An Application of Capacity Utilization to the Measurement of Technical Efficiency of Public Sector Unit (BVFCL, Namrup): North Eastern Region of India

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Abstract

BVFCL located in Namrup, Assam is the only fertilizer unit located in entire North Eastern Region of Assam. Located near to the source of inputs, but the unit is not able to use its capacity to the fullest as indicated by the capacity utilization estimation. Among the two inputs labour and capital; only the labour factor is significant in the production function. The technical efficiency of the unit is on a declining trend. Thus, the only fertilizer unit for the entire region is undergoing loss, this call for immediate policy by the government to improve the capacity utilization of the unit.

Keyword: Public Sector Unit, Fertilizer Unit, North Eastern Region, Time Series, Capacity Utilization, Stochastic Production Function and Technical Efficiency

Introduction

Economic reforms of 1990's liberalized the Indian economy and created a platform for private industries to come in the field along with the public sector. But the responsibility mainly lied on the public sector for accelerating the process of economic development. Even after economic reforms the economy primarily remained agrarian in nature. Development of nation was entrusted on the two wheels, viz. agricultural development and industrial development. Large scale investment was made in both the sectors. Both the sectors are interlinked with each other for both input and output. Use of fertilizers with high yield variety of seeds improves productivity of agricultural sector. The fertilizer sector is interlinked with industry and agriculture. Indian fertilizer journey started in 1960's with East India Distilleries (Parry) at Madras. Initially this sector had most of its units under public sector. With passage of time private sector started its participation n the fertilizer sector. The consumption of fertilizer has increased overtime improving productivity of agricultural sector, however the production of fertilizer by domestic units have remained stagnant. The demand for fertilizers has been increasing in the last decades but comparatively there have been low or no addition in domestic capacity for public units. This scenario of Indian fertilizer sector is increasing its imports. Policies have been implemented to encourage investment through Public Private Partnership. SSI, MSME can contribute immensely to economic growth. Improving the productivity and capacity utilization of public unit becomes very essential to get positive results from the investment made by government on these units.

Table: 1.1 Production, Imports and Consumption of All Fertilizers

Year	Production	Consumption	Gap	Imports
2002-03	14468.00	16094.00	1626	1757.00
2003-04	14265.00	16798.00	2533	2018.00
2004-05	15405.00	18398.00	2993	2752.00
2005-06	15575.00	20340.00	4765	5254.00
2006-07	16095.00	21651.00	5556	6080.00
2007-08	14706.50	22570.00	7864	7750.16
2008-09	14334.00	12470.00	-1864	10221.00
2009-10	16221.00	26486.00	10265	9148.00
2010-11	16380.00	28122.00	11742	12364.00
2011-12	16363.00	27790.00	11427	13002.00
2012-13	15735.00	25534.00	9799	9157.00
2013-14	16092.00	24482.00	8390	7434.00
2014-15	16269.00	25576.00	9307	9135.00

Source: Indian Fertilizer Scenario 2010, 2015. (Thousand tones of nutrients)

The table reflects that gap between production and consumption is on continuous rise, which is making the country more and more dependent on import of fertilizers to meet the increasing consumption requirement. Increased consumption of fertilizer contributes positively to improvement of agriculture sector. Thus to reduce the burden on BOP for increased import it can be done only by improving the capacity utilization and efficiency of the fertilizer units. But when the fertilizer consumption is compared with food grain production, India has a long way to go. . Agricultural production can be increased either by bringing more land under cultivation or increasing yield per hectare; of the two option available the latter option is more viable for the improving the productivity.

Table: 1.2 Fertilizer Consumption Vis-A-Vis Food Grain Production

Year	Foodgrain Production (In lakh MT)	Fertilizers Consumption in Nutrients (in lakh MT)
2002-03	1747.80	160.94
2003-04	2131.90	167.99
2004-05	1983.60	183.98
2005-06	2086.00	203.40
2006-07	2172.80	216.52
2007-08	2307.80	225.70
2008-09	2344.70	249.09
2009-10	2182.00	260.86
2010-11	2358.80	281.12
2011-12	2592.90	277.90
2012-13	2571.30	255.36
2013-14	2647.70	244.82
2014-15	1240.50	255.76

