Climate Resilient Water Management Practices for in situ Moisture Conservation

Abstract

Climate changes have an impact on Indian agriculture in various direct and indirect ways besides affecting the lives and livelihood of millions of Indians. Efficient management of natural resources is key for enhancing the adaptive capacity of the system and contributes towards the resilience of communities. Successful crop production in frequently drought and flood affected regions depends on how effectively we conserve the deficit rainfall and manage the excess rainfall and soils to retain the moisture for longer periods for successful arable crop production. Present study was conducted with the objective of evaluation of performance of different In situ Water conservation measures with respect to the climatic variability prevailed in the village. Demonstrations of appropriate practices and technologies recommended by the National Agricultural Research System (NARS) are being taken up in a farmer participatory mode so that the communities become familiar with these technologies and help in their adoption resulting in enhancing their adaptive capacity and coping ability against climatic change and variability. It was observed that use of forest leaves and paddy straw was found very profitable to conserve soil moisture in situ with BCR Rs. 7.16 followed by use of naturally occurred leaves in fruit plants with BCR Rs. 6.22 and use of plastics in vegetables with BCR 4.41. Respondents opined that use of natural mulch was very cost effective as well as it is compatible to existing farming system and very simple in its application. Wheat with cultivation through ZTD showed maximum yield of 46q/ha. Zero tillage technology showed very promising results in pulse and oilseed cultivation.

Key Words: in situ Moisture Conservation, Climate Resilient Water Management Practices

Introduction: India is a large country with 15 agro-climatic zones, diverse seasons, crops and farming systems. For a majority of the people in India, agriculture is the main source of livelihood. Agriculture is also most vulnerable to climate change because it is inherently sensitive to climate variability. Climate change will have an impact on Indian agriculture in various direct and indirect ways besides affecting the lives and livelihood of millions of Indians. Agriculture and allied activities, such as livestock and fisheries, constitute an important component of India's Gross Domestic Product (GDP) contributing nearly 25 per cent of the GDP. Bihar and Jharkhand characterized by rich natural resources but poor productivity of agriculture and allied sector. The region has favourable climate and an abundant supply of water, however, frequent occurrence of flood and drought adversely affect the agricultural productivity and livelihood security. The small and scattered land holdings, unavailability of quality seeds and planting material, imbalance use of fertilizer, deterioration of soil health, lack of stress-tolerant crop varieties, poor extension mechanism and marketing of the agricultural products are some of the major bottlenecks to improve upon the productivity and there by profitability of the farmers.

Efficient management of natural resources is key for enhancing the adaptive capacity of the system and contributes towards the resilience of communities. Successful crop production in frequently drought and flood affected regions depends on how effectively we conserve the deficit rainfall and manage the excess rainfall and soils to retain the moisture for longer periods for successful arable crop production. In the context of climate change and variability, farmers need to adapt quickly to enhance their resilience to increasing threats of climatic variability such as droughts, floods and other extreme climatic events. Participatory on-farm demonstration of site-specific technologies will go a long way in enabling farmers cope with current climate variability. Such an approach can ensure adaptation gains and immediate benefits to farmers.

With the objective to enhance the resilience of Indian agriculture to climatic variability and climate change through development and application of improved production and risk management technologies, NICRA been functioning in thirteen district and in 26 villages In the zone IV and are being implemented by KVK. Proven resilient practices of resource management, crop production and livestock and fisheries were demonstrated to enhance resilience against climatic vulnerabilities such as droughts, floods, and heat wave. Present study was conducted with the objective of evaluation of performance of different In situ Water conservation measures with respect to the climatic variability prevailed in the village.

Materials and Methods: Demonstrations of appropriate practices and technologies recommended by the National Agricultural Research System (NARS) are being taken up in a farmer participatory mode so that the communities become familiar with these technologies and help in their adoption resulting in enhancing their adaptive capacity and coping ability against climatic change and variability. Location specific in-situ moisture conservation measures are important concern in managing water sustainably over long period of time. Harvesting of excess water and efficient use of harvested water, efficient irrigation methods, supplemental irrigation, enhancing cropping intensity with the harvested water, recharge of wells, improved drainage in the flood and cyclone affected regions, soil health management, green manuring, soil test-based nutrient application are the important approaches given emphasis and proven technologies on these aspects are being demonstrated.

The village was selected based on vulnerability of agriculture to climatic variability. Highly vulnerable village may get priority in selection. Using secondary/ published data, the village which was relatively more vulnerable to climatic variability like prolonged drought, Dry-spells, extreme rainfall events, hailstorms, extreme temperatures, cold and heat waves, frost, flood, seawater inundation, *etc* was selected. The climatic vulnerability of the village (frequency and intensity of droughts, floods, heat wave, cold wave, *etc*) represents that of the district. It was stressed that the selected village must represent the dominant farming system, climatic vulnerabilities and adverse weather situations of the selected district.

