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Ajayakumar
Ph.D. Scholar, Department of Agricultural Economics, University of Agricultural Sciences, GKVK, Bengaluru, Karnataka, India

Suresh S Patil
Retired Dean (Agri.), College of Agriculture, Kalaburagi. University of Agricultural Sciences, Raichur, Karnataka, India

BS Reddy
Professor and Senior Farm Superintendent, ZARS, Kalaburagi, Karnataka, India

SB Goudappa
Professor and Director of Extension, University of Agricultural Sciences, Raichur, Karnataka, India

GM Hiremath
Associate Professor, Department of Agribusiness Management, College of Agriculture, UAS, Dharwad, Karnataka, India

Corresponding Author:
Ajayakumar
Ph.D. Scholar, Department of Agricultural Economics, University of Agricultural Sciences, GKVK, Bengaluru, Karnataka, India

Resource use efficiency of pigeon pea farming in Kalyana-Karnataka region

Ajayakumar, Suresh S Patil, BS Reddy, SB Goudappa and GM Hiremath

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Abstract
Pulses play important role in the farming economy of Kalyana-Karnataka region. The study on technical and Allocative efficiency of pigeonpea farming was carried out to assess the economic efficiency. Multistage purposive random sampling technique was used for selection of respondents. Totally 120 farmers constituting 40 from each district growing TS-3R and GRG-811 were selected from Bidar, Kalaburagi and Yadgir districts. The findings of the study indicated that the per acre cost incurred in the cultivation of GRG 811 (Rs. 25409.00) variety of pigeonpea was considerably higher than TS 3R (Rs. 22598.00) variety. The resources like seeds, fertilizer, plant protection chemicals and human labour in GRG 811 variety and plant protection chemicals and human labour in TS 3R variety cultivation were underutilized. Similarly, land, FYM and bullock labour in GRG 811 and land, seeds and bullock labour in TS 3R variety cultivation were over utilized. The data envelopment analysis indicated that more than 50 per cent of the sample farmers were operating above 80 per cent efficiency level across the study area. However, only few farmers (<30%) were operating below 80 per cent efficiency level. Further, 18.33 per cent and 33.34 per cent of pigeonpea farmers have achieved 100 per cent efficiency level under Constant Returns to Scale (CRS) and Variable Returns to Scale (VRS) respectively.

Keywords: Variety, technical efficiency, allocative efficiency, resources, CRS, VRS, SAU's, TS-3R and GRG-811

1. Introduction

Pigeonpea (*Cajanus cajan* (L) mill. sp.) is a significant pulse crop in tropical and sub-tropical regions, known for its unique characteristics. It holds the second position in terms of importance among pulse crops, following bengalgram. Pigeonpea plays a crucial role in the farming systems adopted by small-scale farmers in developing countries. Its origin is traced back to Peninsular India, with India being responsible for 90 percent of the world's output. In India, pigeonpea is cultivated across 4.43 million hectares of land (14.5% of the area under pulses), yielding 4.25 million tonnes. In Karnataka specifically, pigeonpea is grown over 8.90 lakh hectares, producing 8.20 lakh tonnes and achieving a productivity rate of 1150 kg/ha.

Efficiency in resource utilization is a key aspect of agriculture, encompassing technical efficiency and allocative efficiency. It involves the effective use of public investment, subsidies and credit in agricultural practices. Different regions exhibit variations in factor productivity due to diverse factors influencing farming outcomes. Factors such as sowing and transplanting methods, irrigation techniques, proper input application and suitable input combinations contribute to the variations in crop productivity among farms. Challenges like shrinking land holdings, fragmented ownership, informal tenancies and inadequate rural infrastructure (including roads, electricity, markets and education) also impact factor productivity.

Although few empirical studies have been conducted in the state, they offer limited insights into the performance of high-yielding pigeonpea varieties. Therefore, there is an urgent need to investigate the efficiency of pigeonpea farming in order to develop appropriate policies and enhance production. This study aims to evaluate the economic efficiency of TS 3R and GRG 811 pigeonpea varieties in the Kalyana-Karnataka region, providing valuable perspectives for policymaking and productivity improvement.

