Title: Technical Efficiency of Small Scale Food Industries : The case of Kedah and Perlis.

Ibrahim Yunus

Department of Economics and Agricultural Business. 06010 UUM, Sintok,

Kedah Darulaman

Abstract: This study attempts to examine technical efficiency of small food industries in the states of Kedah and Perlis. The most important problems of entreprenuers found in this study were limited export market thus limit for further expansion of small scale food industries. In addition the entreprenuers still adopting the traditional type of production which may be time consuming and this lead to become inefficient in the process of production. An econometric technique of the Stochastic Frontier Production function approach was applied whereby technical efficiency was measured. The results showed that technical efficiencies were rather low among the small scale food manufacturers. This is due to changing structure and labor saving technologies which focus towards modernization of the food industry. However several policy reforms are needed to enhance the competitiveness of the food industries especially pertaining to export markets. It can be conclude that improved extension linkage to sentisize the producers of the need to increase the production to cater for export market. In addition, the government must make every efforts of some joint cooperation between these small medium industries with the Government Link Companies.

Key Words:Technical efficiency, technical progress, scale efficiency, stochastic frontier

---

1.1 Introduction

The state government has planned a series of economic measures to be implemented in the state from 2001-2010. The economic measures, contained inside the ‘Kedah Development Action Plan 2010’ report had identified a number of targeted industries to be promoted in the state. Agriculture is the backbone of the Kedah economy and this sector provided employment 19% for Kedah, 21.7% for Perlis and 1.4% for Penang respectively. The agricultural activities in the Northern Corridor include the cultivation of paddy, and the planting of commercial crops such as oil palm, rubber and sugar cane, by which 49% and 42% are utilized for oil palm and paddy respectively. Apart from agriculture, industrial sector is supposed to be in par and plays a pivotal role as a strong growth driver. It contributes 34% of regional GDP in 2000 employing 28% of the region's workforce in the same year. The strategy of structuring the economy to achieve sectoral economic balance was to be achieved through the modernization of the rural sector by transforming it into a dynamic force for agricultural and economic development through the application of science and technology. The strategy of structuring the economy to achieve sectoral economic balance was to be achieved through the modernization of the rural sector by transforming it into a dynamic force for agricultural and economic development through the application of science and technology. Although the Northern Corridor contributes to over a third of the country's manufacturing exports, but it needs to increase competitiveness in order to attract foreign investments, especially with the new emerging countries such as Vietnam, Thailand, China and India. Setting up the agro-based industries whenever possible to act as new growth centres. The transformation from existing practices will definitely improving the productivity of land, whereby improving rural incomes. Leading agricultural practices and marked improvements in planting materials, will boost efficiency, productivity and quality of products and fetched for a better marked up.

The state government has planned a series of economic measures to be implemented in the state from 2001-2010. The economic measures, contained inside the 'Kedah Development Action Plan 2010' report had identified a number of targeted industries to be promoted in the state. Among others, is the food processing industry and the major targeted food processing sub-sectors are listed in Table 1. As reported in the Kedah Development Action Plan 2010, the SMEs in Kedah were relatively weak and majority of them were still exposed to market demand votalities. Many are lacking in efficiency management, and producing products below acceptable standards. Financially, most of these firms need help from financial institutions.

Table 1: Categories of Food Processing Industries

No	Categories	Examples
1	Rice based industry	*Keras*, peneram, bauhulu
2	Fish based industry	Fishballs,snack sea food,,siput
3	Herbs and spices based industry	Kurma powder, curry powder
4	Fruit based industry	Fruit juices
5	Dairy/meat based industry	Meat balls, salted eggs
6	Coffee	Coffee powder
7	Sauce	Food sauce

Source: MADA

1.2 Problem statement

There are many small scale industries but their contributions to total productivity and job opportunities are small due to inefficiency in production. This shortcomings can be overcome through various efforts such as exposure to training, getting more financial assistance and market expansions. Besides there is a lack in linkages between the industrial sectors which hinders their expansions. The food sector which is dominated by enterprenuers from the rural areas with little capital, still using the traditional methods of productions. The alternative is for this sector to commercialize so that it becomes more competitive and be able to penetrate the global market.

1.3 Objectives

The general objective of this research encompassing the survival of the SME due to competiveness in the market place, and the specific objectives are as:-

i. To investigate the SME status especially involving the food industry in MADA area.

ii. To analyse and elucidating issues and problems concerning SME in MADA area.