Source: Indian Fertilizer Scenario 2010, 2015

Balanced use of fertilizer in agricultural cultivation has been emphasized. But consumption of fertilizer is skewed towards few crops and is limited to few states. The consumption of fertilizer has increased in agricultural field over the years but yet it is not equivalent to the amount produced. The per hectare yield of agricultural land depends on soil, water and climatic conditions, availability of seeds, fertilizers, irrigation, etc

Assam is yet to develop both in agricultural and industrial sector. Tea industry is oldest industry of Assam which is recognized globally and employs the largest work force. The profitability of the industry depends on its productivity and the productivity can be encouraged using fertilizer. Even agriculture sector productivity can be enhanced by use of fertilizer. Assam has the only public sector fertilizer unit for entire north eastern region but both the production and consumption of fertilizer is below. For Assam other industries have not developed equivalently due to infrastructural bottlenecks and agricultural sector have not achieved much in terms of productivity.

Hindustan Fertilizer Corporation Limited w.e.f. 1st April 2002, was renamed as Brahmputra Valley Fertilizer Corporation Limited (BVFCL) after bifurcation of Namrup Fertilizer Complex. BVFCL is engaged in the manufacture of Urea, Bio- fertilizers, Vermi- Compost manure at Namrup (Assam) and also trading of Seeds, Pesticides, and Fertilizers (MOP, DAP/SSP). Its products are marketed under the brand name "Mukta". BVFCL has 3 units and since mid 2002 Namrup I has stopped production due to non viability of cost of production. Its Corporate Offices and Registered Offices are situated at Namrup. The other establishments of the company are Liason Offices at NOIDA & Kolkata and Marketing Offices at Guwahati, Sliguri & Kolkata.

For entire Assam, other North-Eastern States, West Bengal and Bihar BVFCL is the only Urea producing PSU. Its close proximity to source of gas and even to the neighboring countries makes transportation cost low for BVFCL. The company comes within the purview of Sick Industrial Unit as per section 2(46AA) of the Companies Act, 1956.

Literature Review

Empirical Review:

Chapman (2001) stated that the synthetic fertilizer industry ensures security to food supply, originated in Germany is presently established in more than 100 countries. The expansion of fertilizer industry can be attributed to intervention of government as it has long gestation period and huge investment is needed.

Hazarika and Saikia (2003) used the Restricted Least Squares Technique (RLS) and The Unrestricted Least Squares (ULS) Technique for the production process for testing the hypothesis of constant returns to scale for two industries of Assam – HFCL, Namrup and Oil, Duliajan. The study for the data from 1991 to 2000 for HFCL, found RLS to be more suitable. The HFCL unit of Namrup was running in the declining stage of business cycle and was making loss day by day due to financial problem, political causes. Though the hypothesis of constant returns to scale was accepted but in real world it was not happening, but the unit is in position to improve its output by increasing investment in labour and capital and proper maintenance.

Saikia (2004) generalized C-D production for HFCL Namrup fertilizer plant. But due to small value of R2, the C-D production model was not suitable. Finally tested the hypothesis of constant returns to scale using the RLS technique for VES production the elasticity of substitution was found to be constant.

Sharma and Thaker (2011) India had achieved self sufficiency in N and P, which is met by indigenous production and nominal import and in their analysis mentioned that India is the 2nd largest consumer of fertilizer in world after China and by 2020 the fertilizer demand in the country is projected to increase.

Ray and Pal (2011) TFP was growing at a negative rate; specifically due to fall in capacity utilization. Growth in Indian fertilizer industry was basically input driven growth and there was huge capacity expansion in the post reform period due to abolition of licensing rules, but capacity utilization was found to be negatively related to TFPG rate.

The relationship between labor's share and the degree of utilization of capacity for the years 1929-51 was analyzed by Beck (1956). Labor's share rises as the degree of utilization of capacity either increases or decreases from "normal".

Kemal and Alauddin (1974) found capacity underutilization for almost 80% of the large scale units of Pakistan manufacturing industries. Salim (2007) examined the impact of policy related variables such as size, age, ownership and effective rate of assistance on the rate of productive capacity realization (PCR) of firms using a panel of 92 food manufacturing firms of Bangladesh for the period 1992-94 and 1997-99. Firm size has a positive impact on PCR, while capital intensity and age of the firm have negative impact. Effective rate of assistance and outward orientation do not have any significant impact on PCR due to partial nature of policy reforms.

