

Technical Efficiency of Small Scale Food and Beverage Enterprise of Female Entrepreneurs in Bantul using Data Envelopment Analysis (DEA)

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ABSTRACT

Thirty five female entrepreneurs of food and beverage subsector in Bantul district were interviewed to find out the efficiency of the business they operated. All of the businesses were of the kind of micro and small enterprises. Analysis was made using data envelopment analysis (DEA). The results of the analysis showed that there were 9 efficient small scale enterprises (SSE) and the remaining was inefficient. The mean technical efficiency was 0.79. Overall, there were 3 SSE in a condition of constant return to scale, 3 SSE in a condition of increasing return to scale and 29 SSE in a condition of decreasing return to scale. It was possible for the inefficient SSE to reach efficiency level by decreasing input and increasing output as recommended.

General Terms

Agribusiness Management.

Keywords

Female entrepreneurs, efficiency, small scale enterprise (SSE), data envelopment analysis (DEA).

1. INTRODUCTION

In the past decades there has been an increase in the number of females who were self-employed, built and operated their own businesses. Global Entrepreneurship Monitor (2012) reported that there were 126 millions of females who began their businesses, while 98 other females have operated their own businesses for at least 3.5 years. Based on the report there were at least 224 million businesses operated by females. The number would increase if all countries were included because the GEM included only 67 countries [1].

In the past few years the number of females who owned businesses in United States of America increased dramatically. In 1997, there were 8.5 million females who owned their own businesses. The number represented one third of all of the existing businesses in the district. There were 23.8 million labors absorbed. In the period of 1987-1997 there has been significant increase (262%) in the number of the labors [2]. According to the data of Kementerian Pemberdayaan Perempuan dan Perlindungan Anak Republik Indonesia (2011) there were 46 million small and medium enterprises in Indonesia, some of them were home industries. About 60% of the home industry managers were women. Concerning with the significant number, the role of the women was very dominant in economic endurance because they were able to create employment, to produce products and services at affordable price and to alleviate poverty [3].

The increase in the number of the women that owned the businesses resulted from some factors, which were among others their independence and their need to seek self-

achievement [4], [5], flexibility [6], autonomy and financial needs [7], [8] and environment [9].

Though the growth rate of the businesses of the women was higher than that of the businesses of men, quantitatively it was still relative small. The size of the businesses of the women tended to be small as compared to that of the businesses of the men and concentrated in service and retail sectors. Additionally, Singh et. al. (2001) suggested that their businesses in Indonesia concentrated in informal sector with low income in which 78.8% of them was in food processing subsector [10]. There was indication that the number of the female entrepreneurs in Indonesia was more likely to decrease related to the size of their businesses [8].

The businesses owned by women had higher failure level, while the selling rate, the profitability and the number of labors were lower than those of the businesses of men [11]. The activity space was smaller than that in the past and it was more likely to slow down [12]. The characteristics and the responsibility for family were in fact insignificant as compared to the responsibility for the performance of their businesses [13].

The problems facing them related in general to the businesses/the entrepreneurship, social and technical aspects. According to Minniti and Win (2010) it resulted from the behavior of the female entrepreneurs related to characteristics, motivation, success level and the difference in gender that were complex and multifaceted in nature [14]. They would have negative impact on working efficiency [15], [16] and business performance.

Based on the aforementioned data, the study of the efficiency of the businesses owned by female entrepreneurs could provide more complete description of their businesses. The study would examine the efficiency level of the businesses and give recommendations for efficient operation of the businesses.

2. LITERATUR REVIEW

2.1. The Previous Studies

There have been many studies related to the efficiency of the small and medium enterprise (SME). One of them was the study by Batra and Tan (2003) of the small and medium manufacture enterprise in six developing countries. The results showed that the size of the businesses was not directly proportional to the efficiency level. Some small firms had equal and even higher efficiency than the bigger ones. The causal factors of the difference were training and education, investment in new technology, automation and quality control [17]. Subsequently, Bhasin (2009) concluded that there was still wide enough space for the female entrepreneurs in food and beverage business to improve technical efficiency in Cape

Coast with the mean value of the technical efficiency of 64.5% [18]. Heilbrunn, Rozenes and Vitner (2011) suggested that there were 89 small and medium enterprise of 248 small and medium enterprise in Israel, which were efficient and concentrated in general on decreasing the cost of their business activities [19]. Charoenrat, Harvie and Naburana (2013) measured the technical efficiency of the small and medium manufacture enterprise in Thailand using stochastic frontier analysis (SFA) and data envelopment analysis (DEA). The results showed that the mean technical efficiency was relative low [20]. Purwanto, Mangongga and Pakereng (2014) conducted a study of small and medium businesses in Salatiga. The results showed that there were 8 small and medium businesses of 31 small and medium businesses, which were efficient [21].