The study was carried out in five purposively selected villages of Jharkhand and Bihar where intervention on in situ water conservation were carried out under Natural Resource Managemnt on NICRA.

The data were collected by personally interviewing the respondents through a structured scheduled. Apart from the use of schedule, detailed information were collected through informal discussion with the respondents and by critically scrutinizing the practices followed for in situ water conservation measure. Use of PRA tool, field observation and non-participant observation techniques were thoroughly used. Field observation was done periodically. "Focused Group discussion" of PRA was also followed to gather data on the opinion of respondent's towards the demonstrated technology.

After collection, the data were systematically arranged and tabulated for analysis and interpretation. For economic analysis, economic evaluation data of crops were used. The gross cost of cultivation was calculated on the basis of different operations performed and materials used for raising the crops. The statistical techniques used for analysis of data under the study included mean yield, net return, B: C, increase in family income in Rs. /year

Results:

1.The performance of different in-situ moisture conservation practices is presented in following table. It was observed that use of forest leaves and paddy straw was found very profitable to conserve soil moisture in situ with BCR Rs. 7.16 followed by use of naturally occurred leaves in fruit plants with BCR Rs. 6.22 and use of plastics in vegetables with BCR 4.41 . Respondents opined that use of natural mulch was very cost effective as well as it is compatible to existing farming system and very simple in its application.

Table1. Performances of demonstration of in-situ moisture conservation technologies

Technology demonstrated	No. of farmers	Area (ha)	Yield (q/ha)	Economics of demonstration (Rs/ha)		
				Gross Cost	Net Return	BCR
Green Manuring for Soil resilience and fertility management through Green Gram	800	220	7.5	18102	17898	1.99
In- situ moisture conservation in with paddy straw	240	70	38	29064	20436	1.70
Plastic Mulching in summer Vegetables	42	10	280	45329	154671	4.41
Plastic Mulching in kharif Vegetables	20	12	280	43562	134980	4.10
Application of natural mulch in fruit crops	190	260	107	25689	134186	6.22
Wind breaks for saving bitter gourd from heat stroke	110	72	276	43391	120709	3.78
Hole planting of pointed gourd for saving soil moisture	22	8	278	43074	134276	4.12
Paddy after brown manuring	85	21	38	29164	17636	1.60
Leaf mulching in ginger	27	5	534.0	65000	278000	4.12
Use of paddy straw, forest leaves in elephant foot yam for mulching	25	5	24 1.5	75000	3,94,200	7.16
Total	**800**	**220**				

Fig 1: Use of plastic mulch and natural mulch

2. Conservation Tillage

Sowing of rabi crops depends on soil moisture status of soil and duration of preceding crop. In case of wheat,this involves 2 to 3 or even more tillage operations for obtaining appropriate tilth before planting of wheat. In addition to the costs incurred and energy required, this causes delay in planting of wheat which often results in coincidence of vulnerable stage with high temperature stress during February/ March. This often leads to reduction in grain yield and loss to farmer. Zero till technology offers viable and practical solution by avoiding repeated tillage for land preparation and sowing, reducing cost of cultivation and also permits planting early by 10-15 days. Advancement in sowing date is an adaptation to avoid terminal heat stress. Zero tillage refers to direct drilling of wheat in unploughed paddy fields immediately after rice harvest using zero till. Conservation tillage in wheat,paddy, lentil, pea and chickpea demonstrated in 15 NICRA adopted villages in an area of 243 ha covering 458 farmers. The results of the ZTD invarious crops are presented in below table. Wheat with cultivation through ZTD showed maximum yield of 46q/ha. Zero tillage technology showed very promising results in pulse and oilseed cultivation.

Table 2: Performance of conservation tillage on various crops

Technology demonstrated	No. of farmers	Area (ha)	Output (q/ha)	Economics of demonstration (Rs./ha)		
				Gross Cost	Net Return	BCR
Sowing of paddy with ZTD machine	180	124	38	25631	27569	2.07
Sowing of wheat with ZTD machine	140	65	46	29658	25670	1.86
Dry seeding of Rice	70	22	38	26354	25180	1.95
Furrow irrigated Raised Bed Technique	68	32	37	28564	28192	1.98
Total	458	243				

Fig 2: Zero Tillage in Wheat

Conclusion: This study summarizes the climate change mitigation and adaptation work undertaken by National Initiative on Climate Resilient Agriculture (NICRA) to improve the water availability for agriculture production and recharging of aquifers. The successful water management interventions taken up by NICRA were use of natural mulches, use of plastic much in vegetables , brown manuring zero tillage machine in wheat etc . in the backdrop of climate challenges for improving soil moisture, augmentation and management of farm level resources for improving livelihoods of small farmers. Implementation of these in situ water management practices has resulted in increasing the net cultivated area, profitability of crops and improvement in the soil moisture levels.

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