Original Research Article

Climate resilient technological paddy variety CR 1009 sub 1 in NICRA village, Thiruvarur district, Tamil Nadu

ABSTRACT

The study was conducted in the villages of Rayapuram and Keezhapattu in Tamil Nadu, as part of the National Innovation on Climate Resilient Agriculture (NICRA) project, led by Krishi Vigyan Kendra in the Needamangalam district of Thiruvarur from 2015 to 2018. These villages frequently experienced floods, particularly impacting the rabi season's crop growth and maturity. The monsoon season (September to December) contributed to about 71% of the total rainfall. A comparative analysis was carried out to assess the economic performance of the flood-resistant paddy variety CR 1009 sub 1 in contrast to the commonly grown CR 1009. Traditionally, farmers in Rayapuram and Keezhapattu favored CR 1009 due to its high market value during the monsoon period. However, they faced low income due to flooding in the rabi season. To address this challenge, scientists from KVK, Thiruvarur, recommended the flood-tolerant paddy variety CR 1009 sub 1 for cultivation during the rabi season under the "National Innovations in Climate Resilient Agriculture (NICRA)" project. Specific climate-resilient technologies, including flood-tolerant paddy variety "CR 1009 sub 1" and a high-yield, long-duration rice variety, were tested and demonstrated in the project villages to ensure rice production despite climatic variations leading to floods. It was crucial to assess how these varieties responded to climate vulnerabilities and how receptive farmers were to adopting them. Calculations were made to compare paddy productivity and economic returns under the improved technology with the traditional practices of farmers. The results indicated that the "CR 1009 sub 1" variety yielded higher harvests compared to the farmers' practices in the years 2015–16, 2016–17, and 2017–18, with increases of 12.60%, 11.69%, and 12.95% respectively. Furthermore, using improved technologies for paddy cultivation generated higher net returns of Rs. 57233, 60768, and 57728 per hectare in 2015–16, 2016–17, and 2017–18, respectively, in contrast to the farmers' practices (which yielded Rs. 49147, 50295, and 46266 per hectare in the same years). In comparison to the farmers' practices (with an average net return of Rs. 48569 per hectare and a benefit-cost ratio of 2.37), the demonstration fields showed an average net return of Rs. 58576 per hectare and a benefit-cost ratio of 2.56.

Key words: Climate resilient paddy, CR 1009 sub 1, Improved Practices, Economics

1. INTRODUCTION

Thiruvarur district in Tamil Nadu is a major paddy producing district in Tamil Nadu. The NICRA (National Innovations in Climate Resilient Agriculture) project was conducted in the villages Rayapuram and Keezhapattu of Needamangalam block in Thiruvarur district. With a geographic area of about 920 ha, the village of Rayapuram has a population of 3176 (846 farm families/households). During the Samba season (September through January), paddy is the main crop grown. Flooding was a climatic vulnerability in the village. Due to heavy, prolonged rainfall and cyclones during this time, the village's main issue this season is paddy crop submersion for roughly 10 to 15 days. As a result, the farmers in the village waste all of the paddy straw and lose about 75% of their paddy production. The Thiruvarur district is one of the areas most vulnerable to natural disasters, especially from September to November, which causes varying degrees of damage to wet season rice and other field crops. Since 2015 to 2018, flood-tolerant varieties were evaluated for suitability in an effort to lessen the situation. The goal of growing submergence tolerant varieties is to produce higher yield in such unpredictable, unfavorable conditions (particularly on stagnant water conditions).

A project called "NICRA" was started in June 2015 with this goal in mind as well as the desire to produce submergence high yielding rice in flood-affected Needamangalam block in Thiruvarur district of Tamil Nadu. In agricultural trials, CR 1009 sub-1 has proven to be able to withstand floods for up to 17 days. The most common variety of rice grown in lowland areas is CR 1009 sub-1. High production potential and water resistance are two qualities of CR 1009 sub-1.Along with better agronomic practices, other factors that affect paddy production and productivity include farmers' lack of knowledge about new, high yielding varieties and their failure to adopt the right set of practices. In order to introduce and popularize the sowing of the CR 1009 sub-1 variety of paddy in actual farm settings, Krishi Vigyan Kendra, Needamangalam (TN), had undertaken demonstrations.