Ray and Pal (2008) Due to economic reforms there was expansion of capacity in Indian Chemical Industry but with stagnated demand, resulting slow growth of output and in 90's it had a declining trend. Engineering measure of capacity utilization is lower than Economic measure.

Goldar and Renganathan (2008) assessed econometrically using Arellano Bond General Method of Moments Estimator to study the impact of import penetration on capacity utilization. Estimates of capacity utilization in 62 industries of organized manufacturing sector showed that capacity utilization fell between 1995 -2001, but rose between 2001- 2004.

The installed capacity of fertilizer has remained stagnant over the years. The Urea production of BVFCL has not made any significant improvement. The sales of BVFCL have been improving and over the years majority of the products are sold out. Thus there has been improvement in sales of fertilizer. For the period 2006-07, company has achieved all time high sales record of 3, 14, 678 MT Urea.

Table 1.3: Urea Capacity, Production and Sales (in MT)

Year	Licensed Capacity	Installed Capacity	Urea Production	Sales
2002-03	715000	315000	186500	156032
2003-04	715000	315000	240590	234623
2004-05	715000	315000	203060	247572
2005-06	715000	351320	234578	213700
2006-07	715000	510000	308303	314676
2007-08	715000	510000	329977	333473
2008-09	715000	510000	190528	200067
2009-10	715000	510000	309577	308812
2010-11	715000	510000	285143	288303
2011-12	715000	510000	278889	276449
2012-13	715000	510000	390693	383354

Source: Annual Reports of BVFCL

The aim of the paper is to examine capacity utilization of BVFCL and accordingly the hypothesis, The BVFCL is running at full Capacity Utilization is tested for BVFCL. Secondly the paper examines the efficiency of the unit.

BVFCL is the only fertilizer plant in Assam and cost efficient production by the unit will help to reduce price of fertilizer and increase it's per hectare consumption. The improvement in the fertilizer industry will also directly and indirectly generate employment in the states of Assam & other North- Eastern states which are predominantly economically backward by improving the scenario of both agricultural sector and industrial sector. For a state which is scarce in capital, the efficient use of resources will improve sates productivity.

The output which can be produced at minimum point of average total cost, given factor prices is the economic concept of productive capacity. With no constraints on flow of variable inputs and cost, the engineering capacity refers to the maximum potential output per unit of time that a plant can produce under given conditions. The full capacity utilization of existing capital by fertilizer industry will be required in future to meet the increasing demand because it will take long gestation to start new industries. The efficiency of industry is reflected by capacity utilization as it influences the use of resources, cost of production and profitability. Additional investment in capacity creation is not required if an increase in utilization of capacity increases output. Rate at which installed capacity has been utilized is one of the critical determinants of productivity Capacity utilization shows the use of productive capacity of a unit or how efficient the unit is.

Methodology:

Capacity Utilization

(a) Minimum Labour Output Ratio Method

To estimate capacity utilization with the help of this method, a time series of Labour - Output Ratio (L/Y) at constant prices is constructed. From this series, the value of L/Y which is minimum (L*/Y*) is selected a base year. Given the lowest value of labour -output ratio, the capacity output for another time period is calculated by dividing the real labour of that year (Lt) by the lowest value of labour output ratio(L*/Y*). The ratio of utilization is obtained by dividing actual output of that year (Yt) by the estimated output (Yt) Given the lowest value of labour output ratio,

$$\widehat{Yt} = \frac{L_t}{L^*/_{Y^*}} \text{ and } CU = \frac{Y_t}{\widehat{Y}_t}$$

3.1(b) Minimum Capital-Output Ratio Method

Under Capital-Output method, fixed capital output ratio (K/Y) are estimated and a benchmark year is then selected on the basis of the observed lowest capital output ratio (K*/Y*). The lowest observed capital output ratio is considered as capacity output. The estimate of capacity is obtained from real fixed capital stock (K_t) deflated by minimum capital output ratio (K*/Y*). The utilisation rate is given by actual output as a proportion of the estimate of capacity.

$$\widehat{Yt} = \frac{K_t}{K^*/_{K^*}} \text{ and } CU = \frac{Y_t}{\hat{Y}_t}$$

Where, CU=Capacity Utilisation, Yt=Real Output (gross value added), Kt=Estimate of Capacity Real Fixed Capital (gross block), (K*/Y*) = Minimum Capital Output Ratio.

