangwar
Krishi Vigyan Kendra, Piprakothi, East Champaran, Dr Rajendra Prasad Central Agricultural University, Pusa, Samastipur (Bihar), India
Brajesh Shahi
Directorate of Extension Education, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur (Bihar), India
Ram Babu Sharma
Krishi Vigyan Kendra, Piprakothi, East Champaran, Dr Rajendra Prasad Central Agricultural University, Pusa, Samastipur (Bihar), India
Neelam Kumari
Krishi Vigyan Kendra, Piprakothi, East Champaran, Dr Rajendra Prasad Central Agricultural University, Pusa, Samastipur (Bihar), India
Satish Kumar Singh
Department of Plant Breeding, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur (Bihar), India
SriKant
Department of Horticulture, Government of Bihar, Motihari, East Champaran (Bihar), India
Vikas Kumar Rai
Centre of Excellence on Water Management, Dr Rajendra Prasad Central Agricultural University, Pusa, Samastipur (Bihar), India

*Corresponding author. E mail: ashishraishiats@gmail.com

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Abstract
In India, the precious freshwater resources are becoming scarcer due to the climate change effect coupled with their inappropriate planning and management at the field level. Development of water resources and sensitization of farming community/irrigators towards effective utilization of these resources is need of the hour and it is one of the most important factors in conservation and preservation water resources for future requirements. This case study has highlighted the direct and indirect benefits derived by implementation of National Innovations on Climate Resilient Agriculture (NICRA) scheme in Nawada, a village of the district East Champaran in Bihar state initiated by Krishi Vigyan Kendra, Piprakothi, East Champaran under Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar. Two groups of farmers of the village was chosen to evaluate the benefits derived from this scheme. Under this scheme, tube-wells were developed to facilitate assured irrigation. This study revealed that the total savings of approximate Rs.10,000 ($140) per hectare to irrigate wheat crop three times in Rabi season was achieved over conventional irrigation system. This scheme has also resulted in other intangible benefits which included a reduction in pollution, an increase in the number of crops- *rabi* , *kharif* and *zaid* seasons and adequate time to carryout out other farm operations.

Keywords: Agriculture, Climate change, Irrigation, Socio-economic, Wheat

INTRODUCTION

India's farming sector is undergoing a dynamic phase change in the current perspectives of global agriculture development. This sector accounts for the creation of 67% of livelihood opportunities for the working demography of the nation and serves as the basis for the economic development and sustainability of the country's agricultural communities (Das et al., 2020). Irrigated agriculture contributes more to food production in term of higher agricultural productivity as compared to rainfed agriculture system. In our country, a substantial proportion of agriculture is still rainfed, and also the management of water resources has been poor (State of Indian Agriculture, 2015-16). In India, major adverse effects were correlated with medium-term (2010-2039) climate change, which is expected to reduce yield between about 4.5% to 9% and it is approximately 1.5 per cent of GDP annually (Venkateswarlu et al., 2013). This fundamental idea of transforming rainfed agriculture into irrigated agriculture in order to battle the adverse effects of climate change on crop production and the availability of assured irrigation is one of the main domains for policymakers. Rainfed agriculture is critical to bring prosperity. Rainfed agriculture that represents almost 58% of the net sown area will be most affected by climate change (Venkateswarlu and Prasad, 2012). Climate change would intensify global hydrological cycle and might have a significant effect on regional water supplies, on the availability of land and surface waters for agricultural purposes, domestic and industrial uses (Arnell et al. 2001). Thus, it is highly necessary to enhance agriculture's resilience to climate change effects through anticipated adaptation measures.

