IJTA © Serials Publications

National Academy of Agricultural Science (NAAS) Rating : 3.03

Economic Efficiency and Determinants of Gherkin Production in Karnataka

Tanveer Ahmed*[1], B. V. C. Reddy[2], K. B. Umesh[2], Sudheesh Kulkarni[3] and Tanveer Ahmed Khan[4]

ABSTRACT: *This study estimated the technical efficiency and further examined the factors influencing technical efficiency for the sampled gherkin growers in Karnataka State. By using stochastic frontier production function an effort has been made for identifying the relationship between the gherkin output and the level of input used and to identify the gaps that may help in optimizing the use of scarce available inputs in the study area. The paper used multistage random sampling technique to select 150 gherkin growers in the study area. The study found that the magnitude of mean technical efficiency varied from 2 grade gherkin farms to 3 grade gherkin farms. The mean technical efficiency of 2 grade gherkin farms was slightly higher (46 %) than that of 3 grade gherkin farms (43%).*

The study concluded that there is scope for increasing gherkin production by about 57% and 54% for 3 grade and 2 grade gherkin crop respectively with the present technology in the study area. The determinants of efficiency are area under cultivation, neem cake, PPC and women labour in 3-grade gherkin crop and area under cultivation, nitrogenous fertilizer, tank silt, fertilizer split, PPC and women labour in 2-grade gherkin crop.

Key words: *Ordinary least square, Technical Efficiency, Economic Efficiency, Value of the marginal product, Marginal factor cost*

INTRODUCTION

Efficient use of production resources is the concentration of any enterprise for that matter. Applying correct resource, in exact quantities at right time will yield best output levels given the favorable weather conditions. Farming being no excuse, a farmer entrepreneur is focused on maximizing his profits and income at the farm level. Productivity efficiency means the attainment of the production goal without waste while enterprise inefficiency involves the disproportional an excessive usage of inputs. Irz and McKenzie (2002) opined that when producer are highly efficient in the use of available inputs large productivity gains could only come from new technologies developed from investments in research. However improving farm management by converted technical know-how is likely to be the most efficient means of raising productivity at the small hold farm level, (Ojo, 2007).

This paper examines the productivity of the resources involved in gherkin production in the study area. Gherkin (Cucumis anguria L.) is popularly known as "pickling cucumber" or small cucumber among farmers and belongs to the family Cucurbitaceae. Stem is angled with small simple tendrils. Fruits are oval to oblong, 4-5 cm long, covered with long sharp glistening hairs on warty pimples and rind is pale green turning to ivory on ripening, Flesh is greenish (Perseglove, 1968).

Gherkin crop can be grown throughout the year in all seasons and possess great potential and comparative advantage to compete in the liberalized economy. The crop responds favourably to high optimal levels of organic / inorganic fertilizer and requires regular spraying of insecticides and fungicides. It provides employment opportunities to the family members of both the land holders and landless labourers in rural area.

[1] Assistant Professor, Department of Agricultural Economics, UHS, Bagalkot, Karnataka
[2] Professor, Department of Agricultural Economics, UAS, Bangalore, Karnataka
[3] Assistant Professor, Dept of Spices and Plantation Crops, UHS, Bagalkot
[4] Research Associate, NIVEDI, Hebbal, Bangalore
**Correspondence Author: tanveerecon@gmail.com*

The study also examines the factors influencing the productivity and technical efficiency of the farmers in the study area with a view to identifying;

1. Contribution of each input to the output.
2. Predicting the economic efficacy of the gherkin farmers in the study area.

MATERIALS AND METHODS

This study was carried out in Karnataka States of India. It is situated between 11°5′ and 19°0′ North latitude and between 74° and 78° East longitude in the southern plateau. Karnataka State covers an area of 1,91,791 square kilometers. The average annual rainfall of the state is about 1139 mm from both South-West and North-East monsoons. The temperature ranges from 21.5°C to 31.7°C. Multi-stage sampling design was followed in the present study. In the first stage, Karnataka state was purposefully selected. In the second stage, among the important gherkin growing districts Bellary and Hassan districts were selected randomly. In the third stage, the list of farmers growing gherkin was collected from the export firms since gherkin was mainly cultivated under contract farming with the export firms. In the final stage about 150 gherkin cultivating farmers were randomly selected for the detailed investigation. The data was collected through personal interview using the pre-tested questionnaire developed for the purpose.