1.4 Literature review

J.C. Rohan Jayatilake applies the Stochastic Frontier approach to estimate the technical efficiency of tea manufacturing firms in Sri Lanka. The study estimates that the average technical efficiency of the tea manufacturing firms in sri Lanka is 80% , indicating that there is a potential to increase the production by 20% through efficiency improvement, and this can reduce the cost of production. The results also indicates that the output capacity of the larger factories is higher than that of the smaller factories. The study also identifies that the production capacity of tea factories vary between the regions.

S.O. Ojo examined the productivity and technical efficiency of poultry egg production in Nigeria using the stochastic frontier production function analysis. Primary data were collected using a set of structured questionnaire from two hundred poultry egg farmers. Results showed that the technical efficiencies of the farmers varied widely between 0.239 and 0.933 with a mean of 0.763 and about seventy nine percent of the farmers had technical efficiency exceeding 0.70.

Abdul Hamid Jaafar *et al* (1985) investigated the technical efficiency of pepper cultivation industry in Sarawak and to ascertain whether there is any difference in the technical efficiency of the Bumi and non Bumi pepper farms. The method employed based on the Kopp technical efficiency measures.

The results revealed that the pepper cultivators of Sarawak are not technically efficient. Also the Bumiputra cultivators are generally less efficient than the non- Bumi cultivators. In general, technical inefficiency occurs because a producer has failed to use the correct amount of input to produce a given amount of output.

Khumbhaker *et al* (1986) investigated the technical, allocative and scale inefficiency of owner-operators of dairy farms in Utah. A stochastic production frontier as been applied to analyse these inefficiencies. The results indicate that there is a positive association between years of education and productivity of labor and capital. Productivity is also found to be negatively related to off-farm income. Regarding the effects of farm size and efficiency, it is found that large farms are the most efficient of all sizes considered. Separate estimates of technical, allocative and scale inefficiency indicate that large and medium sized farms are technically more efficient than small farms. Large farms on average are are found to be performing much better than medium-sized and small farms, so far as allocative and scale inefficiency are concerned.

Khalid (2001) investigated the Technical efficiency of broiler farms in the central region of Saudi Arabia. He noticed that the broiler farms in the central region of Saudi Arabia experienced a wide range of technical and managerial problems, coupled with under capacity while others ceased operations. The stochastic frontier analysis was applied to estimate the technical efficiency of broiler farms in the central region of Saudi Arabia. At the same time, the mean technical efficiency is compared between the large farms and the small farms to find out whether policy instruments should be applied. He found out that, substantial technical inefficiency exists in broiler farms in the central region of Saudi Arabia. The mean technical efficiency was estimated to be 89 percent, 83 percent, and 82 percent for all, small, and large farms respectively. In addition the study showed that the technical efficiency level was found to be higher among the larger sized farms which may be attributed in part to differences in sample size.

1.5 Methodology

Farm efficiency and how to measure it is an important subject in agriculture. If farmers are inefficient in their practices, then output could be increased with less cost through educational efforts and extension services. The measurement of efficiency has been a popular field of research and focused on the economic efficiency of agricultural production. Farrell(1957) developed a concept of technical efficiency based on the relationship between inputs and outputs.

1.6 Technical Efficiency

Efficiency in production can be defined in terms of production function that relates the level of various inputs. Technical efficiency is a measure of a firm's success in producing maximum output from a given set of inputs. Technical efficiency measures output relative to that of the efficient isoquant. The concept of technical efficiency relates to the question of where a firm uses the best available technology in its production process.

In general, the measuring of farm level of efficiency is to estimate the frontier that envelops all the inputs and output data with observations lying on the frontier as being described as technically efficient. Anything below the observation is considered inefficient.

Technical efficiency for any observation is defined as:

$$TE = \frac{y_{it}}{f(x_{it,t;}\,ß)\,.\,\exp(v_{it})} \qquad (1.2)$$

Where $f(x_{it\ ,\ t;}\ ß)$ represents the deterministic translog production function. If TE = 1, then production is efficient and lies on the frontier. If TE < 1, then production is inefficient and lies below the frontier.

Technical efficiency is the capacity and willingness of an economic unit to produce maximum possible output from a given technology and a mix of inputs. The concept of technical efficiency may be ignored by researchers for sometime and its usefulness as a measurement is relatively new. The existence of technical efficiency is thus not just a theoretical concept and there is a need to address and quantify this measure.