(c) Traditional Method

In the traditional method CU has been calculated as the ratio of total production of the unit by its installed capacity.

Table 3.a : Yearly CU under 3 methods

Year	CU Min K-Y	CU Min L - Y	Traditional Method
2002-2003	31.69	31.6	59.21
2003-2004	58.77	42.24	76.37
2004-2005	46.42	38.57	64.46
2005-2006	33.54	47.28	66.77
2006-2007	59.75	68.85	60.45
2007-2008	65.35	80.96	64.70
2008-2009	37.80	46.52	37.36
2009-2010	56.77	81.92	60.70
2010-2011	53.01	80.54	55.91
2011-2012	49.47	80.41	54.68
2012-2013	59.85	100	76.61
Average	50.22	63.54	61.56

Source: Author's calculation based on annual report of BVFCL

Capacity Utilization rate for BVFCL has remained mostly stagnant and it is below 100%. BVFCL has under utilization of capacity. The reasons cited for underutilization in its annual reports is frequent break down of old machines and their parts, which lead to loss of working days. The unit also faces the bottleneck of continuous supply of inputs to the unit. Thus, BVFCL is not using the available inputs efficiently, and this hampers productivity of the unit.

Low technical efficiency signals that output growth can be achieved with efficient utilization of current input and available technology. Therefore, technical efficiency of production is an important element in the pursuit of output growth in PSU.

Stochastic Production Function:

The frontier model by Farewell (1957) has developed in two stages, the first stage is the deterministic model, and the second stage is a more flexible stochastic model for estimation of efficiency.

A deterministic frontier model can be written as

$Yi = f(Xi, \beta) \exp(-ui)$

Where Yi is a scalar output of producer (unit), Xi is a vector of inputs used by producer ($Xi = (X1, \ldots, Xn) > 0$), $f(Xi, \beta)$ is the deterministic frontier and β is the vector of parameters to be estimated, ui represents inefficiency and is assumed to be a non-negative random variable. Technical efficiency is defined as the ratio of observed output to maximum potential output.

$TEi = f(Xi, \beta) \exp(-ui) / f(Xi, \beta) = \exp(-ui), \; 0 < TE \leq 1$

Yi achieves the maximum value of $f(Xi, \beta)$ and TEi = 1 if ui = 0. Otherwise $ui \neq 0$ provides the shortfall of observed output from the maximum potential output.

A stochastic frontier model can be written as

$Yi = f(Xi, \beta) \exp(vi-ui)$,

In this model error component consist of two components; vi which represents components beyond the control of a producer and ui represents inefficiency component. vi is a symmetrical random variable and i.i.d. N(0, σ2v). ui is a non-negative , one-sided random variable and is the inefficiency part. vi and ui are distributed independently of each other and of xi .

$TEi = f(Xi, \beta) \exp(vi-ui) / f(Xi, \beta) \exp vi = \exp(-ui)$, $0 < TE \leq 1$.

Yi achieves its maximum value of $f(Xi, \beta) \exp vi$ and TEi = 1 if ui =0, otherwise $ui \neq 0$ indicates shortfall of output as firms are not making most of its inputs and technology.

In reality shortfall in output is affected not only by producer's inefficiency but also by random shocks such as measurement errors and weather conditions that are beyond producer's control; this is taken into consideration by stochastic frontier. Therefore, in our analysis of technical efficiency, we use a Cobb- Douglas function which has a stochastic function rather than deterministic function.

$\ln(Y) = a + \alpha \ln L + \beta \ln K + v - u$

Where Y is output, L labour, K capital and the error term is assumed to be non-negative.

Table: 3.b Estimates of Stochastic Production Function (exponential distribution)
Dependent Variable Value added output in natural logarithms

Variables (all in natural logarithms)	Coefficients	Standard error	t-ratio (p value)
Constant	43.482	14.917	2.91(0.004)
Labour	-3.737	1.034	-3.62 (0.000)

Capital	-0.945	0.853	-1.10 (0.268)
Variance Parameters			
Sigma_v	0.247	0.11	2.24
Sigma_u	0.344	0.184	1.91
Sigma2	0.179	0.109	1.64
Lambda	1.391	0.260	5.35
Log likelihood	-5.381		
LR test of error u	1.44 (0.105)		

Source: Author's calculation based on annual report of BVFCL

The sum of the elasticity's is -4.288, which is indicative of decreasing returns-to-scale. The null hypothesis H0: σ u2= 0 against the alternative hypotheses H1 : σ u2 > 0, is tested with likelihood-ratio test, to judge technical efficiency or inefficiency. The LR= 1.44 is significant at 10% significance label, which leads to rejection of null hypothesis, i.e., inefficiency exist in the model. Only the negative coefficient of labour is significant, which indicates overuse of labour.

