Journal of Tropical Resources and Sustainable Science

journal homepage: jtrss.org

Efficient Utilisation of Credit by The Farmer-Borrowers in Chittoor District of Andhra Pradesh, India

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Abstract

The present study has aimed at analyzing the technical and scale efficiencies of credit utilization by the farmer-borrowers in Chittoor district of Andhra Pradesh, India. DEA approach was followed to analyze the credit utilization efficiency and to analyze the factors influencing the credit utilization efficiency, log-linear regression analysis was attempted. DEA analysis revealed that, the number of farmers operating at CRS are more in number in marginal farms (40%) followed by other (35%) and small (17.5%) farms. Regarding the number of farmers operating at VRS, small farmers dominate the scenario with 72.5 per cent followed by other (67.5%) and marginal (42.5%) farmers. With reference to scale efficiency, marginal farmers are in majority (52.5%) followed by other (47.5%) and small (25%) farmers. At the pooled level, 26.7 per cent of the farmers are being operated at CRS, 63 per cent at VRS and 32.5 per cent of the farmers are either performed at the optimum scale or were close to the optimum scale (farms having scale efficiency values equal to or more than 0.90). Nearly 58, 15 and 28 percents of the farmers in the marginal farms category were found operating in the region of increasing, decreasing and constant returns respectively. Compared to marginal farmers category, there are less number of farmers operating at CRS both in small farmers category (15%) and other farmers category (22.5%). At the pooled level, only 5 per cent of the farmers are operating at DRS, majority of the farmers (73%) are operating at IRS and only 22 per cent of the farmers are operating at CRS indicating efficient utilization of credit. The log-linear regression model fitted to analyze the major determinants of credit utilization (technical) efficiency of farmer-borrowers revealed that, the three variables viz., cost of cultivation and family expenditure (both negatively influencing at 1% significant level) and family income (positively influencing at 1% significant level) are the major determinants of credit utilization efficiency across all the selected farmers categories and at pooled level. The analysis further indicate that, escalation in the cost of cultivation of crop enterprises in the region, rise in family expenditure and prior indebtedness of the farmers are showing adverse influence on the credit utilization efficiency of the farmer-borrowers.

1. Introduction

In the era of globalization and economic liberalization, the farmers' focus shifted towards market led production from subsistence farming. This calls for revamping the agricultural production sector towards strengthening of requisite farm infrastructure, extensive use of machinery, cultivation of cash crops etc., and such modernization of agri–business had significantly increased the credit requirements of Indian farmers. However, despite substantial improvement in agricultural output as well as distribution of credit through institutional sources with the introduction of the new agricultural technology, efficient utilization of credit by the farmers is the ultimate concern. Various factors like cropping pattern, family living expenditure, operating expenses of the crop enterprises, size of land holding etc., influence the effective utilization of credit by the farmers. The major indicators of the effective utilization of credit by the farmers include asset creation and the prompt repayment of the credit from the sales proceeds of the crop enterprises. The ineffective utilization of credit (say, diversion of loans towards unproductive purposes) leads to indebtedness among the rural farmers. This situation is so severe now in the country and of course, this problem of indebtedness is an age-old problem and the disheartening aspect is that, it has been aggravated further in the recent years. In view of the crucial significance of effective utilization of credit by the farmers, this in-depth

study has been taken up to ascertain the efficiency of credit utilization by the farmers.