In this context, ICAR (Indian Council of Agricultural Research), New Delhi initiated a new megaproject, the National Innovations in Climate Resilient Agriculture Initiative (NICRA) in 2010-11, to conduct tactical research on adaptation and mitigating in 100 vulnerable districts, address vital research loopholes, demonstrate innovations in farmers' fields to deal with existing climatic variability and capacity building of various stakeholders (Jasna et al., 2014). The Project is in operational in Nawada village to develop climate-resilient agriculture through the improved irrigation system and agricultural diversification. Irrigation is a function of various dependent factors such as climate, soil, crop, management practices and other inevitable factors greatly affects the system performance of the irrigation system in terms of efficiency. Therefore, evaluation of the performance of any irrigation scheme is needed to understand the present level of its output and also to identify constraint which is hampering the optimum level of performance of irrigation schemes (Rajput et al., 2017). Model irrigated village scheme would help to attend the sustainability of agriculture by promising assured irrigation water availability and offering liberty to farmers to take more crops round the year. The aim of the present case study was to evaluate the impacts of tube well scheme implemented in Nawada village under NICRA project initiated by Krishi Vigyan Kendra, Piprakothi, East Champaran under Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar on the economics of wheat crop irrigation.

MATERIALS AND METHODS

NICRA project: The National Innovations on Climate Resilient Agriculture (NICRA) is a nationwide Project launched by the Indian Council of Agricultural Research (ICAR) on February 2011 (NAAS, 2013). It intended to strengthen the stability and resilience of agriculture to climate change through strategic planning, research and innovations demonstration and interventions at field level. This included four components: strategic study, technology demonstration, capacity building and sponsored / competitive grants.

Implementation of NICRA in Nawada village: In order to develop Nawada village as Model Irrigated Village under East Champaran district Bihar, Dr. Rajendra Prasad Central Agricultural University, Pusa implemented NICRA project in the village through Krishi Vigyan Kendra, Piprakothi, East Champaran Bihar in the year 2017-18 and irrigation facility became functional from 2018 (Fig. 1). The concept behind the implementation of the aforesaid scheme was to develop fresh water resources to improve irrigation facilities for higher crop production by involving the community as beneficiary. Irrigators were solely responsible for the operation and maintenance of the system once the installation is completed. Under this scheme, 06 tube wells with 3 hp submersible pumps were constructed to irrigate 12-15 acres of the area by each boring through underground pipelines water distribution system to irrigate each and every field in its command. Presently, cropping intensity in the Nawada village is only 140 % due to the fact that most of the farmers did not have assured irrigation source and therefore restricted to only Kharif season (June-October) crop, i.e., Paddy crop. However, this present level of cropping intensity can be can increased over 200 % in a year through the development of assured irrigation water sources viz., electricity facilitated tube well irrigation system. This will also help farmers to diversify high-value crops adding further income to them and facilitate to cultivate vegetables/small duration crops in Zaid (Summer season: March-June) to further boost their livelihood.

Specifications of technology (Shed unit): Type of pump: Submersible; Diameter of Bore: 4 inches; Depth of Bore: 300 feet; Pump capacity: 3 hp; Voltage requirement: 220-240 Volt; Discharge: 4.8 litres/second; Capacity of Tube well (1 unit): 12-15 acre/ season.

RESULTS AND DISCUSSION

The present case study highlights the impact of tube well-irrigation system on cost of wheat crop irrigation. The results from research on the effect of the demonstrated climate-resilient technology in the village of Nawada showed a promising success on both the social and economic domains of Nawada village. Irrigation was started in the wheat crop during Rabi season 2018. In order to evaluate the impact of implemented scheme on crop yield and cost of irrigation, two groups of farmers were selected. Each group had 8-10 numbers of farmers. Information pertaining to cost of electric tube well irrigation was compared to conventional Diesel engine operated pumping systems. A net saving of Rs. 3750 ($52.59) per hectare per irrigation was found during the year 2018-19 (Fig. 2.)

The farmers from Nawada village shared their experiences whose livelihood solely depended on agriculture for livelihood. In earlier days, when there was no farm electric connection existing in Nawada village, farmers used to irrigate crops by using Diesel engines. The cost of irrigation used to be high by using diesel engines operating pumping units as compared to electric operated tube wells systems. The higher cost of irrigation also used to restrict to two numbers of irrigations in wheat crops (Rabi season). Though water availability was enough, higher number of irrigation cost could not result in benefit generated by selling produce. Other problems caused due to the use of diesel operated irrigation system were: 1. Environmental pollution and, 2. Limited land area was under irrigation due to poor economic condition and resource development capability of farmers.