Table: 3.c Estimates of Technical Efficiency

Year	T.E
2003	0.335
2004	0.113
2005	0.409

2006	0.300
2007	0.105
2008	0.307
2009	0.194
2010	0.477
2011	0.216
2012	0.137
2013	0.188

Source: Author's calculation based on annual report of BVFCL

The declining technical efficiency is indicative of the need to improve the quality of manpower and technology. The average efficiency of the firm is around 33%. Being an old industry the unit efficiency is low. The plant has not experienced technological innovation and it is running on repair and revamp. In addition to it, the plant also experiences shortage of inputs such as natural gas, ammonia, CO2. Efficient utilization of current input and available technology is required for improving capacity utilization and henceforth technical efficiency. The relatively poor performance over time can be attributed mainly to the scarcity of raw material, old age technology, poor energy efficiencies of the units hampers capacity utilization.

Conclusion:

The conclusions that emerge from the study have many important policy implications both at the investment decision level and at the level of individual industry specific improvements. It would be beneficial for the industry to efficiently utilize its existing capacity rather than going for additional units. On the other hand, increasing the utilization of the available capacity will depend on availability of raw materials, providing better wage and training to labour together with technological improvements would be a prudent policy alternative

References:

Chapman, K. (2001), "Spreading Fertilisers: The Internationalization of an Industry," Geography, Vol.86, No.1, pp 11-21.

Hazarika, J., and Saikia, H(2003), An Econometric Study on Nature of the Returns to Scale in Two Major Industries of Assam," Assam Economic Journal, Vol.XV1, pp. 123-128.

Saikia, H. (2004), An Econometric Study on Various Problems of Production Functions with Special Reference to Some Industrial Products of Assam, PhD thesis, Dibrugarh University.

Sharma, P. V., and Thaker, H. (2011), Demand for Fertilizer in India: Determinants and Outlook for 2020, IIM Research and Publications, pp 1-32.

Ray, S. (2012), Economic Capacity Utilization Adjusted Total Factor Productivity in Selected Manufacturing Industries in India, Research journal of Business Management and

Accounting, Vol.11 (1), pp. 8-18.

Khan, M., and Sajjad, A. (2012), Linkages of Liquidity and Profitability: Evidence from Fertilizer Sector of Pakistan, American Journal of Scientific Research, Issue 72, pp 142-148.

Shetty, S.P., and K, D, R. (2012), Performance of Fertilizer Industry in India, Excel International Journal of Multidisciplinary Management Studies, Vol.2, Issue 3, pp 233-249.

Beck,W. J., (1956), Labor's Share and the Degree of Utilization of Capacity, Southern Economic Journal, Vol.22, No.4, pp 457-467.

Kemal, R.A., and Alauddin.T. (1974),Capacity Utilization in Manufacturing Industries of Pakistan, The Pakistan Development Review, Vol. 13, No.3, pp. 231-244.

Salim, R .(2007),Explaining the Differences in Firm Level Production Capacity realization in Bangladesh Food Manufacturing: A Panel Data Study, The Journal of Developing Areas 40 (2).

Ray, S., and Pal, K.M. (2011), An Application of Economic Capacity Utilization to the Measurement of Total Factor Productivity Growth: Empirical Evidence from Indian Fertilizer Industry, Romanian Journal of Economic Forecasting, pp. 125-142

Goldar, B., and Renganathan.V. S. (2008), Import Penetration and Capacity Utilization in Indian Industries, Institute of Economic Growth, Working Paper Series No. E (293), pp. 1-27.

Bharali,P. (2018), Capacity Utilization, Productivity and Production Function : Results on Public Sector Unit (BVFCL, Namrup).International journal of Research in Social Sciences, pp 183 -203.

Bharali, P., and Chakraborty,K.D. (2019), Technical Efficiency, Subsidy and Financial Performance : A Case Study of BVFCL, Namrup". Indian Journal of Economics and Development, Vol 7 (3).