Let's assume that the production frontier of the i^{th} firm, producing a single output with multiple inputs following the best practice techniques which can be defined as :

$$Y_i^* = f(x_{il}, x_{i2, .., \ldots.,} x_{im}) \mid A \qquad (1.3)$$

where x_{il}'s and Y_i^* are the k^{th} input and frontier output of the i^{th} firm respectively, and A is the given technology that is common to all firms in the sample. Now let us consider the situation where the firm is not producing its maximum possible output due to unforeseen circumstances which may be due to various non-price and socio-economic factors. Then it follows that the production function can take the form of:

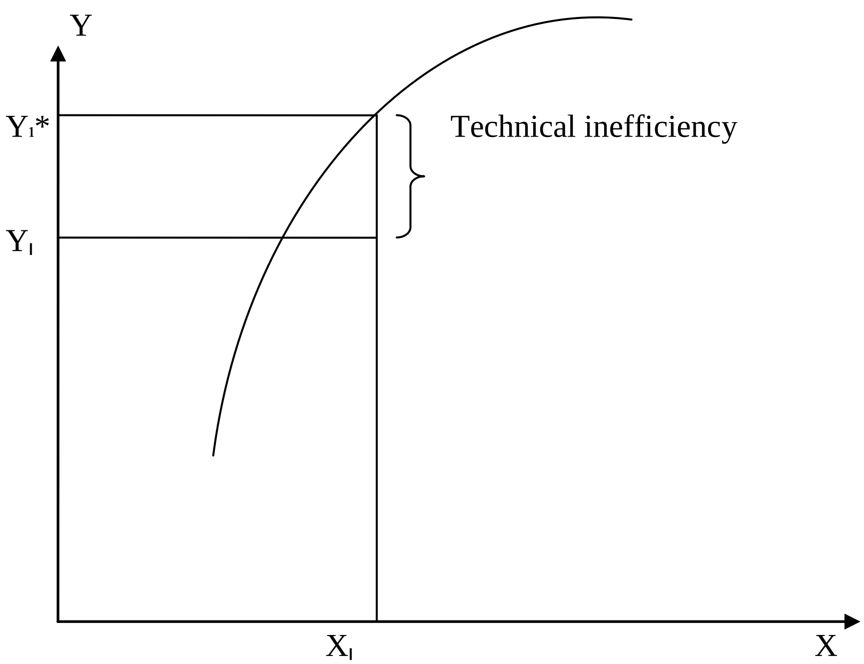
$$Y_i = f(\chi_{il}, \chi_{i2}, .,.., \chi_{im}) \exp(\mu_i) \qquad (1.4)$$

Where μ_i represents the combined effects of various non-price and socio-economic factors which interfere the firm from obtaining its maximum possible output. In other words, μ_i which is firm specific, reflects the firm's ability to produce at its present level, can be referred to as technical efficiency. μ may take the value of 0 when a firm produces output level at 100 percent and at this point we called it the the firm is fully technically efficient. A firm may not be able to produce efficiently probably due to some constraints, as a result the value of μ can be less than 0. Therefore, we can finally deduced that the value of μ reflects the extent to which the firm is effected by various non price and socio-economic factors or constraints. From the above discussion, we can set up the technical efficiency measure which is as follows:-

$$\exp(\mu_i) = Y_i / Y_i^* = \text{Actual output / Maximum possible output} \quad (1.5)$$

Y_i is the actual output or realised output is referred to as observed output for a given sets of inputs and the potential output using the current technology with maximum output produced using the same set of inputs under the production environment faced by firms.

Figure 1: Production Frontier



Diagrammatically, Y* is the frontier output and Y_I is the observed output if firm uses X_I input combination. Thus technical inefficiency is represented by the gap between Y* and Y_I**.** Note that equation (1.5) is the basic model used for measuring technical efficiency.

1.7 Model Specification

The stochastic frontier model for this study can be generally written as follows:-

$$Y_1 = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon \quad (1)$$

The above specification is the stochastic production frontier model,

Where $\varepsilon_{it} = \nu_{it} - \mu_{it}$

Where Y_{it} is (the logarithm of) the production of the i^{th} firm in the t^{th} time period.

x_{it} is a k x 1 vector of (transformation of the) input quantities of the i^{th} firm in t^{th} time period. β is parameter to be estimated. While ν_{it} random variables which are assumed to iid $N(0,\sigma^2_\nu)$ and independent of the μ_{it}.

