THE INTERNATIONAL JOURNAL OF BUSINESS & MANAGEMENT

Technical Efficiency of Soybean Production in Vidarbha Region of Maharashtra, India

A. D. Makesar
Senior Research Assistant, Department of Agril. Economics and Statistics
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra, India
Dr. S. J. Kakde
Associate Professor, Department of Agril.Economics and Statistics
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra, India

Abstract:
Soybean cultivation in Maharashtra is concentrated in two regions: Vidarbha and Western Maharashtra. Around 90% of the soybean production of the state is contributed by these two regions. The present study is an attempt to evaluate the technical efficiency of soybean in Vidarbha region of Maharshtra. For the present study Vidarbha region of Maharashtra state was selected .The study was based on primary data pertained to the year 2012-2013.For estimating technical efficiency of soybean growing farmers, stochastic production function approach was used. The study revealed that High value of (y) 0.99 in Akola district, 0.99in Amravati district, 0.99 in Yavatmal district, 0.91 in Wardha district and 0.99 in Nagpur district indicates the presence of significant inefficiencies in the production of soybean crop. The stochastic frontier analysis has further shown that 99, 99, 99, 91, and 99 per cent of observed inefficiency was due to farmer's inefficiency in decision making and only 1, 1, 1, 9, and 1 per cent of it was due to random factors outside their control in the case of all the farmers in the selected district. Further, it was observed that the allocative efficiency were 80 percent in Akola, 90 percent in Amravati, 88 percent in Yavatmal, 84 percent in Wardha and 84 percent in Nagpur and economic efficiency 57 percent in Akola, 68 percent in Amravati, 98 percent in Buldana, 62 percent in Yavatmal, 53 percent in Wardha and 54 percent in Nagpur. It means that there prevails allocative inefficiency to the extent of 20 per cent in Akloa district,10 percent in Amravati district,12 percent in Yavatmal district, 16 percent in Wardha district and 16 percent in Nagpur district's average farmers in comparison with the progressive farmer who obtained maximum yield.

1. Introduction

The expansion of area under soybean took place at quite a fast rate in absolute as well as relative terms specifically after mid 1980's. The major oilseed crop of Maharashtra was groundnut till the mid 1980's. Thereafter, farmers started cultivating non-conventional oilseed crop, specifically soybean. The area under Soybean crop picked up at a faster rate primarily in the North-East region of the state, where the climatic conditions were suitable for soybean cultivation. Soybean cultivation in Maharashtra is concentrated in two regions: Vidarbha and Western Maharashtra. Around 90% of the soybean production of the state is contributed by these two regions.

Total economy of Vidarbha is based upon the agriculture sector. The farmers are positive in approaching to the modern technique as they are using modern crops and planting method. Among the important issues debated in the current phase pertaining to agriculture sector include the expectations about the next technological phase and the efficiency parameters during the current phase. Growing population as well as income enhances demand for agricultural product and there is no scope for expanding land frontier and further there is increasing trend of diversion of cultivable land for non-agriculture purpose (Deshpande and Bhende, 2003). The only option remained to increase agricultural production is through adoption of improved technology and efficient of available resources. Agricultural output is conditioned by agro climatic factors as well as technology at regional level whereas, varying levels of input use impinge upon the productivity of farm level. Yield gap mainly arises due to sub-optimal or influent use of resources.

Scientific determinations of optimum cropping patterns is the crying need of the day to give real practical meaning to the concept of intensive agricultural development for increasing agricultural production. During the last decade many changes have taken place in the physical, biological, economic technological and institutional setup. These changes naturally demand adjustments in the existing cropping pattern of different areas. Yield increasing technology such as evolution of high yielding varieties, quick maturing crop strains and greater use of fertilizers, have put the existing cropping patterns at below optimum.

One of the main objective of the production unit is to coordinate land utilise resources or factors of production in such a manner that together they yield the highest net returns. The rationality in the allocation of resources shown by the farmers in traditional agriculture was pointed out for the first time by Schultz (1964). Later a number of researchers have examined this problem in traditional and modern agriculture. But in the past studies the focus was on the resource use efficiency at the aggregate crop level.