2. Materials and Methodology

The three districts *viz*., Kalaburagi, Bidar and Yadgir districts of Kalyana Karnataka were purposively selected as area under pigeonpea is relatively higher in these three districts of the region. These three districts of Kalyana-Karnataka region contribute about 51.67 per cent to pigeonpea production of the State. Multistage purposive random sampling technique was used for selection of respondents. In the first stage, three districts of Kalyana-Karnataka region *viz*. Bidar, Kalaburagi and Yadgir were selected based on pigeonpea production potential. At the second stage, six taluks constituting two taluks from each selected district were choosen using same criterion, in consultation with RSK, KVK and AEEC. Further, twenty (20) farmers growing TS-3R and GRG-811 varieties from each taluk were chosen randomly using same criterion as mentioned above in the second stage. In total, 120 sample constituting 60 farmers each growing TS-3R and GRG-811 varieties respectively were selected for the study.

The technique of tabular analysis was adopted to study the cost and returns of pigeonpea production. To study the resource use efficiency, production function analysis is employed. The data envelopment analysis is employed to study the technical efficiency.

2.1 Resource productivity and allocative efficiency

The marginal physical productivity (MPP) of each input variable in the production function was determined using the output elasticity coefficients. MPP represents the expected change in total output resulting from the addition or reduction of one unit of a specific factor, while keeping other factors constant. It can be calculated as follows:

$$E_P = MPP_X/APP_{Xi}$$

i.e., $MPP_{Xi} = (bi) * (APP_{Xi})$

$$MPP_{Xi} = [(bi) * (Y)]/[Xi]$$

Where,

MPP_{Xi} = Marginal physical product of the ith input

bi = Production elasticity of the ith input (Ep)

APP_{Xi} = Average physical product of the ith input

Xi = Geometric mean level of the ith input

Y = Geometric mean level of output

The marginal value product (MVP_{Xi}) of a variable Xi represents the incremental change in total output in monetary terms resulting from the addition of one unit of Xi, while other factors remain constant. It can be calculated as:

$$MVP_{Xi} = [(bi) * (Y) * (Py)]/[(Xi)]$$

Where,

Py represents the output price

To assess resource use efficiency, the ratios of the respective marginal value products to their opportunity costs (OC) were calculated. The resource use efficiency (MVP/MFC) was evaluated based on neoclassical criteria. This evaluation helped determine whether increasing production at the farm level and in the region could be achieved profitably by reallocating expenditure among different resources, considering their profitability ratios.

2.2 Data Envelopment Analysis (DEA)

Data Envelopment Analysis (DEA) is a frontier method that offers flexibility without the need for specifying functional or distributional forms, making it suitable for addressing scale-related issues. In this study, DEA was applied using two classic models: CRS (constant returns to scale) and VRS (variable returns to scale) with input orientation, aiming to minimize inputs while achieving a specific level of output. The linear programming models used to measure farmers' efficiency, assuming constant returns to scale (Coelli, 1996) [5], are represented as follows:

Minimize $\theta\ \lambda\ \theta$

Subject to: $-yi + Y\lambda \geq 0$

$\theta Xi - X\lambda \geq 0$

$\lambda \geq 0$

Here,

yi is a vector (m x 1) representing the output of the i^{th} TPF Farmer

xi is a vector (k x 1) representing the inputs of the i^{th} TPF Farmer

Y is an output matrix (n x m) for n TPF Farmers

X is an input matrix (n x k) for n TPF Farmers

However, the assumption of constant returns to scale is only applicable when firms are operating at an optimum scale. Otherwise, technical efficiency measures may be misinterpreted as scale efficiency, which considers various types of returns to production (increasing, constant, and decreasing). To address this, a convexity constraint is imposed to reformulate the CRS model. The resulting model with variable returns to scale estimates pure technical efficiency, free from scale effects, as shown below:

Minimize $\theta\ \lambda\ \theta$

Subject to: $-yi + Y\lambda \geq 0$

$\theta Xi - X\lambda \geq 0$

$N1\lambda = 1$

$\lambda \geq 0$

Here, N1 is a vector of (n x 1) ones,

When there are differences between the values of the efficiency scores in the models CRS and VRS, scale inefficiency is confirmed, indicating that the return to scale is variable, i.e., it can be increasing or decreasing. The DEA was applied by using both classic models CRS (constant returns to scale) and VRS (variable returns to scale) with input orientation, in which one seeks input minimization to obtain a particular product level (Murthy *et al*. 2009) [7]. The scale efficiency values for each analyzed unit can be obtained by the ratio between the scores for technical efficiency with constant and variable returns as follows:

$$\theta s = \theta CRS\ (XK,YK)/\theta VRS\ (XK,YK)$$

Where,

$\theta CRS\ (XK,YK)$ is the technical efficiency for the model with constant returns

$\theta VRS\ (XK,YK)$ is the technical efficiency for the model with variable returns

θs is scale efficiency

It is to state here that all the models presented above should be solved n times, i.e., the model is solved for each TPF in the sample. Gross yield (Q) was used as an output (Y) in the present case and seeds (kg), human labour (man days), bullock labour (pair days), machine labour (hours), farm yard manure (cart load), fertilizers (kg), plant protection chemicals (Rs.). The models were solved using the DEAP version 2.1taking an input orientation to obtain the efficiency level.

