Impact of Paddy Varietal Demonstrations in Adoption, Knowledge Gain and Economic Perspective of Tiruvallur District, T.N., India

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ABSTRACT

Krishi Vigyan Kendra, Tiruvallur has been instrumental in conducting frontline demonstrations on high yielding, pest and disease resistant, submergence and salinity tolerant paddy varieties like CO 51, TKM 13, CR 1009 Sub 1 and TRY 3 in order to improve the existing yield level, net returns and also to address the specific environment related issues faced by the farmers. The KVK, Tiruvallur and the Department of Agriculture conducted varietal demonstrations and extension activities resulting in the adoption of CO 51 across 11,580 ha (25.7% of short-duration paddy area) and TKM 13 across 8,915 ha (17.29% of medium-duration paddy area). CO 51 provided an additional income of Rs. 24,935/ha over ADT 43, with a cost saving of Rs. 5,510/ha. While TKM 13 yielded Rs. 25,330/ha more than BPT 5204, with a cost saving of Rs. 8,600/ha. Economic impact realized by way of cultivating CO 51 in an area of 11580 ha and TKM 13 in 8915 ha is 28.87 and 22.58 crores respectively. The introduction of CR 1009 Sub 1 in coastal area has helped farmers realize additional income of Rs.24150/ha over the check variety BPT 5204 and cost saving of Rs.5650/ha with economic gain of Rs.72.45 lakhs in 300ha. The introduction of TRY 3 variety has gained popularity among the coastal farmers and cultivated in about 215 ha and earned an economic gain of Rs. 7,33,150 to the farmers apart from addressing problems due to salinity like poor establishment and grain sterility. Cost saving of Rs. 3700/ha and additional net income of Rs.3410 over the check variety BPT 5204 has also been realized. This study clearly indicates the higher economic gains attained by the farmers. The area spread of the popular varieties shows an increasing trend and more area coverage is expected in the coming years. The knowledge gain by the farmers of various blocks of Tiruvallur had significantly improved after intervention where 82-86 per cent farmers had more than 50% knowledge about the high yielding varieties.

Key words: CR 1009 Sub 1, Economic gain, Front line demonstration, Paddy, KVK Tiruvallur, TKM 13

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**Introduction**

Tiruvallur District lies in the North Eastern Zone of Tamil Nadu (Prasad et al., 2020) where Paddy is the major crop cultivated in about 96,609 ha during Sornavari (April-May), Samba (Aug-Sep) and Navarai (Nov-Dec) seasons with the productivity of 4340kg/ha. Samba is the major paddy growing season, covering about 51,567 ha (54.4 % of the total paddy area in Tiruvallur), while the remaining 45,042 ha (46.6 % of the total paddy area in Tiruvallur) is covered under Sornavari and Navarai seasons. Farmers cultivate medium and long duration varieties during the Samba season which starts from August and extends up to Dec/Jan and short duration paddy varieties during the Sornavari and Navarai seasons. Usually, two or three paddy crops in a year are raised in succession by the farmers in a cropping pattern: Paddy-Paddy-Pulses/Oilseeds or Paddy-Paddy-Paddy, depending upon the availability of water from the North East Monsoon. Farmers’ preference for varieties mainly depends on the yield and market price. BPT 5204 is the predominant variety grown by the farmers during the Samba season owing to the premium price fetched for the variety on the market. But the variety poses a lot of problems for the paddy growers by its susceptibility to major pests and diseases (Ganesh Kumar et al., 2019) viz., blast, BPH, sheath rot, sheath blight and inability to withstand water stagnation and salinity. The reduction in yield due to pests and diseases accounts for about 40 to 75 % and abiotic stresses like submergence and salinity account for 30 to 60 %. Among the short duration varieties, ADT 37 and ADT 43 have been the choice of varieties among the paddy growers in Tiruvallur District. Though both varieties perform well in the Tiruvallur district, their yield level hovers around 5-5.5 t/ha. More of these varieties were released more than 20 years ago and need replacement by recent high-yielding varieties. CO 51 is a short-duration slender grain variety with a high yield potential of 6.6 t/ha released by TNAU as a replacement for ADT 43. TKM 13 is a medium duration high yielding slender grain variety with a yield potential of 5.9 t/ha and is non lodging and resistant to major pests and diseases of paddy. It has been released in 2015 to replace BPT 5204 in Tamil Nadu. CR 1009 Sub 1 is a long-duration bold grain variety with submergence tolerance introduced from IRRI, Philippines for submergence prone areas of Tamil Nadu during the year 2015. TRY 3 is a medium duration salinity tolerant variety with bold grain type suitable for special preparations like idly.