2.METHODOLOGY

2.1.Details of Study area

The demonstration took place at a height of about 25 meters above sea level in the Needamangalam block of the Thiruvarur district. positioned at 10°26'59 N latitude and 79°35'10 E longitude (Fig. 1). In Needamangalam block of Thiruvarur district, the villages of Rayapuram and Keezhpattu were included in the NICRA project. During the rabi seasons of 2015–16 to 2017–18, demonstrations were held on 500 farmer fields in the NICRA villages of Rayapuram and Keezhapattu in the Thiruvarur district on medium to deep black soils with low to medium fertility status under a rice-based cropping system.

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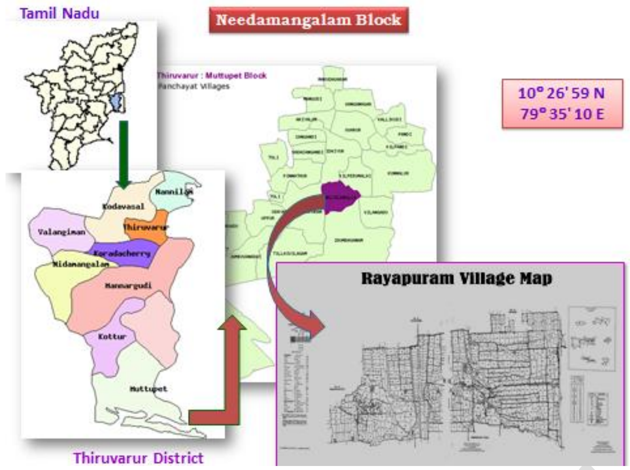
Fig1. Study area of NICRA Village in Needamangalam block of Thiruvaruru district



2.2. Rainfall details

In the villages covered by NICRA, there is a three-part pattern of rainfall distribution. Specifically, during the South West monsoon period spanning from June to September, there was a recorded precipitation of 436.8 mm, while the North East monsoon, which occurred from October to December, registered 723.4 mm of rainfall. The summer months experienced an average rainfall of merely 2.0 mm. Notably, in October and November, there were an increased number of days with substantial rainfall (exceeding 60 mm per day) compared to the usual pattern, particularly in the years 2015, 2017, and 2018, as illustrated in Figure 2. This led to waterlogging issues during the vegetative and flowering stages of the rabi paddy crop, subsequently impacting its overall yield, as indicated in Table 1.

Table 1. Distribution of Rainfall in NICRA village (2015-2020)

Month	Normal rainfall (mm)	Actual 2015	Actual 2016	Actual 2017	Actual 2018	Actual 2019	Actual 2020
January	55	0.00	0.00	107.6 (7)	40.8 (2)	0.00	46.4 (1)
February	16	0.00	0.00	0	00.0 (0)	0.00	0.00
March	19	7.6 (2)	0.00	19.4 (5)	2.0 (1)	0.00	0.00
April	38	105.4 (4)	0.00	0	67.2 (5)	2.00 (1)	30.8(2)
May	53	60.6 (10)	156.4 (7)	31.6 (3)	60.4 (2)	0.00	31.8(2)
June	35	24.2 (5)	14.2 (3)	44.6 (5)	36.8 (3)	2.8 (1)	20.0 (3)
July	56	23 (2)	15.6 (2)	53.8 (3)	34.6 (2)	120.2 (7)	237.8 (7)
August	113	84 (7)	67.6 (6)	227.6 (11)	96.4 (4)	83.6 (7)	43.8 (3)
September	101	22.4 (2)	84.6 (6)	134.2 (11)	17.4 (2)	230.2 (10)	164.6 (5)