After the implementation of the NICRA project at the village level, there was a saving of Rs. 1300 ($18.23) per irrigation for irrigation of one acre of crop field by the farmers. They observed that applying three numbers of irrigations in wheat crop, they could save approximately Rs. 4000 ($56.10) per acre as compared to the use of diesel engine for the same number of irrigations per acre. Wheat production had also increased by 10-15 % in the fields which were irrigated under Project due to ensured availability of irrigation water at critical stages during the crop season. One farmer could save approximated Rs. 10,000 per hectare to irrigate wheat crop three times, i.e. irrigation frequency in rabi season whose land is in command of tube wells of NICRA project with enhanced crop yield. The comparative economic efficiency of the tube well system with a conventional system is given in table 1.

Operation and Maintenance: The efficiency of any developed system depended on the meticulous operation, routine maintenance and awareness of the technology. In order to minimize the operational and maintenance costs of the tube well system, groups of farmers were formed to look after the post-implementation of technology by involving farmers in

Table 1. Comparative efficiency of the Tube well system with conventional system, during the seasons (Rabi) 2018-19.

Particulars	Tube well	Conventional
Environment Pollution	None, Electricity operated	Yes, Engines operated using fossil fuels
Economy	Cheaper	Costlier
No. of irrigations in wheat crop	3	2
Crop Yield	Higher	Lower
Timeliness	Effective, High Capacity	Time consuming, low capacity
Area Irrigated	More	Less
Cropping Intensity	Can be up to 300 %	Can't be higher, Farmers may not afford it
Maintenance cost	Comparatively low	Higher, individually owned
Irrigation Efficiency	Higher	Lower
Farmers acceptance	Higher	Lower due to higher operating cost

Fig. 1. *Tube well with pumping Shed unit.*

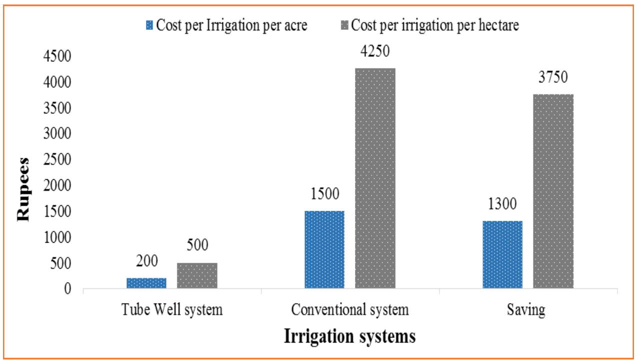

Fig. 2. *Cost economics of irrigation in wheat crop under tube well system and conventional system.*

all such activities. There were six groups formed in the village. Each group usually consisted of 8-10 farmers who owned agricultural land in the vicinity of the tube well command so that they can conveniently irrigate the farm. One member of each individual group was chosen as the president to maintain financial records, records of operation and upkeep, and allocations of irrigation water to the fields as per demand. This community participation approach of managing to tube well irrigation systems helped the farmers to save capital which can be used for other activities.

Conclusion

The study revealed that the concept of development of the village through irrigation water resource development, i.e. NICRA project initiated by ICAR, New Delhi could be a benchmark step towards sustainable agriculture. Cost of irrigation was reduced tremendously along with enhancing the wheat crop production (Rabi season). This technology may help to fill the disparity between created and utilized irrigation potentials in the country. The farmer could save approximately Rs. 10000/- ($140) per hectare per season in wheat crop. Thus, technological intervention can reduce ill impact of climate change phenomenon on crop production. The developed technique may also be suitable to irrigate different crops such as horticultural crops, vegetables and grain crops and even forage crops during off-season by the adoption of micro-irrigation systems.

Conflict of interest

The authors declare that they have no conflict of interest.

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