Using the translog model as specified by Battese and Coelli (1995), the production equation can be written as follows:-

$$\text{Log}(y_{it}) = \beta_o + \beta_1 \log(K_{it}) + \beta_2 \log(L_{it}) + \beta_3 (\log(K_{it}))^2 + \beta_4 (\log(L_{it}))^2$$

$$+ \beta_5 \{(\log(k_{it})\}\{\log(L_{it})\} + (\nu_{it} - \mu_{it})$$

t = 1,2, …,N represents time period

Log Log (y_{it}) is the log of the estimates of production for firm J in year t.

Log (K_{it}) is the log of the value of capital.

Log log (L_{it}) is the log of the total no of labors.

β parameters to estimated

ν_{it} is a normal error terms with a zero mean and variance σ^2_ν

μ_{it} is the technical inefficiency variable having normal distribution with mean μ_{it} and variance σ^2_μ .

1.8 Efficiency Distribution

Efficiency distribution is a useful indication of what is actually happening in the small scale food industry. A frequency distribution of predicted technical efficiency within ranges of 0.4 to 0.98 are presented in Table 2.

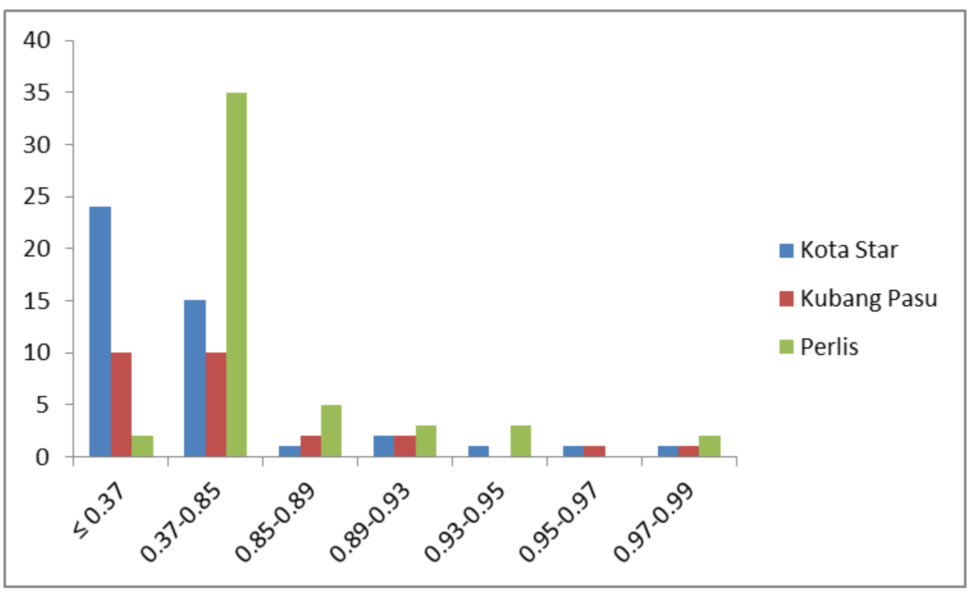
Table 2: Relative frequency distribution of technical efficiency of food industries in Kedah and Perlis

Technical eff	≤ 0.37	0.37-0.85	0.85-0.89	0.89-0.93	0.93-0.95	0.95-0.97	0.97-.99	mean
Freq (Kota Star)	24	15	1	2	1	1	1	0.85
Freq (Kubang Pasu)	10	10	2	2	0	1	1	0.85
Freq (Perlis)	2	35	5	3	3	0	2	0.85

The mean technical efficiency of food industry is around 85 percent, which indicates that the food industry are not operating at their technical efficiency level. In other words there is a 15 per cent potential improvement in this sector,which can be achieved through efficiency improvement of the food industries. Table 2 also shows the estimated technical efficiency distribution of food production in Kedah and Perlis. It shows a wide range in which the minimum technical efficiency recorded was 37 percent while the maximum was 98 percent. Refering to figure 2, which represents the percentage distribution of entreprenuers based on their technical efficiency. The figure shows that 15 percent of firms within the sample are operating above the 85 percent efficiency level for Kota Star district. But the Kubang Pasu district shows a higher level of efficiency at 30 percent within the sample above the 85 percent efficiency level. Compare to the sample taken from the district of Perlis, it registered a much higher level at 35 percent within the sample which operates above 85 percent level of efficiency.

