Increasing farmers income through demonstration of climate resilient technology

Abstract

The project TDC-NICRA (National Innovations on Climate Resilient Agriculture) was initiated in KVK, Dhemaji from 2021-22 in Magurmari village of Simen-Chapori Block under the District Dhemaji. The village was affected by flood every year leaving the villagers in a state of destitute. Several activities were done during 2021-23 with the objective to establish climate resilient agriculture. Majority of the farmers of Magurmari village were marginal farmer. Flood, irrigation, water conservation, diseases infestation on plant and occupational migration were the major problem of the village. Some innovative and progressive farmers were developed and exposed their activity through different programme. In our study we discuss about the few success point of NICRA project in Dhemaji District. The objective of the study was to show the achievement of NICRA project in Dhemaji District through analysis of different success point through climate resilient interventions.

Keywords- NICRA, Flood, Climate, Agriculture, Intervention

Introduction

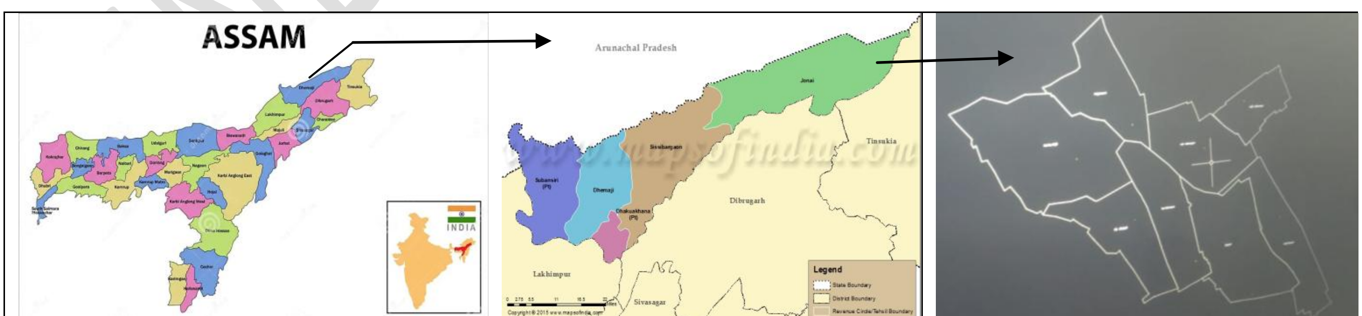
Climate and agriculture are inextricably associated. High variation in environmental factors such as temperature, rainfall and others distress crop growth deleteriously and certain crops get positively affected due to change in these environmental factors. Thus, change in climatic variables may have positive and negative impact on agricultural productivity and food security situation in the economy (Greg et al. 2011). Looking into the concerns, Indian Council of Agricultural Research (ICAR) initiated the National Innovation for Climate Resilient Agriculture (NICRA) in February, 2011 with a prime objective to boost flexibility of Indian agriculture to climate change and climate vulnerability through strategic research and technology demonstration. The strategic research conducted on adaptation and mitigation which covers crops, livestock, fisheries and natural resource management. In other component, technology demonstration the climate resilient technologies developed under strategic research are demonstrated in climatologically vulnerable locations to help the farmers combat vulnerabilities as well to build up the capacity of the farmers. KrishiVigyan Kendra (KVK) Dhemaji has been implementing Technology Demonstration Component NICRA (TDC-NICRA) since 2021. The Dhemaji district is geographically located in between 94°12'18''E and 95°41'32''E longitude and 27°05'27''N and 27°57'16''N latitude and in north bank of river almighty Brahmaputra as well as easternmost corner of state of Assam. The total 3,237 sq. kmarea of the district is a tribal district with inhabitant of 47.5 per cent tribal population as per 2011 census. The major inhabitant groups of the district belong to *Misings*, *Boro, Sonowal, Kachari, Deori, Lalung, Hajong*, *Ahoms*, *Kalitas and Konch* communities.