Grading system

Gherkin growers are classified by the gherkin industry into 3 grade and 2 grade gherkin crop farmers prior to sowing and accordingly the farmer should adjust the harvesting time so that he can get the recommended size of gherkin fruits. Based on girth size of the fruits, 3 grade crop includes three premium grades i.e., 14.5mm, 17mm and 19mm and in case of 2 grade crop 17mm and 19mm are the premium grades. In the study area famers were taking up 3 grade and 2 grade gherkin crops and these farmers are considered for further examination.

Analytical Techniques

To analyse the ability of farmers to achieve the maximum realizable gherkin output (efficiency) with current level of input use under the existing situation and given technologies, a careful examination of farm specific technical efficiency of the farmers is necessary. Technical efficiency evaluates the farm's ability to obtain the maximum possible output from a given set of resources, while allocative efficiency explores the needed adjustments in equating the marginal revenue with the marginal cost for maximizing the profitability.

The Cobb-Douglas production function does not discriminate between technical and allocative efficiency. It ignores the problem of technical inefficiency by assuming that all the techniques of production are identical across farms and every producer is technically efficient which may not be true always.

Farrel (1957) introduced the concept of efficiency, on which the frontier production function is based and this function distinguishes technical and allocative efficiencies. Farrel proposed that efficiency should be measured in a relative sense, as a deviation from the best performance in a representative peer group.

Timmer (1971) modified the procedure in a number of ways and imposed a Cobb-Douglas type of specification on the frontier and evolved an output based measure of efficiency. The function in log from will be

$$\ln Y = A + \sum_{i=1}^{n} \beta_i \ln Xi + U \qquad U \leq 0 \tag{1}$$

The above model was estimated using corrected ordinary least squares (COLS) regression. As a first step, ordinary least square (OLS) was applied to the regression equation to yield best linear unbiased estimates of β_i coefficient. The function estimated was in form,

$$\text{Log}(y) = \log(a) + b_1\log(x_1) + b_2\log(x_2) + b_3\log(x_3) + b_4\log(x_4) + b_5\log(x_5) + b_6\log(x_6) + b_7\log(x_7) + b_8\log(x_8) + b_9\log(x_9) + b_{10}\log(x_{10}) + e \tag{2}$$

Where Y = Gross returns in rupees, a = Intercept, x_1 = Area (acre), x_2 = Seeds (Rs/acre), x_3 = N (Rs/acre), x_4 = P (Rs/acre), x_5 = K (Rs/acre), x_6 = Tank silt (Rs/acre), x_7 = FYM ((Rs/acre), x_8 = Neem Cake (Rs/acre), x_9 = Fertilizer splits (number), x_{10} = PPC (Rs/ acre), x_{11} = Women Labour (Rs/acre), x_{12}= Seasons (Dummy; SW monsoon period=1, otherwise zero), b_i= Elasticities of production (i = 1 to n) and e = Error term.

Equation (2) was estimated in log form using ordinary least square. The Frontier production function was derived from the Cobb-Douglas type of production function fitted to the gross income from gherkin cultivation. The technical efficiency was worked out using potential output that can be realized from a set of inputs. The potential output is given by

$$Y^* = Y + e_m \quad (3)$$

Where, Y^*= Potential gross returns that could be derived from gherkin cultivation, Y= Estimated gross returns from gherkin cultivation and e_m= Highest positive error term.

The intercept estimate 'α' was then corrected by shifting the function until no residual is positive and one observation becomes zero. This was done by the adding the largest error term of the fitted model to the intercept. The new production function with a shift in the intercept in the frontier production function it gives the maximum output obtainable for given level of input and it would be of the form.

$$Ln\, Y^* = A + \sum_{i=1}^{n} \beta_i \ln X_i + U \qquad U \leq 0 \quad (4)$$

If the value of β_i is negative, then the geometric mean of i^{th} input X_i is taken instead of β_i in X_i. The frontier production functions were estimated separately for 3 grade and 2 grade gherkin crops.

Timmer's measure of Technical efficiency

It is the ratio of actual output to the potential output on the production function given the level of input use on the i^{th} farm.

Technical efficiency of i^{th} farm = Y_i / Y_i^*

Where, $\mathbf{Y_i}$ = Actual gross returns from gherkin cultivation on i^{th} farm and $\mathbf{Y_i^*}$ = Potential gross returns attainable from gherkin cultivation on i^{th} farm.