Utilization of resources in optimal direction assumes importance in the context of increasing agricultural production. Efficiency of resource use has been reported to be close to the optimum on Indian farms by some research workers with the static level of farm technology prevailing over a long period, physical conditions and factor costs, Indian farmers had gradually adjusted the factors of production in proportions which resulted in efficient resource organization. Also the resource allocation was close to, the optimum under given technological possibilities and factor-product relationship. However, the breakthrough in farm technology resulted in rapid changes in resource productivity and price relationship, which disturbed the existing resource mix equilibrium on Indian farms. The constantly changing technological and socio-economic conditions increase the extent of mal-adjustments and make the forces change stronger. In such situations, the studies on resource adjustment possibilities for different types of farming areas are of critical importance.

However, analysis of variations between the potential and the actual yield on the farm grown, the technology and resource endowment of farmers, providing better understanding as the productivity gap.

2. Methodology

The Vidarbha region of Maharashtra state was purposively selected for the present study. Vidarbha region comprising of 11 districts i.e. Buldana, Akola, Washim, Amravati, Yavatmal, Nagpur, Wardha, Chandrapur, Bhandara, Gondia and Gadchiroli. Out of which major soybean growing districts i.e. Akola, Amravati, Buldana, Yavatmal, Wardha and Nagpur were selected.

The present study was based on primary data. The primary data was collected from the Agricultural Prices and Costs Scheme, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola for the year 2012-13. In all 260 farmers were selected for the study. The output data include information on gross yield(grains and by product yield) and the input data include the seed, manures, NPK, plant protection, irrigation charges, hired human labours, hired bullock labours, hired machine labours, owned family labour used for soybean crop.

For estimating technical efficiency of soybean crop, Frontier production function approach was used in the present study.

The stochastic frontier production function of the Cobb-Douglas type was specified for this study.

(Narala 2010)

$$\ln Yi = \beta_0 + \beta_1 \ln x_1 + \beta_2 \ln x_2 + \beta_3 \ln x_3 + \beta_4 \ln x_4 + \beta_5 \ln x_5 + \beta_6 \ln x_6 + \beta_7 \ln x_7 + \beta_8 \ln x_8 + \beta_9 \ln x_9 + (vi - ui)$$

Where, the subscript i denotes the i^{th} farmer in the sample and

- Yi = Output of crop (q/ha)
- β_0 – β_9 = Parameters
- x_1 = Quantity of seed (kg/ha)
- x_2 = Human labour (human days/ha)
- x_3 = Machine labour (hours/ha)
- x_4 = Irrigation (number per ha)
- x_5 = Nitrogen (kg)
- x_6 = Phosphorus (kg)
- x_7 = Potash (kg)
- x_8 = Quantity of manure (kg/ha)
- x_9 = Plant protection chemicals (litre/ha)
- vi-ui = Random error – term
- ln = Log to the base e.

The computer programme FRONTIER 4.1 (Coelli, 1996) was used to estimate simultaneously the parameters of the stochastic production frontier and the technical inefficiency effects.

2.1. Allocative Efficiency

The allocative efficiency was calculated using the following formula.

$$\text{Allocative efficiency} = \frac{Yo}{Y_E}$$

Where,

Yo = Observed maximum yield, among all the farmers.

Y_E = Estimated yield or potential output at the levels of inputs used by cultivators who obtained maximum yield

2.2. Economic Efficiency

Economic efficiency is simply the product of technical and allocative efficiencies.