Agriculture, being the main occupation of the people as 85% of the population depends on agriculture and allied sector. Paddy is the major crop constituting more than 60 per cent of gross cropped area followed by rapeseed and mustard, black gram, potato and maize. Vegetables and fruits are also cultivated in moderate scale. Piggery, poultry, goat rearing, fishery and sericulture are major agricultural allied activities in the district. The agriculture and allied sector in the district is merely rainfed. The natural calamities (both flood and draught) are only the hurdles for agricultural activities in spite of hard labour and encouraging engagement of youth class in this sector. The natural calamities such as flash flood, draught spell, unseasonal raining etc are reason for gradual distraction towards field activity. Water course originating from hillock of Arunachal Pradesh are streaming through the district *viz, Dihingia, Jiadhal, Moridhal, Telijan, Kaitongjan, LaipuliaNadi, Kapurdhuwa, Sissi, Gai, Tangani,* and *Guttong*, which was earlier thought as blessing of nature but distressing now a day due to mass deforestation in the hillock. These tributaries carry enormous amount of alluvium through the district before merging with the Brahmaputra. Due to its unique geographical location, the district is vulnerable to floods and which occur regularly during kharif season. Nearly 27% of the net cropped is affected by flood during rainy season and every years farmers face crop loss specially paddy due to floods.Climate resilient technologies are promising tool to guard a farming system from climate variations and impact study of these technologies are prerequisite for guiding the adaptive research for better customization, for upscaling, and out scaling them(VK, 2017).

Materials and Methods

Selection of Village:

To implement the TDC-NICRA programme, Magurmari village of SimenChapori under Jonai MSTD block has selected purposefully observing the climatic vulnerabilities. The village is primarily flood prone, occurs flood during kharif due to overflow of stream 'Seren' originating from Arunachal Pradesh flowing through the village. On the other hand, due to up land situation and sandy soil in one part of the village also affected draught like situation after cessation of rain. The location of the villages with geo coordinates presented in Fig 1.



Map of Assam	Map of Dhemaji District	Map of Magurmari Village

Fig 1. Study area

Baseline survey:

A participatory rural appraisal (PRA) exercise was conducted with active participation of village head (*gaonburha*), public representative (ward member of Panchayat) and the villagers to develop a complete village map, to identify climatic vulnerabilities and to analyze the strength, weakness, opportunities and perceived threat. To gather the data on land and land use pattern, existing farm production system, major farm activities including livestock, farm income at individual household a baseline survey was conducted involving all the farm families of the village. Several awareness programme, trainings were also conducted in the village to motivate the villagers to adopt the new climate resilient technology.

Data collection and analysis:

To unveil the impact of interventions all the parameters attributing yield of crops and economics of the cultivation were taken in to account and data compared with the farmers not included under intervention. The average yield data of respective crops were considered and to calculate the cost of cultivation and profit data was collected from the respondents using personal interview with the help of structured schedule designed for this purpose. Simultaneously, secondary sources like NICRA annual reports, AAU Pop data were used to supplement, and to pay triangulation and crosschecking of primary data. Finally the impact of interventions was tested through t-test using following formula:

$$t = \frac{(\overline{x}_1 - \overline{x}_2) - (\mu_1 - \mu_2)}{s_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

Where

$\bar{x}$1 = Observed Mean of 1st Sample
$\bar{x}$2 = Observed Mean of 2nd Sample
s1 = Standard Deviation of 1st Sample
s2= Standard Deviation of 2nd Sample
n1 = Size of 1st Sample
n2 = Size of 2nd Sample

<u>Result and Discussion</u>

Magurmari is a village located at 27.713159 Latitude and 94.905726 long in Jonai block of Dhemaji District. From Baseline survey following (Table 1) results was obtained about the village.

Table 1: Details about the villages involved in the programme.