2.2. The Definition of Small Scale Enterprise (SSE)

Based on Undang-undang Republic Indonesia number 20/2008 on micro, small and medium enterprise, small scale enterprise (SSE) was independent productive economic enterprise operated by individuals or business entity that was not subsidiary owned, controlled or direct or indirect part of the medium or big business as intended in the act [22]. The criteria of small sale enterprise according to the act were summarized in the following table:

Table 1. SSE Income Criteria (Million Rp)

Enterprise Criteria	Net Assets (IDR)		Annual Sales (IDR)	
	Min	Max	Min	Max
Micro	-	50	-	300
Small	50	500	300	2,500

Source: Undang-undang RI no 20 Tahun 2008

2.3. Data Envelopment Analysis (DEA)

Data envelopment analysis (DEA) was applied in measuring efficiency in this research. The DEA was non-parametric frontier mathematic program [23] that used linear program model to calculate output-input ratio for all of the units in a population. It aimed at measuring relative efficiency level of decision making unit (DMU) of similar activities when all of the units were on or under the frontier efficiency curve. Decision making unit (DMU) was used to avoid the difference in the terms used by organizational entities related to the decision on input and output in economic literature [24]. The analysis was designed to measure relative efficiency of production unit many input and output [25]. There were many models in the DEA. Charnes, Cooper and Rhodes suggested an input-oriented model and assumed constant return to scale (CRS) model. The CRS aimed at maximizing output. The formula was as follow:

$$\begin{aligned} & \max_{\mu_k, v_i} \sum_{k=1}^p \mu_k y_{k0} \\ & \text{s.t.} \quad \sum_{i=1}^m v_i x_{i0} = 1 \\ & \quad \sum_{k=1}^p \mu_k y_{kj} - \sum_{i=1}^m v_i x_{ij} \leq 0 \\ & \quad j = 1, \dots, n \quad k = 1, \dots, p \end{aligned}$$

$$\mu_k \geq \varepsilon, v_i \geq \varepsilon \quad i = 1, \dots, m$$

Then, Banker, Charnes and Cooper (1984) proposed variable return to scale (VRS) model. The model assumed that a business has not operated at maximal scale, meaning that its input and output did not equal. In other words, the increase in the input (x) would not surely cause the increase in the output (y), which might be bigger or smaller [26]. Its formula was as follow:

$$\begin{aligned} & \max_{\mu_k, v_i} \sum_{k=1}^p \mu_k y_{k0} - u_0 \\ & \text{s.t.} \quad \sum_{i=1}^m v_i x_{i0} = 1 \\ & \quad \sum_{k=1}^p \mu_k y_{kj} - \sum_{i=1}^m v_i x_{ij} - u_0 \leq 0 \quad j = 1, \dots, n \\ & \quad k = 1, \dots, p \quad \mu_k \geq \varepsilon, v_i \geq \varepsilon \quad i = 1, \dots, m \end{aligned}$$

Where

y = input of SSE

x = output of SSE

v_i = non negative scalars

μ_k = unit price of output k of SSE

k = pth output

i = mth input

y_{k0} = kth input that maximize cost for SSE

x_{i0} = pth input for mth SSE

3. THE RESEARCH METHODOLOGY

Respondents were 35 female entrepreneurs in food and beverage in Bantul district. They operated businesses categorized as small scale enterprise (SSE). The input data included raw material cost and labor cost, while the output included income and gross margin. The data were analyzed using DEA SOLVER software.

4. FINDINGS

4.1. Data Analysis

Efficiency value, ranking and return to scale of the SSE could be found in table 2.

Table 2. Score, Rank and RTS of SSE

SSE	Score	Rank	RTS
29	1	1	Decreasing
1	1	1	Decreasing
28	1	1	Constant
27	1	1	Constant
4	1	1	Constant
26	1	1	Increasing

23	1	1	Decreasing
18	1	1	Decreasing
13	1	1	Decreasing
12	0.942895	10	Decreasing
17	0.937082	11	Decreasing
6	0.936631	12	Decreasing
35	0.931814	13	Decreasing
8	0.915063	14	Decreasing
16	0.902175	15	Decreasing
22	0.889017	16	Decreasing
15	0.884118	17	Decreasing
25	0.874658	18	Decreasing
7	0.848442	19	Decreasing
32	0.777558	20	Decreasing
31	0.757362	21	Decreasing
34	0.743464	22	Decreasing
14	0.736093	23	Decreasing
21	0.677182	24	Decreasing
33	0.637045	25	Decreasing
3	0.625973	26	Increasing
19	0.598639	27	Decreasing
24	0.583676	28	Increasing
30	0.565435	29	Decreasing
5	0.535241	30	Decreasing
10	0.528597	31	Decreasing
20	0.523585	32	Decreasing
9	0.489675	33	Decreasing
11	0.475397	34	Decreasing
2	0.471942	35	Decreasing
mean	0.7939		

It was clearly observed in the table 2 that the highest efficiency value was 1 for the SSE 29, 1, 28, 27, 4, 26, 23, 18 and 13. The lowest efficiency value was 0.472 for the SSE 2. The mean efficiency was 0.7939. Based on the efficiency value the distribution of the efficiency values of the SSE were summarized in table 3.