3. Results and Discussion

Understanding the resources used, costs, returns, investment patterns and other factors is crucial when assessing the impact and efficiency of any technology. In Table 1. we can observe the average per acre total cost of cultivation for GRG 811 growers was Rs. 25,409 with more than 75% of the total cost being accounted for by variable costs. On the other hand, the total cost of cultivation for TS 3R pigeonpea variety was Rs. 22,598 per acre. In TS 3R, the cost of bullock labor (Rs. 1,160) and machine labor (Rs. 3,210) represented 5.13% and 14.20% of the total cost of cultivation, respectively. Comparatively, the cost of bullock labor (Rs. 1,490/acre) and machine labor (Rs. 3,560/acre) for GRG 811 accounted for 5.86% and 14.00% of the total cost of cultivation. The interest on working capital was higher in GRG 811 (Rs. 1,328) compared to TS 3R (Rs. 1,175) due to additional material costs in GRG 811 production. The fixed costs for GRG 811 and TS 3R were 23.53% and 25.50% of the total cost, respectively. Rental value of land and depreciation were the major components of the total fixed costs. The total fixed cost for GRG 811 (Rs. 5,979) was slightly higher than TS 3R (Rs. 5,761). These results align with a previous study by Tandel *et al.* (2018) [10] on cost structure and profitability of finger millet in the south Gujarat region.

Table 1: Cost and returns of pigeonpea production in the overall study area (Per acre)

Sl. No.	Particulars	Unit	TS 3R variety			GRG 811 variety		
			Quantity	Value (Rs)	% age	Quantity	Value (Rs)	% age
A	**Variable cost**							
1	Seeds	Kg	4.63	350	1.55	4.50	338	1.33
2	Farm yard manure	Cart load	0.976	1223	5.40	1.064	1330	5.24
3	Fertilizers	Kg	93.91	1430	6.32	102.46	1547	6.01
4	PP Chemicals	Liter	1.45	1066	4.70	1.54	1181	4.65
5	Irrigation	Rs.	-	-	-	-	900	3.54
6	Human labour	MD	23.66	7223	32.00	25.32	7757	30.52
7	Bullock labour	PD	1.16	1160	5.13	1.49	1490	5.86
8	Machine labour	Hrs.	4.79	3210	14.20	5.85	3559	14.00
9	Interest on working capital @7.5%	Rs.	-	1175	5.20	-	1328	5.22
	Sub total		-	16837	74.50	-	19430	76.47
B	**Fixed cost**							
1	Land revenue	Rs.	-	62	0.28	-	62	0.25
2	Depreciation	Rs.	-	530	2.35	-	553	2.17
3	Land rent	Rs.	-	4693	20.75	-	4870	19.15
4	Interest on fixed capital @ 9%	Rs.	-	476	2.10	-	494	1.94
	Sub total	Rs.		5761	25.50	-	5979	23.53
C	Total cost of cultivation (A + B)	Rs.	-	22598	100.00	-	25409	100.00
D	Cost of production (Rs/Qtl.)	Rs.	-	4688		-	4228	-
E	**Returns**							
1	Yield (Qtl/acre)	Qtl.	-	4.82		-	6.01	-
2	Price (Rs/Qtl.)	Rs.	-	6637		-	6690	-
3	Gross returns (Rs)	Rs.	-	31992		-	40207	-
4	Net returns	Rs.	-	9394		-	14797	-
5	Returns per rupee of investment		-	1.42		-	1.58	-

Note: 1. Percentages are the total cost of cultivation of respective variety
2. Decimal values are rounded up to its nearer value

Additionally, Table 1. reveals that the per acre yield obtained for GRG 811 (6.01 Qtl) was considerably higher than TS 3R (4.82 Qtl) in the overall study area. This difference can be attributed to the higher yield of GRG 811. The average sale price per quintal for TS 3R and GRG 811 were Rs. 6,637 and Rs. 6,690, respectively. The returns per rupee of investment was calculated to be 1.42 and 1.58 for TS 3R and GRG 811, respectively. Interestingly, despite incurring higher costs, GRG 811 achieved significantly higher returns. These findings are consistent with a comparative analysis study by Priyanka *et al.* (2013) [8] on transplanted and dibbled methods of redgram cultivation in Bidar district of Karnataka.