Front line demonstration (FLD) has been used as a useful extension tool to demonstrate (Singh and Kaur, 2021) high yielding varieties along with production, protection and management practices in the farmer’s field under different agro-climatic regions and farming situations (Beigh et al., 2015). The improved cultivation practices followed in the National demonstrations have already shown high yield potential. Hence, front line demonstrations on the high yielding paddy varieties released/introduced recently by TNAU were conducted during the years 2015-2020 with the objective of promoting the adoption of new high yield varieties by farmers. But the adoption level and knowledge of general farmers towards these varieties need to be studied in order to assess the effectiveness of the frontline demonstrations and the impact on high yield varieties in terms of economic gains over the farmer’s practice. Therefore, it is really essential to study the impact of front line demonstrations on rice conducted by KVK, Tiruvallur to assess its effectiveness and efficacy towards enhancement in yield, economic gains and knowledge of the farmers.

**Materials and Methods**

Front Line Demonstrations on Paddy varieties viz., CO 51, TKM 13, CR 1009 Sub 1 and TRY 3 were conducted from 2015 to 2020 by Krishi Vigyan Kendra, Tiruvallur in various blocks of Tiruvallur District. The number of demonstrations carried out, beneficiaries and the area coverage are given in Table 1. The beneficiaries were selected based on their interest to adopt newer high yielding varieties and were trained with improved package of practices for rice viz., seed treatment and soil application of biofertilizers viz., *Azospirillum* and *Phosphobacteria* and bio inoculant *Pseudomonas fluorescens*; basal application of Paddy Micro nutrient mixture @ 12.5 kg/ha, SRI techniques and Integrated Pest and Disease Management practices. The yield obtained in improved varieties along with the check variety was recorded in the farmer’s field and an increase in yield obtained by cultivating high yielding varieties was calculated and the gap in extension and technology was worked out. The data on Gross income, Gross cost of cultivation and Net income was collected and the cost benefit ratio was calculated for individual farmers and the average was worked out.
for each high yielding varieties. Field days, trainings, paper messages, pamphlets, display boards, Television and Radio talks were conducted to give wider publicity of the high yielding varieties and the success stories were documented. Extension workers in the Department of Agriculture were also sensitized about the special characteristics and cultivation of the High yielding varieties and their suitability to specific environmental conditions. The area coverage and the no. of farmers adopting the high yielding varieties in Tiruvallur District during the year 2022 were collected from the Department of Agriculture to study the impact of the varietal demonstrations by KVK, Tiruvallur.

**Benefit Cost Ratio**

\[
\text{Benefit Cost Ratio (BCR)} = \frac{\text{Total Income}}{\text{Total Cost}}
\]

**Extension gap**

The extension gap refers to the difference between the demonstration yield and the yield achieved by farmer’s practice

\[
\text{Extension Gap} = \text{Demonstration Yield} - \text{Yield in Farmer's practice}
\]

**Technology gap**

The technology gap is a term used to describe the difference between the potential field and the demonstration yield in agricultural

\[
\text{Technology Gap} = \text{Potential Yield} - \text{Demonstration Yield}
\]

**Cost saving**

The cost saving is calculated by subtracting the cost of cultivation in the demonstration plot from the cost of cultivation in farmer’s practice. It quantifies the difference in expenses between the conventional farming approach used by farmers and the cost associated with implementing recommended technologies demonstrated in controlled settings practice.