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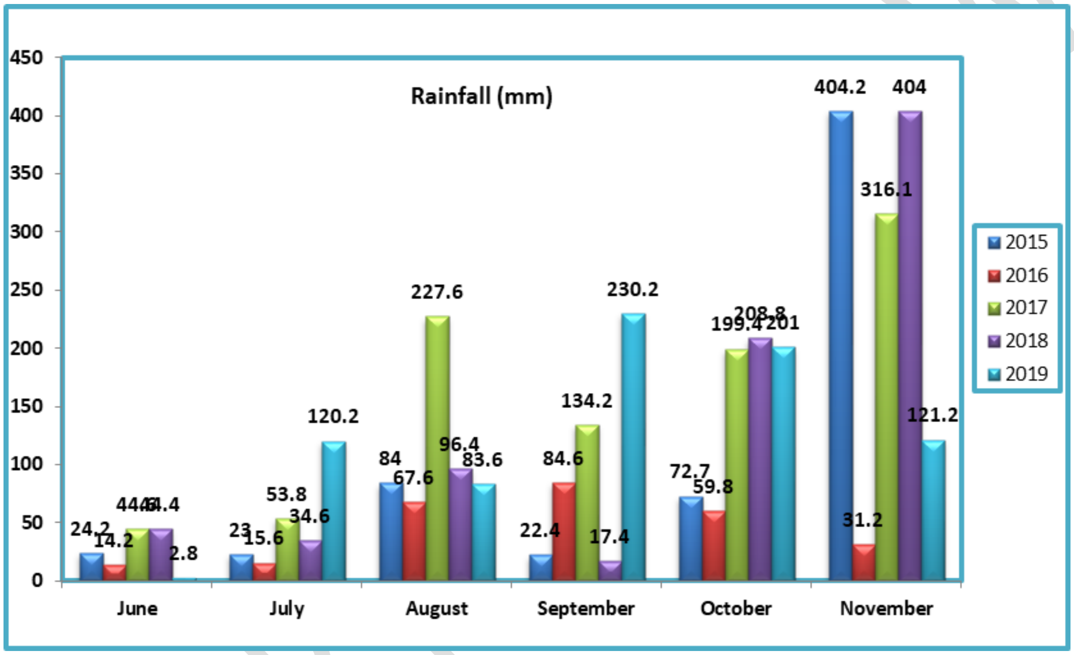
October	200	72.7 (12)	59.8 (3)	199.4 (10)	208.8 (9)	201.0 (12)	108.2 (4)
November	284	404.2 (22)	31.2 (5)	303.8 (19)	404.0 (12)	243.4 (11)	180.8 (9)
December	170	240.6 (13)	27.8 (3)	188.6 (5)	18.4 (2)	279 (10)	373.5 (12)
Total	1140	870.9 (79)	457.2 (35)	1310.6 (79)	986.8 (44)	1162.2 (59)	1237.7 (48)

Fig2. Rainfall characteristic of NICRA Villages in Rabi Season (2015 – 2020)



2.3. Technology Intervention

For demonstration purposes, the improved variety CR 1009 sub-1 was purchased from the Tamil Nadu Agricultural University in Coimbatore. The farmers adhered to the custom of transplanting in the case of the neighborhood check plots. Through demonstration trials, the whole package strategy was shown to farmers and included elements like enhanced variety, line transplanting, advised seed rate, seed treatment, weed and water management, fertilizers, and plant protection techniques (Table 2). Farmers were given essential inputs in the form of improved CR 1009 sub-1 variety seed and balanced fertilizers for the demonstration plots. For local checks, customary procedures were followed. KVK scientists assisted the farmers taking part in the demonstrations in carrying out proper field operations like timely sowing, transplanting, spraying, and harvesting. Field days, farmer trainings, diagnostic visits, and other extension activities were carried out during this time period with the help of the farmers.