It is worth to note that the cost of production of GRG 811 variety (Rs. 4228) was low compared to TS 3R variety (Rs. 4688). This might be due to realization of higher yield by GRG 811 growers than TS 3R growers. Consequent upon the higher yields of GRG 811, the net returns realized was also considerably higher in GRG 811 as compared to TS 3R cultivating farmers. The yield levels of GRG 811 variety could be mainly attributed due to nipping practice followed and resistance of the variety to pest and diseases. The results of the study are in line with Brunda (2018) [4], who conducted study on cost and returns among adopters of improved technologies of bengalgram cultivation.

3.1 Resource use efficiency in pigeonpea production

Table 2. Represents the ratios of marginal value products (MVP) to marginal factor costs (MFC) for pigeonpea production in Kalaburagi, Bidar, and Yadgir districts.

In Kalaburagi district, the ratios of MVP to MFC were greater than one for FYM (2.70), seeds (4.54), plant protection chemicals (1.75) and human labor (4.28). This indicates that these resources were underutilized, and there is potential to increase pigeonpea production by using additional units of these resources. Conversely, the ratios of MVP to MFC were negative for land (-1.84), fertilizer (-3.13), bullock labor (-5.30), and machine labor (-0.98), indicating that each additional rupee spent on these resources resulted in a reduction of gross income by Rs. 1.84, Rs. 3.13, Rs. 5.30 and Rs. 0.98, respectively.

Table 2: Allocative efficiency of pigeon pea production in the study area

Resource	Kalaburagi	Bidar	Yadgir	Pooled
Land	-1.84	-2.05	-1.71	-3.56
FYM	2.70	-3.89	-2.06	0.44
Seeds	4.54	2.16	-4.94	-3.07
Fertiliser	-3.13	4.55	0.65	-0.88
PPC	1.75	3.74	2.07	2.86
Human labour	4.28	5.02	4.15	4.30
Bullock labour	-5.30	-1.46	1.01	-1.35
Machine labour	-0.98	1.75	2.10	0.67

In Bidar district, the ratios of MVP to MFC were greater than one for seeds (2.16), fertilizer (4.55), plant protection chemicals (3.74), human labor (5.02), and machine labor (1.75). On the other hand, the ratios of MVP to MFC were negative for land (-2.05), FYM (-3.89) and bullock labor (-1.46), indicating that each additional rupee spent on these resources led to a reduction of gross income by Rs. 2.05, Rs. 3.89 and Rs. 1.46 respectively.

In Yadgir district, the ratios of MVP to MFC were greater than one for plant protection chemicals (2.07), human labor (4.15) and machine labor (2.10), suggesting underutilization of these resources. This implies that there is potential to increase pigeonpea production by using additional units of these resources. These findings are consistent with a study by Daniel *et al.* (2012) [6] on resource use efficiency among rice farmers.

Furthermore, the ratio of MVP to MFC was less than one for fertilizer (0.65) in the overall study area, indicating excessive use of this input. Additionally, the ratios of MVP to MFC were negative for land (-1.71), FYM (-2.06), and seeds (-4.94), indicating that each additional rupee spent on these resources resulted in a reduction of gross income by Rs. 1.71, Rs. 2.06, and Rs. 4.94 respectively.

3.2 Variety-wise comparison of efficiency

The study conducted an analysis of the ratios of marginal value products (MVP) to marginal factor costs (MFC) in the study area, as presented in Table 3. The results indicate that the MVP to MFC ratio was greater than one for plant protection chemicals (2.86) and human labor (4.30) in the overall study. However, when considering the TS 3R variety, the ratios were higher than one for plant protection chemicals (2.33) and human labor (3.91). Similarly, in the case of GRG 811 production, the ratios exceeded one for seeds (1.57), fertilizer (2.62), plant protection chemicals (4.85), and human labor (3.80). These findings suggest that there is an underutilization of these resources, indicating a potential for increasing returns in pigeonpea production by employing additional units of these factors.