\[
\text{Cost saving} = \text{Cost of cultivation in Farmer’s} - \text{Cost of cultivation in demonstration}
\]

**Effective gain**

The effective gain is calculated by adding the additional net income to the savings in cost. It represents the combined financial benefit derived from both increased revenue and reduced expenses. The effective gain reflects the overall improvement in profit-ability resulting from the adoption of the recommended approach.

\[
\text{Effective gain} = \text{Additional Net Income} + \text{Saving in Cost}
\]

**Economic gains**

The economic gains were worked out by calculating the additional net income got by way of cultivating the high yielding varieties in comparison with the farmer’s practice and multiplied with the area under the high yielding varieties

\[
\text{Economic gain} = \text{Additional Net Income} \times \text{Area under High Yll Varieties}
\]

**Technology Index**

The Technology Index is calculated by subtracting the demonstration yield from the potential yield dividing it by the potential yield and multiplying by 100. This equation expresses the difference between the potential yield and the demonstration yield as a percentage.

\[
\text{Technology Index} = \left(\frac{\text{Potential Yield} - \text{Demonstration Yield}}{\text{Potential Yield}}\right) \times 100
\]

\[A\ higher\ Technology\ Index\ indicates\ that\ the\ technology\ is\ closer\ to\ achieving\ its\ maximum\ potential\ yield,\ suggesting\ higher\ efficiency\ or\ effectiveness.\ Conversely,\ a\ lower\ Technology\ Index\ implies\ that\ there\ is\ more\ improvement\ to\ approach\ the\ potential\ yield.\]

**Adoption rate**

The adoption rate was worked out by number of farmers adopting the high yield varieties during the year of data collection divided by the no. of farmers taken up the demonstration.

\[
\text{Adoption Rate} = \frac{\text{No. of farmers adopting the high yield varieties during the year of data collection}}{\text{total Income}}
\]

**Knowledge gain**

The adoption of high yield varieties during and after the demonstration was compared in order to study the knowledge gain by the non-beneficiary farmers.

A sample of 70 farmers from all the 14 blocks of Tiruvallur district was selected and information regarding the knowledge about the high yielding varieties, cultivation practices, suitability to specific cropping seasons and adoption of high yielding varieties was gathered before and after intervention in order to assess the knowledge gained by the farmers
regarding the cultivation of high yielding varieties. The knowledge level is assessed on a 0 to 100% scale based on information gathered from the farmers before and after intervention and categorized to frequencies ranging from 0-25%; 26-50%; 51-75% and 76-100%. The farmers were grouped in each category and the percentage of the total participants was worked out. Paired ‘t’-test was conducted to assess the significance of the improvement of knowledge levels among the farmers after an intervention.

**Results and Discussion**

The average grain yield obtained in the intervention, B:C ratio, extension gap, technology gap and Technology index are presented in Table 2. The extension gap yielding the difference in yield between the high yield varieties and the farmer’s practice. A wide gap between the high yielding varieties and farmer’s variety was noticed for CR 1009 Sub 1 (2250 kg/ha) followed by TRY 3 (1496 kg/ha). The difference between the varietal demonstration and the farmer’s practice in these varieties may be attributed to the introduction of suitable varieties for the problematic area and the varieties cultivated by the farmers were unable to cope with the problems like submergence and salinity. The technology gap noticed for the variety CO 51 (1223 kg/ha) was higher than all other varieties owing to the varied level of technology adoption and improved package of practices among the farmers. The technology index also reflects the technology gap among the varieties and better extension services that need to be concentrated in the coming years to bridge the difference between the potential yield and demonstration yield. The results confirm to the findings of Girish et al., 2011 and Beigh et al., 2015.