In Andhra Pradesh, there is drastic improvement in credit disbursement to the farmers since past one decade. But, at the same time, there is even widespread in the problem indebtedness of farmers to the financial institutions. The major reasons for the persistence of indebtedness among the rural farmers in the State include viz., excessive dependency of agriculture on vagaries of monsoon rains, continuous mounting of cost of cultivation of agricultural produce, distress sales of produce by the farmers, involvement of large number of market middlemen in transacting the agricultural produce which prevents the farmers from getting remunerative prices for their produce, excessive dependency of farmers on non-institutional credit sources even at high rates of interest despite the strengthening of institutional credit system, diversion of crop loans and term loans towards unproductive purposes etc. Besides these, calamities like floods, droughts, acute pest and disease infestations, use of spurious inputs etc., are still playing a major havoc with the farmers, duly affecting the agricultural production prospects and thereby, making the farmers to end up in a debt trap. This led some of the farmers to commit suicides in Andhra Pradesh. Similar is the situation in Chittoor district in Rayalaseema region of Andhra Pradesh. Hence, it is felt appropriate by the researchers to investigate the credit utilization efficiency by the farmers in Chittoor district in strengthening farm infrastructure (assets) and towards prompt repayment of the loans to the creditors. This study is conducted in the year 2014-15 with the following specific objectives:

• To study the credit utilization efficiency of the farmers in Chittoor district in Andhra Pradesh
• To analyze the distribution of farms in the three regions of production frontier i.e., how many farms are under increasing, decreasing or constant returns.
• To study the factors influencing the credit utilization efficiency of the farmers in Chittoor district in Andhra Pradesh

2. Materials and Methods

Though several methods like ordinary least squares (OLS) regression, stochastic frontier analysis (SFA) and total factor productivity (TFP) indices using price-based index numbers (PIN) are used for the estimation of technical (resource use) efficiency, of late, the popular method of estimating the maximum possible output has been the "Data Envelopment Analysis" (DEA). This method was advocated by Charnes et al. (1978) which overcomes most of the limitations under earlier methods. The present paper has used this DEA approach to estimate the technical efficiency in utilizing the credit

resource by the sample farmers in Chittoor district in Rayalaseema region of Andhra Pradesh.

2.1. Selection of District

Chittoor district in Andhra Pradesh was purposively selected for the study, as the district harbours a wide range of crops and allied enterprises. In view of the tremendous potential of the district in harbouring potential agri-business enterprises, the credit requirements of farmers are increasing at significant note. This actually laid the basis for the investigator to select Chittoor district to execute the study on the research problem.

2.2. Selection of Mandals

The informal discussions held with the banking officials and the details shown through the District Credit Plan were considered for selecting the mandals in the district. For this study, top two indebted mandals viz., Pakala and Pichatur were selected.

2.3. Selection of Villages

Again, the District Credit Plan forms the basis for the selection of villages in the selected mandals, which facilitate to identify the farmer-borrowers indebted to the financial institutions. From the list of villages arranged in descending order of extent of severity of indebtedness, top two villages from each mandal viz., Gorpadu and Nendragunta from Pakala mandal and Govardhanagiri and Niruvai from Pichatur mandal were selected.

2.4. Selection of Farmers

For the selection of farmers, a list of farmers from the selected villages was obtained from the financial institutions. As the extent of credit taken by the farmers depends upon the size of land holding, the farmers were conveniently categorized according to their land holding size i.e., Marginal (<1 ha), Small (1-2 ha) and Other farmers (>2 ha). From these three different categories, a total of 120 farmers were selected at random, representing 40 farmers from each category. So, the sampling frame consists of one district, two mandals, four villages and 120 farmers (40 farmers each in marginal, small and other categories), which forms the basis to elicit the requisite data. A well structured pre-tested schedule was employed to collect the requisite information both from the sample farmers and banking officials.

2.5. Data Envelopment Analysis

The DEA method is a frontier method that does not require specification of a functional or distributional form, and can accommodate scale issues. This approach was first used by Farrell (1957) as a piecewise linear convex hull approach to frontier estimation and later by Boles (1966) and Afriat (1972). This approach did not receive wide attention till the publication of the paper by Charnes et al. (1978), which coined the term data envelope analysis. A large number of papers have extended and applied the DEA technology in the western

world. Very few studies have used this approach in India, especially in agriculture and no studies were conducted so far for analyzing the credit utilization efficiency that too in Andhra Pradesh. DEA method has the disadvantage that it does not explicitly accommodate the effects of data noise. In the present case, the DEA method was preferred because data noise was less of an issue as most of the variables in credit utilization efficiency were included and because of its ability to readily produce rich information on technical efficiency, scale efficiency and peers.