Table 3: Variety-wise comparison of allocative efficiency in the overall study area

Resource	TS 3R	GRG 811	Pooled
Land	-2.18	-3.78	-3.56
FYM	0.51	-1.72	0.44
Seeds	-3.92	1.57	-3.07
Fertiliser	-3.30	2.62	-0.88
PPC	2.33	4.85	2.86
Human labour	3.91	3.80	4.30
Bullock labour	-1.57	-1.82	-1.35
Machine labour	0.74	0.28	0.67

It is worth noting that the MVP to MFC ratio was less than one for machine labor and farmyard manure (FYM) under both varieties in the overall study area, suggesting an excessive use of these inputs. Moreover, Table 3. reveals that a greater number of inputs were under-utilized in GRG 811 compared to TS 3R production in the study area. Therefore, there is a clear opportunity to enhance pigeonpea production by increasing the utilization of these inputs. These findings align with previous studies conducted by Sani *et al.* (2010) [9] and Vinayaka (2015) on resource use efficiency in redgram production in Karnataka.

3.3 Technical efficiency of pigeonpea production

The findings presented in Table 4. Indicate that in Kalaburagi district, the mean technical efficiency of pigeonpea production was 0.80 under Constant Returns to Scale (CRS) and 0.89 under Variable Returns to Scale (VRS). Importantly, none of the farmers in the district had efficiency levels below 50 percent. Under CRS, 25 percent of farmers operated at 100 percent efficiency, 20 percent achieved efficiency levels between 90-99 percent, and 12.50 percent operated at 80-89 percent efficiency. Furthermore, 7.50 percent achieved 70-79 percent efficiency, 17.50 percent operated at 60-69 percent, and the same percentage of farmers operated at 50-59 percent efficiency levels. These findings align with a study conducted by Balamurugan *et al.* (2018) [2] on the economic analysis of technical efficiency and constraints in rice farms using different irrigation systems in Tamil Nadu.

Table 4: Technical efficiency of pigeonpea production in the study area

Efficiency class	Kalaburagi		Bidar		Yadgir	
	Efficiency (CRS)	Efficiency (VRS)	Efficiency (CRS)	Efficiency (VRS)	Efficiency (CRS)	Efficiency (VRS)
<50%	-	-	1 (2.50)	1 (2.50)	1 (2.50)	-
50-59%	7 (17.50)	3 (7.50)	2 (5.00)	1 (2.50)	5 (12.50)	2 (5.00)
60-69%	7 (17.50)	2 (5.00)	3 (7.50)	2 (5.00)	6 (15.00)	6 (15.00)
70-79%	3 (7.50)	6 (15.00)	8 (20.00)	3 (7.50)	10 (25.00)	3 (7.50)
80-89%	5 (12.50)	1 (2.50)	10 (25.00)	9 (22.50)	3 (7.50)	4 (10.00)
90-99%	8 (20.00)	5 (12.50)	6 (15.00)	8 (20.00)	2 (5.00)	5 (12.50)
100%	10 (25.00)	23 (57.50)	10 (25.00)	16 (40.00)	13 (32.50)	20 (50.00)
Mean	0.80	0.89	0.85	0.91	0.82	0.91

Note: CRS= Technical efficiency from Constant Returns to scale and VRS = Technical efficiency from Variable Returns to Scale

In Kalaburagi district, when considering Variable Returns to Scale, 57.5 percent of farmers operated at 100 percent efficiency, while 12.50 percent achieved efficiency levels between 90-99 percent. A small percentage of 2.50 percent had an efficiency level of 80-89 percent, 15.00 percent operated at 70-79 percent efficiency, 5 percent achieved 60-69 percent efficiency, and 7.50 percent operated at 50-59 percent efficiency levels. Moving on to Bidar district, the mean efficiency levels were 0.85 under CRS and 0.91 under VRS. Importantly, only one farmer in the district had an efficiency level below 50 percent, both under CRS and VRS. Under CRS, 25.00 percent of farmers operated at 100 percent efficiency, 15 percent achieved 90-99 percent efficiency, 25.00 percent operated at 80-89 percent efficiency, 20.00 percent achieved 70-79 percent efficiency, 7.50 percent operated at 60-69 percent, and 5.00 percent of farmers were at 50-59 percent efficiency levels. In Yadgir district, the mean technical efficiency of pigeonpea production was 0.82 under CRS and 0.91 under VRS. Notably, no farmers had efficiency levels below 50 percent under VRS, and only one farmer had below 50 percent efficiency under CRS in the district. Under CRS, 32.50 percent of farmers operated at 100 percent efficiency, 5.00 percent achieved 90-99 percent efficiency, 7.50 percent operated at 80-89 percent efficiency, 25.00 percent achieved 70-79 percent efficiency, 15.00 percent operated at 60-69 percent, and 12.50 percent of farmers were at 50-59 percent efficiency levels. Under VRS, 50.00 percent of farmers achieved 100 percent efficiency, 12.5 percent operated at 90-99 percent efficiency, 10 percent achieved 80-89 percent efficiency, 7.50 percent had 70-79 percent efficiency, 15.00 percent achieved 60-69 percent efficiency, and 5.00 percent of farmers operated at 50-59 percent efficiency levels. These findings align with a study conducted by Vinayak and Reddy (2015) on technological interventions for optimum use of resources under pulses production in Karnataka.