S No	Details	Village 1
1	Name of the village	Magurmari
2	Involved in TDC since (year)	2021
3	Cultivated area (ha)	100 ha
4	Rainfed Area (ha)	90 ha

5	Irrigated Area (ha)	10 ha
6	Flood affected area (ha)	10 ha
7	Total Area of village (ha)	110 ha
8	No. of households in the village	109
9	Marginal farmers	72
10	Small farmers	35
11	Semi medium farmers	02

It was evident that the village experienced flash flood during the monsoon season at least twice a year, which causes a major loss in paddy cultivation. Rainfall Characteristics of Dhemaji District are given in Table 2.

Table.2: Rainfall characteristics during kharif and rabi in Dhemaji district of Assam.

Rainfall		**Year**	
		Normal RF	**2022-23**
Annual rainfall (mm)		2999.2	2482.1
June		618	773.17
July		548	324.55
August		469	365.67
September		444	191.77
Total *Kharif* rainfall		2079	1848.00
No. of rainy days (*Kharif*)		80	98 days
No. of dry spells during *kharif* season 2022	>10days		
	>15days	No	
	>20days	No	
No. of intensive rain spells (2022)	>60 mm per day	4 days	
Flood situations experienced in NICRA villages (Timing, Duration and Crop stage)	**Flood occurs during the month of June for 4 days and in July for 8 days which affected the Sali paddy during seedling and tillering stages**		

Based on data obtained during baseline survey including climatic vulnerabilitiesmagurmari village was divided into four farming system typologies as mentioned in table 1 :Rainfed upland with animal, rainfed medium land with animal, irrigated medium land with animal and rainfed low land and interventions were selected against each typology to enhance their standard of living.The list of interventions along with farmers covered was presented in Table 3.

Table 3: The list of interventions along with area and farmers covered, season, duration conducted during 2021-23

Sl. No.	**Interventions**	**Farming situation**	**Season**	**Duration**	**Area**	**No. of farmers covered**
1	Demonstration on submergence tolerant rice variety 'Ranjit sub-1'	Rainfed Low land	Kharif	150 days	10 ha	50
2	Demonstration on medium duration rice variety Numoli	Rainfed medium land with animal	Kharif	135 days	5 ha	20
3	Cultivation of megha turmeric through organic mulching	Irrigated medium land with animal and rainfed upland with animal	Kharif and Rabi	315 days	0.65 ha	30
4	Cultivation of rabi vegetables – Cabbage, Broccoli, Cauliflower and Tomato (variety ArkaAbhed) using	Rainfed medium land and irrigated medium land with animal	Rabi	90-120 days	0.13 ha	30

	paddy straw as organic mulch					
5	Low cost raised bed vermicompost production	Rainfed medium land with animal	Kharif-rabi	3-4 months	16 nos	16 nos

Table 4 :Economics of Interventions /Demonstration conducted on the village:

Intervention	Crop/enterprise	Variety	Production	GR	GC	NR	BC
Demonstration on submergence tolerant rice variety 'Ranjit sub-1'	Sali-paddy	Ranjit sub 1	48	93,120.00	38,000.00	55,120.00	2.45
		Ranjana (check)	39	54,660.00	31,500.00	23,160.00	1.73
Demonstration on medium duration rice variety Numoli	Sali-paddy	Numoli	46	89,240.00	38,000.00	51,240.00	2.34
		Nilanjana	31	60,140.00	36,684.00	23,456.00	1.63
Cultivation of Rabi vegetables using organic mulching	Rabi vegetables	Cabbage	220	1,85,000.00	52,000.00	1,23,000.00	3.55
		Cauliflower	180	2,15,000.00	57,000.00	1,58,000.00	3.7
		Broccoli	70	2,05,000.00	65,000.00	1,40,000.00	3.15
		Tomato	210	2,10,000.00	52,000.00	1,58,000.00	4.03
Cultivation of meghaturmeric through straw mulching	Tuber crop	Megha turmeric	247	4,95,000.00	90,000.00	4,05,000.00	5.5
Low cost vermicompost production	Organic manure	vermicompost	6 q	13,260.00	2,8000.00	10,450.00	4.75