Several DEA models have been presented in the literature. The basic DEA model evaluates efficiency based on the productivity ratio which is the ratio of outputs to inputs. This study applied Charnes, Cooper and Rhode's (CCR) (1978) model and Banker, Charnes and Cooper (BCC) (1984) model. The production frontier has constant returns to scale in CCR model. The basic CCR model formulation (dual problem/ envelopment form) is given by :

$$\text{Min}\theta - \varepsilon\left(\sum_{j=1}^{m} s_j^- + \sum_{r=1}^{s} s_r^+\right)$$

Subject to :

$$\sum_{j=1}^{n} \lambda_J x_{ij} + s^- = \theta x_{i0} \quad (i=1, \ldots\ldots, m)$$

$$\sum_{j=1}^{n} \lambda_J y_{rj} - s_r^+ = y_{r0} \quad (r=1, \ldots\ldots, s)$$

$$\lambda_j \geq 0 \quad (j=1\ldots n)$$

Source :Zhu (2003, p.13)

Where, θ denotes the efficiency of DMUj , while yrj is the amount of rth output produced by DMUj using xij amount of ith input. Both yrj and xij are exogenous variables and λj represents the benchmarks for a specific DMU under evaluation (Zhu 2003). Slack variables are represented by si and sr. According to Cooper, Seiford and Tone (2004) the constraints of this model are:

i. The combination of the input of firm j is less than or equal to the linear combination of inputs for the firm on the frontier;

ii. The output of firm j is less than or equal to the linear combination of inputs for the firm on the frontier; and

iii. The main decision variable θj lies between one and zore.

Further, the model assumes that, all firms are operating at an optimal scale. However, imperfect competition and constraints to finance may cause some firms to operate at some level different to the optimal scale (Coelli, Rao & Battese 1998). Hence, the Banker, Charnes and Cooper (1984) BCC model is developed

with a production frontier that has variable returns to scale. The BCC model forms a convex combination of DMUs (Coelli, Rao & Battese 1998). Then the constant returns to scale linear programming problem can be modified to one with variable returns to scale by adding the convexity constraint Σλj = 1. The model given below illustrates the basic BCC formulation (dual problem/envelopment form).

$$\text{Min}\theta - \varepsilon\left(\sum_{j=1}^{m} s_j^- + \sum_{r=1}^{s} s_r^+\right)$$

Subject to:

$$\sum_{j=1}^{n} \lambda_J x_{ij} + s^- = \theta x_{i0} \quad (i=1, \ldots\ldots, m)$$

$$\sum_{j=1}^{n} \lambda_J y_{rj} - s_r^+ = y_{r0} \quad (r=1, \ldots\ldots, s)$$

$$\lambda_j \geq 0 \quad (j=1, \ldots\ldots.., n)$$

$$\sum_{j=1}^{n} \lambda_j = 1$$

Source :Zhu (2003, p.13)

This approach forms a convex hull of intersecting planes (Coelli, Rao & Battese 1998). These planes envelop the data points more tightly than the constant returns to scale (CRS) conical hull. As a result, the variable returns to scale (VRS) approach provides technical efficiency (TE) scores that are greater than or equal to scores obtained from the CRS approach (Coelli, Rao & Battese 1998). Moreover, VRS specifications will permit the calculation of TE decomposed into two components: scale efficiency (SE) and pure technical efficiency (PTE). Hence, this study first uses the CCR model to assess TE then applies the BCC model to identify PTE and SE in each DMU. The relationship of these concepts is given below:

Relationship between TE, PTE and SE:
$TE_{CRS} = PTE_{VRS}*SE$, where
TE_{CRS} = Technical efficiency of constant return to scale
PTE_{VRS} = Technical efficiency of variable return to scale
SE = Scale efficiency
Source: Coelli, et al., (1998)

The above relationship, which is unique, depicts the sources of inefficiency, i.e., whether it is caused by inefficient operation (PTE) or by disadvantageous conditions displayed by the scale efficiency (SE) or by both. If the scale efficiency is less than 1, the DMU will be operating either at decreasing return to scale (DRS) if a proportional increase of all input levels produces a less-

than-proportional increase in output levels or increasing return to scale (IRS) at the converse case. This implies that resources may be transferred from DMUs operating at DRS to those operating at IRS to increase average productivity at both sets of DMUs (Boussofiane et al.,1992).