Economic efficiency = Technical efficiency x allocative efficiency

3. Results and Discussion

For estimating technical efficiency of soybean growing farmers in Vidarbha region of Maharashtra, stochastic production function approach was used. The parameters of production function were estimated using the maximum likelihood estimation (MLE) and results are presented in the Table 1. High value of (y) 0.99 in Akola district, 0.99 in Amravati district, 0.99 in Yavatmal district, 0.91

in Wardha district and 0.91 in Nagpur district. In all the farmers indicates the presence of significant inefficiencies in the production of soybean crop. It shows about 99, 99, 99, 91, and 91 per cent of differences between the observed and maximum production frontier outputs were due to the factors which were farmer's control respectively. The stochastic frontier analysis has further shown that 99, 99, 99, 91, and 91 per cent of observed inefficiency was due to farmer's inefficiency in decision making and only 1, 1, 1, 9, and 9 per cent of it was due to random factors outside their control in the case of all the farmers in the selected district. Thus, the one sided-error ui dominated the symmetric error vi and the short fall of realized productivity from the frontier was largely due to technical inefficiency and mainly within the control of individual farmers. Statistically significant and positive values of the estimated coefficient indicated that farmers put increase per hectare yield by applying more units of these inputs.

It can be seen from the same table that there prevails allocative inefficiency to the extent of 20 per cent in Akola district, 10 percent in Amravati district, 1 percent in Buldana district, 12 percent in Yavatmal district, 16 percent in Wardha district and 16 percent in Nagpur district among average farmers in comparison with the "Best" farmer who obtained maximum yield. Its important implication is that an average farmers' productivity can increased to the extent of 20,10,1,12,16 and 16 percent of his prevailing productivity is beingpursued to follow the resource allocation pattern followed by the best farmer in selected districts.

Details regarding farmers – specific technical, allocative and economic efficiency are important as they provide details information to policymakers on the nature of production technology used in farms. Table. 2 shows the frequency distribution of farmers in selected districts of Vidarbha region by the level of technical efficiency in raising soybean crop. It was observe that there were variations in the level of technical efficiency across the selected farmers in raising soybean crop. The average level of technical efficiency has been estimated as 72 per cent in Akola, 76 percent in Amravati, 99 percent in Buldana 71 percent in yavatmal, 63 percent in Wardha and 64 percent in Nagpur districts for farmers as a whole, implying that on an average the selected farmers tend to realize around 80,90,99,88,84 and 84percent respectively of their technical abilities. Hence, on an average, approximately 20,10,1,12,16 and 16 per cent of the technical potentials are not realized. Therefore, it is possible to improve the yield by 20,10,1,12,16 and 16per cent following efficient crop management practices without increasing the levels of inputs applications. It was observed that a majority of the farmers (34.38%) operated at technical efficiency levels more than 90 per cent with an average productivity 21.25 quintal per hectare in Akola district, (31.71%) operated at technical efficiency levels between 80- 90 per cent with an average productivity 22.33 quintal per hectare in Amravati district, (100%) operated at technical efficiency levels more than 90 per cent with an average productivity 17.28 quintal per hectare in Buldana district, (29.55%) operated at technical efficiency levels between 70-80 with an average productivity 14.90 quintal per hectare Yavatmal district, (26.83%) operated at technical efficiency levels below 50 with an average productivity 5.43 quintal per hectare in Wardha district and (26.92%) operated at technical efficiency levels below 50with an average productivity 9.64 quintal per hectare in Nagpur district.

Further it was observed that the allocative efficiency were 80 percent in Akola, 90 percent in Amravati, 99 percent in Buldana, 88 percent in Yavatmal, 84 percent in Wardha and 84 percent in Nagpur and economic efficiency 57 percent in Akola, 68 percent in Amravati,98 percent in Buldana district, 62 percent in Yavatmal, 53 percent in Wardha and 54 percent in Nagpur district. It can also be seen from the same table that there prevails allocative inefficiency to the extent of 20 per cent in Akloa district, 10 percent in Amravati, 1 percent in Buldana12 percent in yavatmal, 16 percent in Wardha and 16 percent in Nagpur districts among other farmers in comparison with the "Best" farmer who obtained maximum yield. Its important implication is that an average farmers' productivity can increased to the extent of 20 per cent in Akloa district, 10 percent inAmravati, 1 percent in Buldana,12 percent in yavatmal, 16 percent in Wardha and 16 percent in Nagpur districts

of his prevailing productivity is beingpursued to follow the resource allocation pattern followed by the best farmer. It means that maximum 20,10,1,12,16, and 16percentscope to improve economic efficiency in Akola Amravati, Buldana, Yavatmal, Wardha and Nagpur districts respectively.