Demonstration on Sali paddy using the submergence tolerant variety *Ranjit sub 1* was conducted in the village in 10 ha of area which covered 48 farmers in the village. Their traditional paddy variety Ranjana was used as check. The demonstration variety was cultivated by following scientific cultivation practices as per PoP, 2021 developed by AAU, 2021. From the study, it was found that average plant height was148 cm, tiller per hill was15, panicle length was 24 cm, grains per panicle was 236 and grains yield was 48(q/ha) of Ranjit sub-1 for the season 2022-23 whereas average plant height was 122cm , tiller per hill was 9, panicle length was 19 cm, grains per panicle was 160 and grains yield was 39(kg/ha) of check (Var.Ranjana) and it is quite clear from the data presented in Table 3 that Ranjit sub-1 showed better yield performance than farmer's variety in all attributes. The variety performed well in stressful flooded situation and it out-yielded the traditional variety *Ranjana* due to non-submergence to flooded situation. On average, there was a 9 % increase in crop yield. It was also found from the demonstration that the Benefit Cost Ratio (BCR) of the demonstration unit was 2.45 which was more than normal cultivation practice (BCR 1.73). Goswami*et. al.* (2020) stated that the benefit cost ratio (B: C) in demonstrated variety (1.58) was more than the farmers' variety (1.31) for the year 2018-19 and During 2019-20, the B: C ratio (1.54) was also found to be more in case of demonstrated variety then the farmer's variety (1.35) which concluded that farmer's income was more in demonstrated technology than their own practice.90 farmers have come forward to adopt the technology and have exchanged 2.65q of submergence tolerant variety Ranjit sub1 seeds in their village leading to a horizontal spread of the technology. An additional area of 7 hectare has been covered by cultivation of Ranijit Sub 1.

Unavailability of medium duration Kharif paddy variety is a major setback for the farmers of Magurmari due to which the paddy fields remain fallow after Kharif paddy cultivation**.** With an objective to increase the farm income of the villagers and also boost double cropping, a demonstration on Medium duration Kharif paddy variety Numoli was undertaken in Magurmari village covering 15 farmers in an area of 5 hectare. They were provided with necessary inputs and technical guidance throughout the demonstration in order to encourage efficient utilization of land through double and triple cropping. The local cultivar Nilanjana was used as check.From the study it was found that average plant height was 132 cm, tiller per hill 14, panicle length was 22 cm, grains per panicle was 228 and grains yield was 46q/ha of Numoli for the season 2022-23 whereas average plant height was 115, tiller per hill 8, panicle length was 17 cm, grains per panicle was 168 and grains yield was 35 of local cultivar Nilanjana. From the data presented in the Table 4 it is evident that Numoli showed better yield performance than farmer's variety in all attributes.

Apart from providing necessary nutrients, vegetable cultivation renders a plethora of benefits such as their short growing cycles, and efficient use of irrigation and aids to reduce farmers' vulnerability to climate change. Lack of knowledge among farmers regarding scientific cultivation practices of vegetables caused low yield. With the objective to increase farm income and minimize the risk, an initiative was taken to the cultivate of rabi vegetables after Kharif Paddy under the project. After the harvest of paddy, they opted for seasonal vegetables. Owing to the interest of the villagers' a demonstration on Rabi vegetables viz. cabbage, cauliflower, broccoli, and tomato was conducted among the villagers using paddy straw as organic mulch. The results indicated that Rabi vegetables fetched them a good profit with an average BC ratio of 3.60. This inspired their fellow farmers towards double cropping and enhancement of income.