2.6.   Data and Variables for the Study

DEA assumes that, the inputs and outputs have been correctly identified . Usually as the number of inputs and outputs increase, more DMUs tend to get an efficiency rating of 1 as they become too specialized to be evaluated with respect to other units. On the other hand, if there are too few inputs and outputs, more DMUs tend to be comparable. In any study, it is important to focus on correctly specifying inputs and outputs. DEA is commonly used to evaluate the efficiency of a number of States and UTs and it is a multi-factor productivity analysis model for measuring the relative efficiency of a homogeneous set of (DMUs). For every inefficient DMU, DEA identifies a set of corresponding efficient DMU that can be utilized as benchmarks for improvement of performance and productivity. DEA is developed based on two scale of assumptions viz., Constant Return to Scale (CRS) model and Variable Return to Scale (VRS) model. CRS means that the producers are able to linearly scale the inputs and outputs without increasing or decreasing efficiency. This is a significant assumption. The assumption of CRS may be valid over limited ranges but its use must be justified. As an aside, CRS tends to lower the efficiency scores while VRS tends to raise efficiency scores.

For enabling the study of evaluation of States and UTs with respect to the implementation efficiency, we have observed the resources or inputs and productivity indicators or outputs as follows:

Inputs : X_1 – Amount indebted (Rs), X_2 - Size of land holding (ha),

X_3 – Cost of cultivation (Rs.), (X_4) – Family expenditure (Rs.),

X_5 – Family income (Rs.).

Outputs : Y_1 – Assets created (Rs.), Y_2 – Amount of loan repaid (Rs.)

The study involves the application DEA to assess the efficiency of 120 farmers in the year 2014-15. DEA model is executed using input-orientation with radial distances to the efficient frontier. By running these programmes with the same data under CRS and VRS assumptions, measures of overall technical efficiency (TE) and 'pure' technical efficiency(PTE) are obtained. The DEA was solved using the MAXDEA version 5.2 taking an input orientation to obtain the efficiency levels.

Determinants of Technical Efficiency: Ray (1991) and Worthington and Dollery (1999), used traditional DEA in the first stage to estimate the technical efficiency and in the second stage estimated the determinants of technical efficiency from the factors contributing to this technical efficiency by using econometric procedure. In the present study, the technical efficiency values obtained from the DEA model considering the CRS input-oriented model were used for examining the relationship between the technical efficiency and factors influencing it. The technical efficiency score from CRS model was chosen as the dependent variable for its high accuracy in discriminating efficiency as compared to variable returns to scale (Gonclaves et al., 2008). The above inputs are considered as explanatory variables. The traditional method of regression was used for this purpose and OLS analysis was carried out to estimate the regression equation. The regression model specified for the present study is given in Equation 6:

$$Y= a\ X_1^{b1}\ X_2^{b2}\ X_3^{b3}\ X_4^{b4}\ X_5^{b5}\ U$$

where, Y = Technical efficiency scores (CRS), X_1 – Amount indebted (Rs), X_2 - Size of land holding (ha), X_3 – Cost of cultivation (Rs.), (X_4) – Family expenditure (Rs.), X_5 – Family income (Rs.), 'a' and 'bi' are the constant and the coefficients respectively, which were estimated through the OLS analysis after appropriate log conversion

3.   Results and Discussion

To obtain credit utilization efficiency of each farmer, DEA model which is input oriented was used at different scales under the assumption of CRS. After introducing convexity in CRS, the VRS were estimated. By using efficiency levels of these CRS and VRS models, the scale efficiency of each farmer was obtained. According to Ferreira (2005), the farmers that operate with scale efficiencies >= 0.9 are considered to be efficient. The explanation for this flexibility is to avoid compromising the analysis through a farmer that stands out as being an outlier rather than for its true relative efficiency. Data recording errors and external factors were attributed for this flexibility.