4. Conclusions

The study revealed that there were variations across the districts in the region in productivity of soybean is due differences in there technical, allocative and economic efficiency levels. Buldana district could achieved highest technical efficiency levels whereas Wardha district achieved lowest technical efficiency levels. The shortfall in realized soybean productivity from the frontier has largely been due technical inefficiency and is largely within the control of individual farmers. The mean technical efficiency has been found in Akola district 72 percent, 76 percent in Amravati,71 percent in Yavatmal 63 percent in Wardha district and 64 per cent in Nagpur district which indicates that on an average, the realized output can be raised by 28,24,29,37 and 36 per cent respectively without any additional resources in the districts. By proper management and proper allocation of the existing resources and technology, sufficient potential exists for improving the productivity of soybean.

5. References

i. Anupama J., R.P. Singh and Ranjit Kumar2005. Technical efficiency in Maize production in Madhya Pradesh: Estimation and Implications.Agricultural Economics Research Review Vol. 18 July-December. pp 305-315.
ii. Anuradha Narala and Y.C. Zala, 2010. Technical efficiency of rice farms under irrigated conditions in Central Gujarat, Agril. Economic Res. Rev. pp.375-381.
iii. Bhendeand K.P. Kalirajan, 2007. Technical efficiency of major food and cash crops in Karnataka (India).Indian J. Agril. Econ.62(2): 178-191.
iv. Deshpande, R.S. and Bhende, M.J. (2003) Land Resources and Policy in Karnataka, Working Paper 132, Institute for Social and Economic Change, Nagarbhavi, Bangalore.

v. Hake A.D., S.S.Wadkar and P.J. Kshirsagar 2012. Technical efficiency in rice production in Thane district (M.S.).International Research Journal of Agricultural Economics and Statistics Volume 3 Issue 1March. 176-180.
vi. Kachroo Jyoti, Arti Sharma and Dileep Kachroo, 2010. Technical efficiency of dryland and irrigated wheat based on scholastic model.Agril. Econ. Res. Rev. 23:383-390.
vii. Kaur Manjeet, Amir Kaur Mahal, M.K. Sekhon and H.S. Kingra, 2010. Technical efficiency of wheat production in Punjab. A Regional Analysis,Vol. 23, Jan-June, pp.173-179.
viii. Patil H.A. and V.K. Khobarkar.2013. Technical efficiency in Wheat production of Amravati Division. Indian J. of applied res. Vol.3 issue 7. 215-216.
ix. Sarkar, D. and S. De, 2004. High technical efficiency of farms in two different agricultural lands: A study under deterministic production frontier approach.Indian J. Agril. Econ. 59(2):197-207.
x. Sekhon, M.K. and Amrit Kaur Mahal, Manjeet Kaur and M.S. Sidhu, 2010. Technical efficiency in crop production. A regionwise analysis.Agril. Econ. Res. Rev. 23:367-374.
xi. Sharma, R.K., S.K. Chauhan and Sanika Gupta, 2008. Technical efficiency in North-Western Himalayan region; A study of Himachal Pradesh Agriculture,Agril. Econ. Res. Rev. pp.82-90.
xii. Shende,N.V. and S.S.Kalamkar (2009). Technolgy Adoption gap in Pigeon Pea Cultivation in Maharashtra Agricultural Economics Research Review.22.496.
xiii. Shenthil Kumar S. 2002. Resource use efficiency and technical efficiency of selected crops of Vidarbha region. M.Sc. (Agri.) Thesis (unpub.), Dr. PDKV, Akola.
xiv. Singh, C.M., C. Sen and L.S. Gangwar. Resource productivity and allocative efficiency in crop production. A case study of Mirzapur district of Uttar Pradesh.Agril. Situation in India, Vol. III, pp.777-781.