For the most efficient farmer (Y=Y*) the technical efficiency will be highest i.e.,=1. In frontier approach a producer is said to be technically efficient if the observed output is maximum for the given level of input. Thus the production frontier is defined as the locus of maximum possible output for each level of input used. A failure on part of firm to produce the frontier level of output at given input level is attributed to technical inefficiency.

Allocative efficiency

The allocative efficiency or price efficiency is an economic measure as against technical efficiency, which is a physical measure. A production activity is allocatively efficient when the value of the marginal product (VMP) of a factor is equal to the marginal factor cost (MFC).

The Cobb-Douglas type production function was fitted for gherkin crop and used to compute the allocative efficiencies. The first differential itself was the VMP of the factor as the dependent variable was the gross returns from gherkin cultivation. Since all the independent variables in regression are the cost of inputs, the MFC of all factors was unity. Thus the allocative efficiency measure of all factors are given by the equation

$$Allocative\ efficiency = \frac{VMP_{Xi}}{MFC_{Xi}} \quad (5)$$

$$VMP_i = \frac{\beta_i \overline{Y}_i}{\overline{X}_i} \quad (6)$$

VMP_i = Value marginal product of i^{th} input, β_i = input co-efficient of i^{th} input, $\overline{Y}_i$ =Geometric mean of gross returns of i^{th} input and $\overline{X}_i$ =Geometric mean of input of i^{th} input.

The value marginal product of the inputs was worked out by multiplying the respective input co-efficient with the geometric mean level of output and divided by the geometric mean level of respective input (equation 6).

The allocative efficiency equal to unity represents the most efficient allocation or optimal allocation while less than or more than unity represents over or under use of the factor (sub-optimal use) respectively. The allocative efficiency of all the factors was computed at the geometric mean level of the inputs and the output for the two grades of gherkin crop and the same were compared.

Economic efficiency

Economic efficiency (EE) is the product of technical efficiency (TE) and allocative efficiency (AE)

$$EE = TE * AE \quad (7)$$

Returns to Scale

The return to scale was estimated directly by getting the sum of 'b_i' coefficients. The returns will be increasing, constant or diminishing based on whether value of summation of 'bi' is greater, equal or less than unity, respectively.

RESULTS AND DISCUSSION

Technical and allocative efficiencies in gherkin production

On processing of data, it was observed that factors like, area, seeds, NPK, tank silt, FYM, neem cake, number fertilizer split, amount spent on PPC, women labour and season were important variables having bearing on the production activity. Hence, these variables were considered for studying resource use efficiency. A Cobb-Douglas type of production function was fitted to data in order to estimate the functional relationship between the dependent variable and independent variables. The dependent variable was gross income per acre and independent variables mentioned above were used. Marginal Value Product (MVP) of each explanatory variable was computed and compared with its Marginal Factor Cost (MFC) to know the allocative efficiency of resources.

In imputing the marginal cost of land, per hectare rental value of land in the study area was considered, but for the other inputs like seed, FYM, tank silt, NPK, neem cake, women labour *etc.*, per unit value was considered as their marginal factor cost. Results of the regression analysis and estimated MVP and MFC values are presented in table 1.

Resource use efficiency at 3 grade and 2 grade gherkin crops

The output of regression analysis for the 3 grade gherkin farms and the 2 grade gherkin farms are presented in table 1. The intercept, which represents the contribution of the factors that are not included in the model, was found to be higher in the case of 3-grade gherkin farms (5.576) compared to the 2-grade gherkin farms (1.586). The coefficient of multiple determinations was 0.708 and 0.770 for 3-grade gherkin and 2-grade gherkin farms respectively, indicating adequacy of fit of the model, as 71 and 77 percent variability in gross returns was explained by the variables considered in the model.

The variables of area (0.266), neem cake (0.013), PPC (0.168) and women labour (1.097) in 3-grade gherkin crop and area (0.253), nitrogenous fertilizer (0.398), tank silt (0.024), fertilizer split (0.709), PPC (0.263) and women labour (0.835) in 2-grade gherkin farms were significantly influencing the gross income. This implied that increase in the use of these factors over and above the present level will lead to a significant increase in the gross returns. The elasticity coefficients of seeds, phosphorous fertilizer, tank silt and fertilizer splits in 3-garde gherkin farms were negative but not significant. The elasticity coefficient of phosphorous and potash fertilizer and neem cake were negative in 2-grade gherkin crop farmers but non-significant (table 1).