3.1.   Marginal Farmers

It was observed that, 40 per cent of farmers under assumption of CRS performed with efficiency level equal to 0.90 or greater, i.e., 16 out of the total 40 farmers. The average efficiency score was 0.6127. Based on this, it could be inferred that remaining 24 farmers, who did not operate at the maximum efficiency level, could reduce the input level by 38.73 per cent and maintain the same level of credit utilization efficiency as achieved by 40 per cent of the farmers.

When the assumption of constant scale was relaxed and the model with variable returns to scale was calculated, the impact of production scale on technical

efficiency level was visible. In marginal farmers, the number of efficient farmers increased by 42.5 per cent and the average technical efficiency score increased to 0.8219. These better results from the model with variable returns were mainly due to the inclusion of scale efficiency, which the previous model did not take into consideration. Further, the lower value of standard deviation of mean in model with variable returns suggested concentration of farmers in the higher efficiency levels. As regards to the scale efficiency, 52.5 per cent of the farmers (21 out of 40 farmers) under marginal farmers category either performed at the optimum scale or were close to the optimum scale (farms having scale efficiency values equal to or more than 0.90).

3.2. Small Farmers

In contrast to the marginal farmers, only 17.5 per cent of farmers are being operated at CRS with efficiency level equal to 0.90 or greater, i.e., 7 out of the total 40 farmers. The average efficiency score was 0.5349. This implies that, remaining 33 farmers, who did not operate at the maximum efficiency level, could reduce the input level by 46.51 per cent and maintain the same level of credit utilization efficiency as achieved by 17.5 per cent of the farmers. Nearly 73 percent of the farmers are being operated at variable returns at an average technical efficiency score of 0.9176. As regards to the scale efficiency, 25 per cent of the small farmers (10 out of 40 farmers) either performed at the optimum scale or were close to the optimum scale (farms having scale efficiency values equal to or more than 0.90).

Table 1: Efficiency measures and descriptive statistics across farms according to Scale of Operations

Scale of Operations Standard	Efficient Farms ($\theta \geq 0.90$)		Efficiency Measures		
	No.	%	Mean	Maximum	Minimum
Marginal farmers					
Technical efficiency (Constant returns)	16	40.0	0.6127	1	0.2341
Technical efficiency (Variable returns)	17	42.5	0.8219	1	0.5142
Scale efficiency	21	52.5	0.8491	1	0.4076
Small farmers					
Technical efficiency (Constant returns)	7	17.5	0.5349	1	0.1327
Technical efficiency (Variable returns)	29	72.5	0.9176	1	0.7314
Scale efficiency	10	25.0	0.5711	1	0.1928
Other farmers					
Technical efficiency (Constant returns)	14	35.0	0.6728	1	0.1625
Technical efficiency (Variable returns)	27	67.5	0.8919	1	0.3816
Scale efficiency	19	47.5	0.7316	1	0.2362
All farmers (Pooled)					
Technical efficiency (Constant returns)	32	26.7	0.6249	1	0.1727
Technical efficiency (Variable returns)	76	63.3	0.8923	1	0.3816
Scale efficiency	39	32.5	0.6942	1	0.1196

3.3. Other Farmers

It was observed that, 35 per cent of farmers under assumption of CRS performed with efficiency level equal to 0.90 or greater, i.e., 14 out of the total 40 farmers. The average efficiency score was 0.6728 (Table 1). This indicates that, remaining 26 farmers, who did not

operate at the maximum efficiency level, could reduce the input level by 32.72 per cent and maintain the same level of credit utilization efficiency as achieved by 35 per cent of the farmers. Nearly 68 per cent of the other farmers are being operated at variable returns with an average technical efficiency score of 0.8919. As regards to the scale efficiency, 47.5 per cent of the farmers (19 out of 40

farmers) under other farmers category either performed at the optimum scale or were close to the optimum scale (farms having scale efficiency values equal to or more than 0.90).