Table 2: Improved production technology and Farmers practices of Paddy under Demonstration

S. No	Technology	Improved practices	Farmers practice	GAP(%)
1.	Variety	CR 1009 sub 1	CR 1009	Full gap
2.	Land preparation	Ploughing and levelling	Ploughing and levelling	Nil
3.	Pre emergent herbicide	Pendimethalin @2.5 l/ha	No herbicide	Full gap
4.	Seed rate	30 kg/ha	75 kg/ha	Partial gap
5.	Seed treatment	Biofertilizers & *Pseudomonas*	No seed treatment	Full gap
6.	Fertilizer dose	INM	Indiscriminate application	Partial gap
7.	Irrigation	Alternative wetting & drying	Surface irrigation	Partial gap
8.	Plant protection	IPM	Indiscriminate application	Full gap

By using a random crop cutting method, the yield data were gathered from both the farmers' practice and the demonstration. Quantitative information was taken from qualitative data and expressed as a percent increase in yield. Simple statistical tools were used to further analyze the data. The benefit cost ratio, extension gap, technological gap, and technological index [10] were calculated as follows:

Technology gap = Potential yield - Demonstration yield

Extension gap = Demonstration yield - Farmers' yield

$$\text{Technology index (\%)} = \frac{\text{Technology gap}}{\text{Potential yield}} \times 100$$

3. RESULTS AND DISCUSSION

3.1. Constraints in Paddy production

Prior to the demonstrations, the respondent farmers' challenges with paddy cultivation were identified using preferential ranking techniques. Table 3 lists the rankings given by the various farmers. The results show that the three main constraints were a lack of suitable high yielding varieties (84.63%), sucking pest incidence (Leaf folder and Stem borer) (80.27%), and delayed sowing (73.34%). Similar results were published by [11]. The demonstrations were carried out using the high yielding paddy variety (CR 1009 Sub 1) and other crucial cultivation inputs in accordance with the constraints.

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Table 3. Ranks given by farmers for different constraints.

Sl. No	Constraints	RBQ	Overall Rank
1.	Lack of high yielding varieties	84.63	I
2.	Sucking pest incidence (Leaf folder & Stem borer)	80.27	II
3.	Delayed sowing	73.34	III
4.	Water logging	71.20	IV
5.	Non adoption of seed treatment	66.00	V
6.	Inadequate nutrient management	63.20	VI
7.	Weed infestation	54.22	VII
8.	Bacterial leaf blight	51.76	VIII
9.	Labour shortage	36.00	IX

3.2. Crop Performance and Yield

During rabi 2015-16, 2016-2017, and 2017-18, the yield of paddy harvested for the demonstration was 62.10, 64.26, and 60.05 q ha-1, respectively (Table 4). By comparison to farmers' practices, the improved practices increased yield by 12.60, 11.69, and 12.95%. The increase in yield for the rice and other crops being tested has been amply documented by [8], [4], and [12].

Table 4. Impact of improved production technology on productivity of Paddy

Year	No. of demonstration	Area (ha)	Demo	Local check	% increase in yield over local check
2015-16	100	40	62.10	54.27	12.60
2016-17	200	80	64.26	56.75	11.69
2017-18	200	92	60.05	52.27	12.95
Total	500	212	186.4	163.3	37.2
Average	250	106	93.2	81.6	18.6

3.3. Technology Gap

The difference between potential yield and the yield of a demonstration plot is the technology gap. The demonstration plots' technology gaps were 7.90, 5.74, and 9.95 q/ha in 2015–16, 2016–17, and 2017–18, respectively (Table 4). On average, there was a 7.86 q/ha technology gap under three years of demonstration. The observed technology gap may be attributed to differences in local climatic conditions, crop production, crop protection methods, and soil fertility status.