The allocative efficiency of phosphorous fertilizer in both 3-grade and 2-grade crop farms was negative indicating it's over usage. The allocative efficiency of seeds, tank silt were negative in 3-grade gherkin farms indicating their overuse, Veerapur (1999) recorded a similar result in case cotton resource use efficiency in Raichur. This clearly brings out the fact that there was over and indiscriminate use of seeds and tank silt in 3-grade gherkin cultivation. In case of 2-grade gherkin crop the MVP:MFC ratio of potash fertilizer and neem cake were negative but not significant.

The coefficient of multiple determination indicated that 71 and 77 per cent of the variation in gross income of 3-garde gherkin crop and 2-garde gherkin crop respectively was explained by the independent variables included in the production function. The return to scale result in both graded crop confirm previous findings by Sreenivasa MD, Sudha M, Hegde MR, Dakshinamoorthy V, (2009) in which tomato production exhibited increasing returns to scale. However return to scale was highest among the 2 grade (2.388) gherkin farmers which agree with apriori expectation that there were more economic returns from 2 grade gherkin crop production when compare to 3 grade gherkin crop (1.139) in the study area.

Technical efficiency in gherkin production

Timmer's measure of technical efficiency was calculated using new production function and the mean technical efficiency in gherkin production was calculated.

The mean technical efficiency of 2 grade gherkin farms was slightly higher (46%) than that of 3 grade gherkin farms (43%). About 85 per cent and 92.41 per cent of the farmers come under low efficiency group in 2 grade and 3 grade gherkin farms, respectively. The difference in the gross returns between the two grades confirms the difference in the technical efficiency. It indicates that there was a scope for further improvement of the gross return in both districts using resources at optimum level. This study is in line with the earlier findings by Ogunniyi, L.T and Oladejo, J.A (2011).

Allocative efficiency in gherkin production

Overall allocative efficiency of resources used in gherkin production was assessed by computing the ratio of the actual gross income realized by the farmers to the gross income that can be achieved by the farmer if one can go for the recommended level of input use.

The mean allocative efficiency of 3 grade gherkin farms was higher (83%) than that of 2 grade gherkin farms (66%). This indicated that there was more scope to increase returns in case of gherkin production with optimum allocation of resources. These results were supported by resource use efficiency tables, which indicate that majority of the resources, were either

Table 1
Resource use efficiency level and returns to scale for 3 grade crop and 2 grade gherkin crops

Sl.No.	*Particulars*	*Parameter*	*3-Grade crop* Estimated values	*3-Grade crop* Standard Error	*3-Grade crop* MVP:MFC Ratios	*2-Grade crop* Estimated values	*2-Grade crop* Standard Error	*2-Grade crop* MVP:MFC Ratios
1	Intercept	a	5.576	2.726		1.586	3.490	
2	Area (acre)	b_1	0.266**	0.112	4.387	0.253**	0.120	4.866
3	Seeds (Rs/acre)	b_2	-0.212	0.302	-3.623	0.051	0.367	0.951
4	N (Rs/acre)	b_3	0.067	0.151	4.150	0.398**	0.184	25.369
5	P (Rs/acre)	b_4	-0.162	0.133	-6.138	-0.035	0.164	-1.476
6	K (Rs/acre)	b_5	0.079	0.094	5.048	-0.125	0.110	-8.273
7	Tank silt (Rs/acre)	b_6	-0.009	0.017	-1.289	0.024**	0.011	1.035
8	FYM (Rs/acre)	b_7	0.031	0.030	0.549	0.004	0.040	0.017
9	Neem cake (Rs/acre)	b_8	0.013**	0.006	2.434	-0.011	0.008	-2.202
10	Fertilizer Splits (No.)	b_9	-0.201	0.126	–	0.709***	0.190	–
11	PPC (Rs/acre)	b_{10}	0.168***	0.069	3.765	0.263**	0.127	6.072
12	Women Labour (Rs/acre)	b_{11}	1.097***	0.120	3.963	0.835***	0.141	2.953
13	Season (Dummy)	b_{12}	0.002	0.011	–	0.024	0.012	–
		Σb_i	1.139			2.388		
		R^2	0.708			0.770		
		F	13.520			16.153		

Note: *** & ** Significant at 1per cent & 5 per cent level of significance respectively

underused or over used inputs in gherkin production. The low allocative efficiency in gherkin was due wider deviation from optimum use of inputs like NPK, FYM, neem cake etc.