From the above analysis, it is clear that, the number of farmers operating at CRS are more in number in marginal farms (40%) followed by other (35%) and small (17.5%) farms. Regarding the number of farmers operating at VRS, small farmers dominate the scenario with 72.5 per cent followed by other (67.5%) and marginal (42.5%) farmers. With reference to scale efficiency, marginal farmers are in majority (52.5%) followed by other (47.5%) and small (25%) farmers. At the pooled level, 26.7 per cent of the farmers are being operated at CRS with an average technical efficiency score of 0.6249 ie., 32 farmers out of 120 farmers. This indicates that, remaining 88 farmers, who did not operate at the maximum efficiency level, could reduce the input level by 37.51 per cent and maintain the same level of credit utilization efficiency as achieved by 26.7 per cent of the farmers. Sixty three per cent of the farmers at pooled level are being operated at variable returns with an average technical efficiency score of 0.8923. As regards to the scale efficiency, 32.5 per cent of the farmers (39 out of 120 farmers) at pooled level, either performed at the optimum scale or were close to the optimum scale (farms having scale efficiency values equal to or more than 0.90).

Regions of Operations in the Production Frontier: In addition to knowing about the number of efficient farms, extent of inefficiency and optimum scale of operation, it is also important to understand the distribution of farms in the three regions of production frontier, i.e. how many farms are under increasing, decreasing or constant returns. These were estimated using the equations given under methodology and the results have been presented in Table 2. Nearly 58 per cent of the farmers in the marginal farmers category were found operating in the region of increasing returns or the sub-optimal region. The production scale of these farms could be increased by decreasing the costs, since they were performing below the optimum production scale. Only 15 per cent of the marginal farmers were found in the decreasing returns region and they could increase their technical efficiency by reducing their credit requirement. This region is also called as supra-optimal, i.e. the farms were performing above the optimum scale of production. In the constant region of frontier, i.e., optimum scale of production, nearly 28 per cent of the marginal farms were found operating.

Regarding small and other categories, it is heartening that, no farmers operate at DRS. Majority of the farmers ie., 85 per cent of small farmers and nearly 78 per cent of other farmers are operating at IRS and this

implies that, for these farmers the credit disbursement must be increased, as it is being presently utilized effectively in the sub-optimal region of production function (ie., region of increasing returns). Compared to marginal farmers category, there are less number of farmers operating at CRS both in small farmers category (15%) and other farmers category (22.5%). This indicates that, there is more efficient utilization of credit by the marginal farmers compared to small and other farmers. However, as mentioned earlier, more number of farmers of both small and other categories are operating at IRS compared to marginal farmers. This further indicate that, for those farmers operating at DRS in marginal farmers category, their credit disbursement must be decreased and the same can be diverted towards the farmers experiencing IRS, so as to ensure credit utilization efficiency in both categories.

Table 2: Category-wise distribution of farmers in Chittoor district according to types of return among different scale of operations

Types of return	Marginal Farmers	Small Farmers	Other Farmers	All Farmers
Increasing returns	23 (57.50)	34 (85.00)	31 (77.50)	88 (73.33)
Constant returns	11 (27.50)	6 (15.00)	9 (22.50)	26 (21.67)
Decreasing returns	6 (15.00)	---	---	6 (5.00)

Note: Figures in parentheses indicate percents to respective total farmers

On the whole, at the pooled level, only 5 per cent of the farmers are operating at DRS and majority of the farmers (73%) are operating at IRS. This signifies that, there should be more credit disbursement towards these farmers (operating at IRS) and the same should be decreased towards the farmers operating at DRS. Only 22 per cent of the farmers are operating at CRS indicating efficient utilization of credit.