The economic gain of the varieties gives a clear picture of the additional Net Returns, cost saving and effective gain of the high yield varieties (Table 3). The additional Net Returns from TKM 13 (Rs.25,330) was the highest among high yield varieties demonstrated followed by CO 51 (Rs.24,935), CR 1009 Sub 1 (Rs.24,150) and TRY 3 (Rs.3,410). The saving in cost of cultivation in the high yield varieties also shows a similar trend with TKM 13 showing the highest cost saving followed by CR 1009 Sub 1, CO 51 and TRY 3. BPT 5204 being the choice of

**Table 1. Demonstrations on high yielding varieties undertaken by KVK, Tiruvallur**

<table>
<thead>
<tr>
<th>Variety</th>
<th>Year</th>
<th>No. of Demonstrations</th>
<th>No. of Beneficiaries</th>
<th>Area coverage (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO 51</td>
<td>2015-2017</td>
<td>30</td>
<td>30</td>
<td>12</td>
</tr>
<tr>
<td>TKM 13</td>
<td>2015-2018</td>
<td>40</td>
<td>40</td>
<td>16</td>
</tr>
<tr>
<td>TRY 3</td>
<td>2014-2017</td>
<td>35</td>
<td>35</td>
<td>14</td>
</tr>
<tr>
<td>CR 1009 Sub 1</td>
<td>2018-2020</td>
<td>30</td>
<td>30</td>
<td>12</td>
</tr>
</tbody>
</table>

**Table 2. Impact of KVK intervention**

<table>
<thead>
<tr>
<th>Variety</th>
<th>Yield (kg/ha)</th>
<th>B:C ratio</th>
<th>Extension gap (kg/ha)</th>
<th>Technology gap</th>
<th>Technology Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO 51</td>
<td>6602</td>
<td>2.72</td>
<td>1400</td>
<td>1223</td>
<td>15.63</td>
</tr>
<tr>
<td>TKM 13</td>
<td>5820</td>
<td>2.79</td>
<td>1230</td>
<td>402</td>
<td>6.46</td>
</tr>
<tr>
<td>CR 1009 Sub 1</td>
<td>6000</td>
<td>2.40</td>
<td>2250</td>
<td>652</td>
<td>9.80</td>
</tr>
<tr>
<td>TRY 3</td>
<td>5850</td>
<td>2.63</td>
<td>1496</td>
<td>425</td>
<td>6.77</td>
</tr>
</tbody>
</table>

**Table 3. Economic gains over the check variety in demonstrations**

<table>
<thead>
<tr>
<th>Variety</th>
<th>Net Income (Rs.)</th>
<th>Additional Net Income (Rs.)</th>
<th>Saving in Cost (Rs.)</th>
<th>Effective gain in Demonstration (Rs.)</th>
<th>Economic gain in Demonstration (Rs.)</th>
<th>Overall Economic gain of the high yield varieties (Lakh Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO 51</td>
<td>58400</td>
<td>24935</td>
<td>5510</td>
<td>30445</td>
<td>2,99,220</td>
<td>2887</td>
</tr>
<tr>
<td>TKM 13</td>
<td>63750</td>
<td>25330</td>
<td>8600</td>
<td>33930</td>
<td>4,05,280</td>
<td>2250</td>
</tr>
<tr>
<td>CR 1009 Sub 1</td>
<td>55350</td>
<td>24150</td>
<td>5650</td>
<td>29860</td>
<td>1,93,200</td>
<td>72.45</td>
</tr>
<tr>
<td>TRY 3</td>
<td>47200</td>
<td>3410</td>
<td>3700</td>
<td>7150</td>
<td>47,740</td>
<td>7.33</td>
</tr>
</tbody>
</table>
farmers during the Samba season is susceptible to major pests and diseases and hence requires more cost for plant protection measures. The cost of cultivation of the high yield varieties was comparatively low, by virtue of the high yield varieties to withstand the biotic as well as the abiotic stresses. The economic gain of demonstrating the high yielding varieties in the intervention area as well as with the current area spread under the high yield variety needs to be assessed to get an overall picture of the benefits derived out of the high yield varieties. The area covered by the short duration variety CO 51 (11580 ha) was the highest (11.99% among the total paddy area and 25.7% among the short duration varieties) in Tiruvallur district followed by TKM 13 with 8915 ha (9.23% among the total paddy area and 17.29% among the medium duration varieties) (Table 4). Hence the economic gain derived out of the popularization of CO 51 was 28.87 crores and TKM 13 was 22.50 crores.