3.4. Extension Gap

The term "extension gap" refers to the variations in yield between farmers and demonstration plots. The extension gap was 7.83, 7.51, and 7.78 q/ha in 2015–16, 2016–17, and 2017–18, respectively (Table 4). In a three-year demonstration program, the average extension gap was 7.71 q/ha, highlighting the need

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for farmers to be educated about adopting better production and protection technologies through various extension programs, such as demonstration.

This alarming trend of a bounding extension gap will be changed by increasing the use of cutting-edge production practices with high yielding varieties.

3.5. Technology Index

Technology Index demonstrates the viability of advanced technology in agricultural settings. Higher technology feasibility is associated with lower technology index values [2]. According to Table 5, the technology index ranged from 8.20 to 14.21 percent. During the three years of the demonstration program, a technology index of 11.23 percent on average was seen, demonstrating the effectiveness of technical interventions that perform well. This will hasten the adoption of technical solutions that have been proven to increase paddy yield performance.

Table 5. Impact of paddy var. CR 1009 sub 1 on potential yield, demonstration yield, farmers yield, technological gap, extension gap and technology index

Sl. No	Potential yield (q ha^{-1})	Demonstration yield (q ha^{-1})	Farmers yield (q ha^{-1})	Technological gap	Extension gap	Technology index
1.	70.00	62.10	54.27	7.90	7.83	11.28
2.	70.00	64.26	56.75	5.74	7.51	8.20
3.	70.00	60.05	52.27	9.95	7.78	14.21
Average	70.00	62.14	54.43	7.86	7.71	11.23
Total	210.00	186.41	163.29	23.59	23.12	33.69

3.6. Economic Return

Based on the information provided in Table 6, the adoption of new technology in the paddy industry demonstrated varying costs but proved to be more financially advantageous. When compared to traditional farmer practices (amounting to Rs. 49147, 50295, and 46266 per hectare in 2015–16, 2016–17, and 2017–18, respectively), employing advanced technologies for paddy cultivation resulted in higher net returns of Rs. 57233, 60768, and 57728 per hectare for the same respective years. Furthermore, in contrast to the farmers' practices with a return of Rs. 48569 per hectare and a benefit-cost ratio of 2.37, the demonstration fields yielded an average net return of Rs. 58576 per hectare and a benefit-cost ratio of 2.56.

The studies conducted by [5], [7], and [3] all corroborated these findings. They consistently showed that the benefit-cost ratio of Integrated Crop Management (ICM) in paddy, when utilizing improved cultivation techniques, consistently outperformed traditional farmer practices. This is primarily attributed to the enhanced yield achieved through the adoption of advanced technologies compared to the local check (traditional farmer practices). These outcomes align with the research conducted by [6], [9], and [1].

Table 6. Economics of improved technologies and farmers practice in paddy

Year	Total cost of cultivation (Rs.ha^{-1})	Gross Returns (Rs.ha^{-1})	Net Returns (Rs.ha^{-1})	B:C ratio

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	Improved technology	Local check	Improved technology	Local check	Improved technology	Local check	Improved technology	Local check
2015-16	35917	32258	93150	81405	57233	49147	2.59	2.52
2016-17	38192	37100	98960	87395	60768	50295	2.59	2.36
2017-18	38352	37366	96080	83632	57728	46266	2.51	2.24
Average	37487	35575	96063	84144	58576	48569	2.56	2.37

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4. CONCLUSION

The study's findings suggest that there is a significant discrepancy between paddy yield potential and actual yields, which is primarily caused by gaps in technology and extension as well as a lack of knowledge of new technologies in paddy cultivation in Tamil Nadu's Thiruvarur district. By demonstrating the tested technology, the yield potential of paddy cultivation was greatly increased. This significantly improved the livelihood and income of the farming community in Tamil Nadu's Thiruvarur district. The productivity of this type of paddy (CR 1009 Sub 1) increased, which had an effect on the farming community.

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