3.4. Determinants of Credit Utilization (Technical) Efficiency of farmer-borrowers

Log linear regression model was used to analyze the major determinants of credit utilization (technical) efficiency of farmer-borrowers (Table 3). The input variables considered under DEA Model were again considered as influential factors for the CRS obtained for the three categories of farmers. The analytical findings revealed that, across all the categories of farmers and at pooled level, the models are statistically significant, as indicated by higher and significant R^2 values. The three variables viz., cost of cultivation (X3) and family expenditure (X4) (both negatively influencing at 1% significant level) and family income (X5) (positively influencing at 1% significant level) are the major determinants of credit utilization efficiency across all the selected farmers categories and at pooled level. The

influences of cost of cultivation (X3) and family expenditure (X4) are highest on marginal farms and the influence of family income (X5) was found highest on small farms followed by marginal and other farms. It is interesting that, amount indebted (X1) was found statistically non-significant on other farms suggesting that, it had no influence on the credit utilization (technical) efficiency. It was further captured in the production functional analysis that, both amount indebted (X1) and size of land holding (X2) had positive and significant (5%) influence on the credit utilization efficiency across all the categories of farmers and at pooled level, except amount indebted (X1) turned insignificant on other farms. The analysis further indicate that, escalation in the cost of cultivation of crop enterprises in the region, rise in family expenditure and prior indebtedness of the farmers are showing adverse influence on the credit utilization efficiency of the farmer-borrowers.

Table 3: Determinants of Credit Utilization (Technical) Efficiency of farmer-borrowers in Chittoor district

Variables	Marginal Farmers	Small Farmers	Other Farmers	All Farmers
Intercept	-0.8173	0.4971	0.4237	0.3193
Amount Indebted (X_1)	-0.2429*	-0.0319*	-0.1791[NS]	-0.1134*
Size of land holding (X_2)	0.3162*	0.2617*	0.1837*	0.2038*
Cost of Cultivation (X_3)	-0.2017**	-0.3343**	-0.2361**	-0.2651**
Family Expenditure (X_4)	-0.0627**	-0.0916**	-0.0939**	-0.1194**
Family Income (X_5)	0.1984**	0.2928**	0.1931**	0.2136**
Adjusted R^2	0.86**	0.81**	0.88**	0.79**

Note : ** - Significant at one per cent level, * - Significant at five per cent level, and

NS – Non-significant

4.   Conclusions

Technical and scale efficiencies have been estimated for analyzing the credit utilization efficiency of farmer-borrowers in Chittoor district of Andhra Pradesh, India by DEA approach. The above analysis regarding resource use efficiency of farms revealed that, only 40, 17.5 and 35 per cents of marginal, small and other farms are found operating under the assumption of CRS with efficiency level equal to 0.90 or greater. Thus, the number of farms operating at CRS are more in number in marginal farms (40%) followed by other (35%) and small farms (17.5%). Similarly, regarding the number of farmers operating at VRS, the small farms are more in number with 72.5 per cent followed by other (67.5%) and marginal farms (42.5%). With reference to scale efficiency, marginal farms dominate the scenario with 52.5 per cent followed by other (47.5%) and small farms (25%). At pooled level, 26.7 per cent of the farms are being operated at CRS, 63 per cent of the farmers are being operated at VRS and regarding scale efficiency, nearly 33 per cent of the farmers, either performed at the optimum scale or were close to the optimum scale (farms having scale efficiency values equal to or more than 0.90). Regarding category-wise distribution of farmers in Chittoor district according to types of returns to scale among different scale of operations, nearly 22 per cent of farmers are operating at CRS indicating efficient utilization of resources. Majority of the farmers (73%) i.e., 88 out of 120 are operating at IRS and only 5 per cent of the farmers (6 out of 120 farmers) are operating at DRS. Log linear regression model employed to analyze the major determinants of credit utilization (technical)

efficiency of farmer-borrowers revealed that, cost of cultivation (X3) and family expenditure (X4) (both negatively influencing at 1% significant level) and family income (X5) (positively influencing at 1% significant level) are the major determinants. Escalation in the cost of cultivation of crop enterprises in the region, rise in family expenditure and prior indebtedness of the farmers are showing adverse influence on the credit utilization efficiency of the farmer-borrowers.

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