Low levels of efficiency for the food industries may be due to the practiced of traditional methods in production. The food produced are mainly for the local consumption, thus there is no incentive to produce in large volume. Most of the entreprenuers are rather old people with lack of education, and the acceptance of new ideas may be met with some resistence. On top of that, most of the operations are run as a family business, which may be handed down through generations. There is no product development taking place, which may play a pivatol role for business expansion. In the light of these limitations, the state government must make every efforts to take some measures, to upgrade the efficiency of the food industries. With further expansion, it opens for a new export market and hence the sustainability of small food industries.

Figure 2: The percentage distribution of food industry technical efficiencies within the sample



1.9 Results and Discussion

The maximum-likelihood estimate of the of the Cobb-Douglas model is represented in Table 1. The Frontier 4.1 program estimates the variance parameters in terms of $\sigma^2 = \sigma^2_v + \sigma^2_u$ and $y = \sigma^2_u / \sigma^2$. The estimate of y in this model is 0.84 and significant at the one percent level, which may indicates of inefficiencies in management process and not to random errors. This is an indication of technologies variations used in the production process and the weakness in the inputs mix.

Table 1: Maximumlikelihood estimates of the Stochastic Frontier model

Variable	Coefficient	standard error
Constant	1.089	0.520
Labor (InL)	3.718	0.542
Capital (InK)	15.501	0.153
Inefficiency Model		
In (Age)	0.751	1.129
In (Experience)	-1.894	1.152
In (Time)	-0.097	0.012
σ^2	1.996	-
y	- 84.874	-
Log likelihood	-80.693	-

The estimated ML coefficient are significant. The coefficients for labour and capital are 3.7 and 15.5 respectively. If a one percent increase in labour, production will increase in food by 3.7 percent, ceteris peribus. Similarly, the output value capacity can be increased by 15.5 percent if capital is increasing by one percent.

The tests for null hypothesis that there are no technical inefficiency effects ($\delta=0$) in the model is rejected for the Cobb-Douglas production function. The results showed that the inefficiency model is relevant in explaining the food industry technical inefficiency. Statistically, age and experience made a significant effect on the technical inefficiency of the food industry. The positive coefficient of age denotes the energetic of the entreprenuers, such that the older producer tend to be less active in producing food products. The negative coefficient of experience representing the skills involve by the entreprenuers in the food industry, new skills and new methods of production usually tend to increase the production. Found not significant is the time involve in the food industry. Duration does not have a positive effect in the food production.

1.10 Conclusions and Policy Recommendations

This study focussed on the estimation of the technical efficiency of the food industry in Kedah and Perlis applying the Stochastic Frontier Analysis. The study results show that the inefficiency in the production process can influence the productivity of entreprenuers. The average technical efficiency of the food industry in Kedah and Perlis is estimated at 60% which indicates that there is a great potential to increase the production by 40% through efficiency improvement, which may lead to reduce cost of production. In other words, if all the producers can produce at their maximum technical efficiency, the products will be more competitive locally, because they are producing at low cost. The study showed that the low level of efficiency for food industries may be due to traditional methods of production. The reason may be due to the food produced to cater for local production. Product development is minimal and no incentive for large production and most of the business is run as family business. Second stage analysis, identified the determinants of inefficiency which have policy implications especially more training and the adaptation of new technology in food production. Thus potential improvement of the food industry through efficiency improvement may allow for further expansion of the food industry in Kedah and Perlis

References

Abdul Hamid Jaafar & Mansor Jusoh. 1997. Technical Efficiency of Pepper Farms in Sarawak. *Jurnal Ekonomi Malaysia.* 31: 71-85.

Abu Kassim Ali. 2001. *Changes In Food Consumption, The Situation In Malaysia,* Malaysian Agricultural Research Development Institute, Kuala Lumpur, Malaysia .

Adam, F.G. and Brehman, J.R. 1979. *Econometric Modelling of World Commodity Policy.* Lexington Books, Toronto, Canada.

Alrwis, N.R., and Francis, E. 2003. Technical Efficiency of Broiler Farms in the Central Region of Saudi Arabia: Stochastic Frontier Approach. *Resource Bulletin* No. 116, Agriculture Resource Centre, King Saud University: 5-34.

Birthal, P. S., Joshi, P.K., and Gulati, A. 2005. Vertical Coordination in High-Value Food Commodities: Implications For Smallholders. International Food Policy Research Institute, 2033 K Street, NW, Washington, DC 20006-1002, USA.

Coelli, T., Rao, D.S.P., and Battese G. E. 1998. An Introduction To Efficiency and Poductivity Analysis. 101 Philip Drive, Assinippi Park, Norwell, Massachusetts: Kluwer Academic Publishers, 02061 USA.