The area spread of CR 1009 Sub 1 and TRY 3 was 300 ha and 215 ha respectively. These varieties were not spread in a wide area in comparison to TKM 13 as these are confined to a few coastal blocks where submergence and salinity problems are witnessed. However, they are still covering a considerable area (about 20% of submergence and 6.15% of salinity prone area) in the coastal parts of Tiruvallur. The economic gain accrued by cultivation of CR 1009 Sub1 was estimated to be 72.45 lakhs and TRY 3 was 7.33 lakhs. The results confirm the findings of FLDs on Rice by Lathwal (2010); Dayanand et al. (2016) and Khade and Roy (2020). Hence it is understood that the front line demonstrations conducted were highly successful in terms of improving the grain yield and net returns of the farmers. This has been vividly captured by the area spread of these varieties in Tiruvallur district within 3-4 years of the demonstration.

The adoption level and adoption rate of the varieties by the farmers show an encouraging picture with CO 51 showing 25% adoption followed by TKM 13 showing 17.9% adoption among the farmers growing short duration and medium duration varieties respectively (Table 5). The adoption rate depicts the many fold increase in the adoption of high yield varieties by the farmers to the demonstrated farmers. Accordingly, CO 51 shows 1175 times increase in the farmers cultivating this variety and TKM 13 shows a 717.5-fold increase in adoption rate while CR 1009 Sub 1 and TRY 3 recorded 28.75 and 12 times increase in adoption of these high yield varieties. The higher the adoption rate, the higher must be the acceptance of the high yield varieties among the farmers and thus signifies the success of the demonstration. This result corroborates with the findings of Singh et al., (2020).

The knowledge level of the farmers regarding the high yield varieties and their cultivation aspects were analysed before and after the intervention. The results indicate that there is a significant increase in the knowledge level viz., 208.14% increase regard-

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**Table 4.** Area coverage and Economic gain of high yielding paddy varieties demonstrated by KVK, Tiruvallur

<table>
<thead>
<tr>
<th>Variety</th>
<th>Area (ha)</th>
<th>Production (tonnes)</th>
<th>Productivity (Quintals/ha)</th>
<th>Per cent area coverage to total Paddy area</th>
<th>Per cent area coverage to Short/ Medium duration Paddy area in Tiruvallur</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO 51</td>
<td>11580</td>
<td>76451</td>
<td>66.02</td>
<td>11.99</td>
<td>25.7</td>
</tr>
<tr>
<td>TKM 13</td>
<td>8915</td>
<td>51885</td>
<td>58.2</td>
<td>9.23</td>
<td>17.29</td>
</tr>
<tr>
<td>CR 1009 Sub 1</td>
<td>300</td>
<td>1800</td>
<td>60.0</td>
<td>0.31</td>
<td>0.58</td>
</tr>
<tr>
<td>TRY 3</td>
<td>215</td>
<td>1258</td>
<td>58.5</td>
<td>0.22</td>
<td>0.42</td>
</tr>
</tbody>
</table>

**Table 5.** Adoption level of high yielding paddy varieties demonstrated by KVK, Tiruvallur

<table>
<thead>
<tr>
<th>Variety</th>
<th>Area (ha)</th>
<th>No. of farmers</th>
<th>Adoption Level (%)</th>
<th>Adoption Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO 51</td>
<td>11580</td>
<td>35250</td>
<td>25</td>
<td>1175</td>
</tr>
<tr>
<td>TKM 13</td>
<td>8915</td>
<td>28700</td>
<td>17.4</td>
<td>717.5</td>
</tr>
<tr>
<td>CR 1009 Sub 1</td>
<td>300</td>
<td>575</td>
<td>3.48</td>
<td>28.75</td>
</tr>
<tr>
<td>TRY 3</td>
<td>215</td>
<td>420</td>
<td>2.55</td>
<td>12</td>
</tr>
</tbody>
</table>
Table 6. Knowledge level of high yielding paddy varieties demonstrated by KVK, Tiruvallur