Economic efficiency of gherkin production

The economic efficiency for gherkin crop was calculated by multiplying the technical efficiency of particular grade with their respective allocative efficiency and results are presented in table 2. The economic efficiency measure was 36 per cent and 30 per cent for pooled data of 3 grade and 2 grade gherkin farmers, respectively, indicating there is scope to increase the returns by 64 and 70 per cent with optimum allocation of resources in 3 grade and 2 grade gherkin crop, respectively. This low economic efficiency may be due to low technical efficiency which in turn could be due to many constraints including ignorance on the part of farmers to use the available resources efficiently.

Table 2
Economic efficiency of gherkin production in the study area (per cent)

Sl.No.	*Particulars*	*Pooled* 3-Grade Crop	*Pooled* 2-Grade Crop
1	Technical Efficiency	43	46
2	Allocative Efficiency	83	66
3	Economic Efficiency	36	30

Table 3
Distribution of gherkin farmers according to technical Efficiency levels (per cent)

Sl.No.	*Particulars*	*Pooled* 3-Grade Crop	*Pooled* 2-Grade Crop
1	High efficiency group (91% and above)	6.33	9.86
2	Medium efficiency group (80-90%)	1.27	5.63
3	Low efficiency group (Below 80%)	92.41	84.51
4	Average efficiency	0.43	0.46

CONCLUSION

The study concluded that there is scope for increasing gherkin production by about 57% and 54% for technical efficiency for 3 grade and 2 grade gherkin crop respectively with the present technology in the study area. The determinants of efficiency are area under cultivation, neem cake, PPC and women labour in 3-grade gherkin crop and area under cultivation, nitrogenous fertilizer, tank silt, fertilizer split, PPC and women labour in 2-grade gherkin crop.

The analysis of technical efficiency revealed that gherkin farmers were not presently operating on the frontier. Productivity improvements can be achieved by educating the farmers to use optimum level of inorganic fertilizers like neem cake, tank silt, and applying correct dosage of inorganic fertilizers at right time and timely control of pest & disease menace. This would make farmers operate more closely to the existing frontier. Also, research efforts directed towards the generation of new technology should not be neglected because a productivity gain stemming from technological innovation remains critical importance.

ACKNOWLEDGMENTS

The authors would like to acknowledge to Dr. H. B. Lingaiah, Dean College of Horticulture, UHS Campus, Bangalore for providing financial support through the project 'Standardization of Production Technology for Export Quality Gherkins'.

REFERENCES

FARREL, M. J., (1957), Measurement of productive efficiency. *Journal of Royal Statistical Society,* 120: 253-290.

IRZ, X. and V. MCKENZIE, (2002), Profitability and technical efficiency of agricultural. A comparison of intensive and extensive production system in the Philippines. A paper presented at Action Thematique Programme Adoption des system priscicole; compare. An interwork shop on comparative Adoption in Aquaculture Systems April 2-5-2002 CIRAD, Montpellier, Frame.

OGUNNIYI, L.T and OLADEJO, J.A, (2011), Technical Efficiency of tomato production in Oyo State Nigeria. *Agricultural Science Research Journal,* 1(4) pp. 84 –91.

OJO, S.O., (2007), Improving Efficiency in food crop production for food security in Nigeria. *Agricultural Journal*, 2(1):9-15 *medwellonline@gmail.com*

PERSEGLOVE, J. W., (1968), Tropical crops, Dicotyledens-*I.* Longmans Green and Co. Ltd. pp. 109-110.

SREENIVASA M.D., SUDHA M., HEGDE M.R., and DAKSHINAMOORTHY V., (2009), Technical Efficiency and its Determinants in Tomato Production in Karnataka, India: Data Envelopment Analysis (DEA) Approach. *Agricultural Economics Research Review*, 22(2): 215-224

TIMMER, C. P., (1971), On measuring technical efficiency. *Food Research Institute Studies*, 9:99-171.

VEERAPUR, (1999), An economic analysis of integrated pest management in cotton in Raichur district, Karnataka. *M.Sc. (Agri.) thesis* (*unpublished*), University of Agricultural Sciences, Dharwad.