Analyzing Table 5. reveals that the mean technical efficiency of farmers cultivating the TS 3R variety, under constant returns to scale, was slightly lower at 0.76 compared to farmers cultivating the GRG 811 variety, who achieved an efficiency of 0.82. It is worth noting that none of the GRG 811 farmers had an efficiency level below 50 percent under CRS, whereas 10 percent of TS 3R farmers fell below this threshold. Additionally, 30 percent of GRG 811 farmers achieved 100 percent efficiency, while 28.34 percent of TS 3R farmers achieved the same level. Among farmers operating between the 90-99 percent efficiency level, 18.33 percent cultivated GRG 811, and 6.67 percent cultivated TS 3R. The percentage of farmers operating between 80-89 percent efficiency was 8.33 percent for both TS 3R and GRG 811. In terms of the 70-79 percent efficiency level, 18.33 percent of TS 3R farmers and 10 percent of GRG 811 farmers fell within this range. Moreover, 25 percent of GRG 811 farmers and 15 percent of TS 3R farmers achieved an efficiency level between 60-69 percent, while 13.33 percent of TS 3R farmers and 8.33 percent of GRG 811 farmers operated within the 50-59 percent efficiency level under CRS in the overall study area.

Table 5: Comparison of variety wise technical efficiency of pigeon pea in the study area

Efficiency class	TS 3R		GRG 811		Pooled	
	Efficiency (CRS)	Efficiency (VRS)	Efficiency (CRS)	Efficiency (VRS)	Efficiency (CRS)	Efficiency (VRS)
<50%	6 (10.00)	1 (1.67)	-	-	8 (6.67)	3 (2.50)
50-59%	8 (13.33)	4 (6.67)	5 (8.33)	2 (3.33)	20 (16.67)	10 (8.34)
60-69%	9 (15.00)	8 (13.33)	15 (25.00)	6 (10.00)	24 (20.00)	14 (11.66)
70-79%	11 (18.33)	14 (23.33)	6 (10.00)	6 (10.00)	16 (13.33)	21 (17.50)
80-89%	5 (8.33)	3 (5.00)	5 (8.33)	4 (6.67)	12 (10.00)	9 (7.50)
90-99%	4 (6.67)	4 (6.67)	11 (18.33)	8 (13.33)	18 (15.00)	23 (19.17)
100%	17 (28.34)	26 (43.33)	18 (30.00)	34 (56.67)	22 (18.33)	40 (33.34)
Mean	0.76	0.84	0.82	0.91	0.75	0.84

It can be concluded that majority of the sample farmers (>50%) were operating above 80 per cent efficiency level in TS 3R, GRG 811 and pooled data of both TS 3R and GRG 811. This was mainly due to awareness and practice of modern cultivation methods of pigeonpea varieties. However, only few per cent farmers (<30%) were operating below 80 per cent efficiency level, this might be due to lack of technical knowledge and unawareness about the improved package of practices (Anupama, 2005) [1]. This clearly indicated that there is scope to improve efficiency to achieve higher technical efficiency level by training farmers on improved package of practices among both TS 3R and GRGR 811 cultivating farmers. The results are in line with Balappa Shivaraya (1998) [3] who conducted study on resource use efficiency in redgram under integrated pest management technology in Gulbarga district.

4. Conclusion

The findings of the study confirmed that the cultivation of pigeonpea was profitable. Similarly, there is a growing demand for the tur dal due to its rich nutrients. Hence there is a need to develop the varieties which are resistant to wilt and pod borer by the SAU's and private companies. Thus, will help in reducing the cost on PPCs and also in meeting the consumer demand of quality tur dal. The indiscriminate use of inputs like land, labour, fertilizer and plant protection chemicals resulted in sizeable deviations from the optimum allocation of resources. This phenomenon calls for concerted efforts for dissemination of new technology for proper as well as judicious use of inputs. Therefore, for increasing pigeonpea production, farmers should concentrate on re-allocation of resources and there after consider on the adoption of new technologies for improving production and profitability.

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