Fan, S. 1989. Regional Productivity Growth in China's Agriculture. PhD Dissertation, Faculty of Graduate School, University of Minnesota,USA.

Fatimah Said and Saad Mohd Said. (2004). Productivity and Malaysian Economic Growth. *Journal Produktiviti* Bil. 20. Perbadanan Produktiviti Negara, Kuala Lumpur.

J.C Rohan Jayatilake (2006). The estimation of technical efficiency of tea manufacturing firms in Sri Lanka: a stochastic frontier analysis, *Annual Research Journal of SLSAJ, Issue 6*

Fatimah Said and Saad Mohd Said. 2004. Total Factor Productivity Growth in Malaysian Manufacturing Sector: Emphasis on Heavy Industries. International Islamic University Malaysia, *Journal of Economic and Management 12(2).*

Helvoigt, L.T. 2006. Productivity Growth, and Time -Varying Elasticity, Elasticity of Substitution in the NW Sawmill Industry: A Frontier Approach. PhD Dissertation, Faculty of Economics, Oregon, State University, USA.

Henderson J.M., and Quandt, R.E. 1980. *Microeconomic Theory. A Mathematical Approach.* McGraw - Hill International Editions, Singapore

Cornelis L.J., Van Der Meer and Saburo Yamada(1992) Japanese Agriculture, *A comparative economic analysis*, Antony Rowe Ltd, Great Britain

Khalid, A.R. 2001. Essays On the Technical and Economic Efficiency of Broiler Production in Saudi Arabia. PhD Dissertation, Gaduate College of the Oklahoma State University, United States .

Kong, X., Marks, E.R., and Wan, H.G. 1999. Technical Efficiency,Technlogical Change and Total Factor Productivity Growth in Chinese State-Owned Enterprises in the Early 1990s. *Asian Economic Journal Vol.13(3).*

Kohls, R.L., and Uhl, J.N. 1972. *Marketing of Agricultural Products*. New York: Collier, Macillan International Editions, York

Kumbhakar, C.S., Biswas, B., and Bailey, V.D.1986. A study of Economic Efficiency of Utah Dairy Farmers: A System Approach. *Review of Economics and Statistics* Vol.68.

Little, J.M.D., Mazumdar, D., and Page, J. M. Jr. 1982. *Small Manufacturing Enterprise. A Comparative Analysis of India and Other Economies*. Bank Research Publications.

Lim, D. 1975. *Supply Responses of Primary Producers*. Kuala Lumpur: Penerbitan Universiti Malaya.

Lim, H. 2005. Analysis of Efficiency and Technical Change Using The Stochastic Frontier Model In Industries and Manufacturing. PhD Dissertation, Department of Economics, the University of Utah, USA.

Mahadevan, R. 2004. Looking beyond obtaining the real TFP growth for Malaysia manufacturing sector. The Economics of Productivity in Asia and Australia. Edward Elgar Publishing Limited Glensanda House, Montpellier Parade, Cheltenham, GLOS GL50, UK.

Mahmood Nazar Mohamed, (1998). Seminar Penyelidikan UUM. Sintok, Kedah Darulaman

Mansor Jusoh & Pa Ismail. 1983. Stochastic Frontier Production Function- A Model. *Jurnal Ekonomi Malaysia* No7.

Nik Hashim Nik Mustapha and Mohd.Anuar Md.Amin. 2004. Total Factor Productivity Growth Measurement And Analysis For Manufacturing Sector, Paper presented at international Seminar at Hilton Hotel Petaling Jaya, organized by the National Productivity Corporation, Malaysia.

Nik Hashim Nik Mustapha,Ismail Omar, Nik Fuad Nik Mohd Kamil, Nur Azura Sanusi (2006). Persidangan Pertama Pembangunan Komuniti Pulau dan Pesisir Pantai 2006. Kolej Universiti Sains dan Teknologi Malaysia, Terengganu.

Rahmah Ismail,Chai Nyet Fung. 2002. Sumbangan Produktiviti Keseluruhan terhadap Pertumbuhan Output Industri Skel Kecil Dan Sederhana (IKS) Di Malaysia. *Analysis* (1& 2), 77-99 .

Sharm, K.R., and Leung, P.S. 2000. Technical Efficiency of Carp production in India: A Stochastic Frontier Production Function Analysis. *Aquaculture Research* 31 : 937-947.

S.O. Ojo.2003. Productivity and Technical Efficiency of Egg Production in Nigeria. International Journal of Poultry Science 2 (6): 459-464, 2003