Annexure

	Akola		Amravati		Buldana		Yavatmal		Wardha		Nagpur	
Variables	Coefficient	S E	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	S E	Coefficient	S E
Constant	2.9144***	0.8783	0.2087	0.9894	2.8918***	0.7881	1.1869	0.9835	3.9652	2.7320	-0.5244	0.6021
Seed	0.0326	0.1969	0.7098	0.8091	0.0521	0.0978	0.2505	0.6444	-0.5624	0.5985	0.6453*	0.3236
Human labour	-0.0411	0.0424	0.071	0.7973	-0.1305*	0.0668	0.291	0.7552	0.2003	0.1429	0.3603***	0.0911
Machine labour	0.1069**	0.0404	-0.0155	0.8622	0.0485	0.1221	-0.0926	0.1556	0.2898*	0.0947	-0.0359***	0.0120
Nitrogen	0.0428*	0.0251	0.0515	0.3894	-0.0516	0.0549	-0.0712	0.3187	-0.1014	0.0854	-0.1436***	0.0269
Phosphorus	-0.0878***	0.0241	-0.1285	0.8788	0.026	0.0612	0.0927	0.3518	-0.231*	0.1776	-0.1342**	0.0643
Potash	-0.1237***	0.0296	-0.012	0.6813	0.0425	0.0760	-0.0227	0.7123	-0.0532	0.1123	0.0496	0.0346
Manure	-0.0468*	0.0253	0.0245	0.4061	-0.0487	0.0366	-0.0209	0.0567	0.055*	0.0590	-0.1649**	0.0799
Plant protection	0.0277***	0.0080	0.0175	0.1588	0.0458	0.0319	-0.025	0.0365	0.0228*	0.0222	0.0609***	0.0146
Sigma-square($\sigma 2$)	0.4070	0.0696	0.1623	0.3784	0.0521	0.0122	0.1941	0.0521	0.4673	0.1766	0.3503	0.1373
Gamma(γ)	0.9999	0.0006	0.9934	0.5050	0.0002	0.0292	0.9999	0.0243	0.9194	0.1173	0.9999	0.0006
Log likelihood function	-11.5391	-	1.7515	-	2.2593	-	52.1923	-	-22.5201	-	-10.6272	-
Technical efficiency	0.72	-	0.76	-	0.99	-	0.71	-	0.63	-	0.64	-
Allocative efficiency	0.80	-	0.90	-	0.99	-	0.88	-	0.84	-	0.84	-
Economic efficiency	0.57	-	0.68	--	0.98	-	0.62	-	0.53	-	0.54	-

*Table 1: Maximum of stochastic frontier likelihood estimates production function for Soybean in Vidarbha region of Maharashtra. ** and ** and * denotes significance at 1 per cent, 5 per cent and 10 per cent respectively*

	Akola			Amravati			Buldana			Yavatmal			Wardha			Nagpur		
Efficiency (%)	No. farmers	% to total	Productivity	No. farmers	% to total	Productivity	No. farmers	% to total	Productivity	No. farmers	% to total	Productivity	No. farmers	% to total	Productivity	No. farmers	% to total	Productivity
Below 50	8	25.00	10.50	4	9.76	10.29	00	00	00	6	13.64	9.63	11	26.83	5.43	14	26.92	9.64
50-60	5	15.63	13.66	4	9.76	18.40	00	00	00	5	11.36	12.33	5	12.20	6.24	9	17.31	12.14
60-70	5	15.63	13.95	2	4.88	17.45	00	00	00	5	11.36	13.84	8	19.51	8.02	5	9.62	17.56
70-80	11	34.38	17.88	9	21.95	21.66	00	00	00	13	29.55	14.90	9	21.95	9.38	9	17.31	16.08
80-90	3	9.38	19.63	13	31.71	22.33	00	00	00	10	22.73	19.32	7	17.07	15.37	6	11.54	20.57
More than 90	11	34.38	21.25	9	21.95	26.91	39	100	17.28	5	11.36	20.57	1	2.44	14.38	9	17.31	18.39
Total farmers	32	100.00	-	41	100.00	-	39	100	-	44	100.00	-	41	100.00	-	52	100.00	

Table 2: Distribution of soybean in Vidarbha region of Maharashtra under different levels of technical efficiency