<table>
<thead>
<tr>
<th>Knowledge level of farmers</th>
<th>CO 51 Before</th>
<th>CO 51 After</th>
<th>TKM 13 Before</th>
<th>TKM 13 After</th>
<th>CR 1009 Sub 1 Before</th>
<th>CR 1009 Sub 1 After</th>
<th>TRY 4 Before</th>
<th>TRY 4 After</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-25 %</td>
<td>51 (72.9%)</td>
<td>1 (1.4%)</td>
<td>45 (64.3%)</td>
<td>1 (1.4%)</td>
<td>31 (44.3%)</td>
<td>1 (1.4%)</td>
<td>37 (52.9%)</td>
<td>1 (1.4%)</td>
</tr>
<tr>
<td>26-50 %</td>
<td>17 (24.3%)</td>
<td>11 (15.7%)</td>
<td>23 (32.9%)</td>
<td>8 (11.4%)</td>
<td>27 (38.6%)</td>
<td>11 (15.7%)</td>
<td>25 (35.7%)</td>
<td>11 (15.7%)</td>
</tr>
<tr>
<td>51-75 %</td>
<td>2 (2.9%)</td>
<td>39 (55.7%)</td>
<td>2 (2.9%)</td>
<td>45 (64.3%)</td>
<td>11 (15.7%)</td>
<td>33 (47.1%)</td>
<td>7 (10%)</td>
<td>36 (51.7%)</td>
</tr>
<tr>
<td>76-100 %</td>
<td>0</td>
<td>19 (27.1%)</td>
<td>0</td>
<td>16 (22.9%)</td>
<td>1 (1.4%)</td>
<td>25 (35.7%)</td>
<td>1 (1.4%)</td>
<td>22 (31.4%)</td>
</tr>
<tr>
<td>Mean</td>
<td>22.1</td>
<td>68.1</td>
<td>24.6</td>
<td>69.3</td>
<td>33.6</td>
<td>69.6</td>
<td>29.1</td>
<td>69.4</td>
</tr>
<tr>
<td>Variance</td>
<td>0.00001</td>
<td>0.00004</td>
<td>0.00003</td>
<td>0.00003</td>
<td>0.00003</td>
<td>0.00003</td>
<td>0.00003</td>
<td>0.00003</td>
</tr>
<tr>
<td>‘p’ value</td>
<td>0.00001</td>
<td>0.00004</td>
<td>0.00003</td>
<td>0.00003</td>
<td>0.00003</td>
<td>0.00003</td>
<td>0.00003</td>
<td>0.00003</td>
</tr>
<tr>
<td>Per cent Increase in level</td>
<td>208.14</td>
<td>181.71</td>
<td>107.15</td>
<td>138.49</td>
<td>107.15</td>
<td>138.49</td>
<td>29.1</td>
<td>69.4</td>
</tr>
</tbody>
</table>

In the cultivable area of these high yield varieties in Tiruvallur district is expected in coming years.

**Conclusion**

Paddy varietal demonstrations conducted by Krishi Vigyan Kendra, Tiruvallur had significant impact in grain yield, income level, economic gain, adoption level, area expansion and knowledge gained by the farmers. The yield gap analysis indicates further need for the extension of improved technologies in crop cultivation to bridge the gap between the potential yield and the obtained yield. The higher economic gains from CO 51 and TKM 13 cultivation is mainly due to the large area brought under cultivation of the high yield varieties and more Net returns gained over the farmer’s practice. Higher adoption level and Knowledge level of the high yield varieties directly implies the higher acceptance of these varieties among the farmers. Hence further increase in the cultivable area of these high yield varieties in Tiruvallur district is expected in coming years.

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**Conflict of interest**

We declare no known conflict of interests that could have appeared to influence the work reported in this paper.

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