Cultivation of Megha turmeric-1 was demonstrated in the NICRA adopted village through organic mulch method to enhance their income which is a new variety developed by the Indian Council of Agricultural Research (ICAR) Complex for NEH Region, Meghalaya has high curcumin content and also has high tolerance towards leaf spot and leaf blotch diseases (Yadav*et.al.*2009). The indigenous turmeric varieties are susceptible to various fungal diseases like leaf spot which limits the yield. Mulching was done immediately after planting and repeated 40 days after planting with suitable mulching material like paddy husk and sawdust, straw, green leaves, etc. The first weeding was done at 40 days after planting (before the second mulching) and repeated depending upon the intensity of weed growth at fortnightly intervals. The crop was ready for harvesting after 8-9 months of planting (Dec-Jan). Turmeric yield (q) and productivity (q/ha) were recorded at farmers' field locations and provided in table 5. Cultivation of megha turmeric leads to productivity enhancement from 235-247 q /ha with B: C ratio of 5.5. The results have motivated several farmers from nearby villages are coming forward with the adoption of turmeric cultivation in a scientific method.

Demonstration on low cost vermicompost production on raised bed for proper utilization of cow dung, rural farm waste, kitchen wastes, other locally available organic waste materials and organic residues was conducted in magurmai village among 16 framers. Vermicomposting is a technology in which earthworms are used for converting organic waste into nutritious composts for crop production (Edward et al., 1985; Yadavet al.,2010). Cow dung manure was the only organic manure used by the farmers of the village but the quality of the manure was very poor due to unscientific management and the villages were not at all aware about the recycling of rural farm waste, kitchen waste and other organic residues for preparation of organic manure. The average time needed for completion of the process of Vermicomposting was found to be 86.53 days and the average production of vermicompost per harvest per tank was found to be 4.9q. From the results as mentioned in Table 4, it was seen that vermicomposting is a profitable business with a B:C ratio of 4.75:1. Pertaining to the benefits rendered by vermicompost, 38 farmers of NICRA village have shown keen interest to produce vermicompost from different organic wastes and residues.

Table 5: Before-after comparison of yield of crops.

Crop/Vegetables		Yield Mean	Standard Deviation	T-value
Sali Paddy (Low land)	Before NICRA	34.425	5.26	1.22*
	After NICRA	**47.35**	1	
Sali Paddy (Medium land)	Before NICRA	31.82	1.82	2.35**
	After NICRA	**45.425**	0.78	
Turmeric	Before NICRA	198.17	8.2	3.54*
	After NICRA	**245.35**	3.58	
Cabbage	Before NICRA	167.6	4.63	1.05**
	After NICRA	**216.07**	2.63	
Cauliflower	Before NICRA	132.25	3.05	1.27*
	After NICRA	**185.6**	2.87	
Broccoli	Before NICRA	52.35	1.89	2.33*
	After NICRA	**69.85**	1.23	
Tomato	Before NICRA	154.35	4.87	4.13**
	After NICRA	**215.2**	4.02	
Vermicompost	Before NICRA	3.65	1.5	2.18*
	After NICRA	**5.66**	0.23	

The Table 5 depicted an increase in average yield for rice both in low land and medium land, turmeric, cabbage, cauliflower, broccoli, tomato and vermicompost in comparison to previous yield. The differences were found to be significant in all the cases. A multitude of factors including Flood resistant, submergence, high yielding, timely sowing, planting and transplanting, high moisture content in soil, increased frequency of irrigations, improved soil and water management practices would have merged in recognition of better yields.

Conclusion

It may be concluded from the above study that NICRA project was a successful project in Dhemaji district and has been able to accomplish the prime objective of the project which was the adoption of new technology with changing of agro-climatic condition to establish resilient agriculture system. The horizontal spread of the demonstrations under the project is one of the key factors that prove its success. The project extended its impacts through different farmers 'clubs, SHGs, and district line departments. KVK scientists perceived that the motivation and interest level of farmers of NICRA adopted Village (Dhemaji) on agriculture were high compared to other villages. This type of task was challenging both for scientists and farmers but it was the only project which can sustain the Indian agricultural system with changing of global agricultural climate. This project will help the farmers' with the adoption of site-specific technology and enhance the decision-making powers among the scientist and policymakers on climate resilience agriculture.

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