Table 3. Distribution of Production Efficiency Level of SSE

score	SSE
1	9
0.9-0.99	6
0.8-0.89	4
0.7-0.79	4
0.6-0.69	3
0.5-0.59	6
0.4-0.49	3
Total	35

Based on the distribution of the efficiency scores it was observed that the highest value was 1, which was for the SSE 9, while the lowest value was in the interval 0.40-0.49 and 0.6-0.69 for SSE 3.

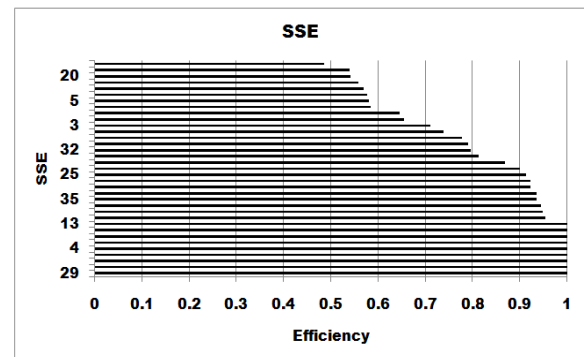


Figure 1. Efficiency Value of SSE by Rank

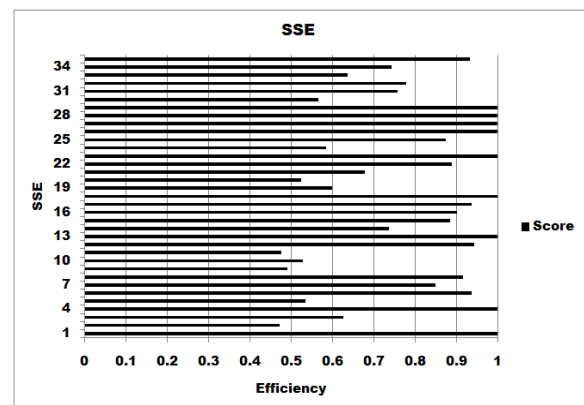


Figure 2. Efficiency Value of SSE by Score

Tabel 4. RTS SSE

RTS	Efficient	Projected	Total
No. of IRS	1	2	3
No. of CRS	3	0	3
No. of DRS	5	24	29
Total	9	26	35

Based on figure 1, 2 and table 4 above, it can be shown that there were 9 efficient SSE and the remaining 26 SSE. There were three SSE of the efficient businesses in constant return to scale category, a SSE in increasing return to scale category, and 5 SSE in decreasing return to scale category. Meanwhile, there were 2 SSE out of 29 inefficient SSE in increasing return to scale category, while the remaining 24 SSE were in decreasing return to scale category. In general, there were 3 SSE in the constant return to scale category, 3 SSE in the increasing return to scale category and 29 SSE in the decreasing return to scale category.

4.2. Development Scenario based on the Efficiency Value

The small scale enterprise in the increasing return to scale category indicated that it was still possible for them to achieve efficiency by increasing input, while the SSE in the decreasing return to scale category showed that they had to decrease the use of the input to achieve improve the condition. The recommendations for each SSE to achieve efficiency were presented in table below.

Table 5. Recommendations for SSE to Achieve Efficiency

SSE	I/O	Recommends
2	Raw material	Lessen up to 52.81%
	Labor	Lessen up to 52.8%
	Margin	Improve up to 266.51%
3	Raw material	Lessen up to 37.40%
	Labor	Lessen up to 37.40%
	Margin	Improve up to 234.71%
5	Raw material	Lessen up to 46.48%
	Labor	Lessen up to 46.48%
	Margin	Improve up to 149.21%
6	Raw material	Lessen up to 6.34%
	Labor	Lessen up to 6.34%
	Margin	Improve up to 36.05%

7	Raw material	Lessen up to 15.16%
	Labor	Lessen up to 15.16%
	Margin	Improve up to 170.86%
8	Raw material	Lessen up to 8.49%
	Labor	Lessen up to 8.49%
	Margin	Improve up to 28.66%
9	Raw material	Lessen up to 51.03%
	Labor	Lessen up to 51.03%
	Margin	Improve up to 269.63%
10	Raw material	Lessen up to 47.14%
	Labor	Lessen up to 47.14%
	Margin	Improve up to 161.77%
11	Raw material	Lessen up to 52.46%
	Labor	Lessen up to 52.46%
	Margin	Improve up to 269.30%
12	Raw material	Lessen up to 5.71%
	Labor	Lessen up to 5.71%
	Margin	Improve up 58.97%
14	Raw material	Lessen up to 26.39%
	Labor	Lessen up to 26.39%
	Margin	Improve up to 298.00%
15	Raw material	Lessen up to 11.59%
	Labor	Lessen up to 11.59%
	Margin	Improve up to 122.58%
16	Raw material	Lessen up to 9.78%
	Labor	Lessen up to 9.78%
	Margin	Improve up to 107.27%
17	Raw material	Lessen up to 5.71%
	Labor	Lessen up to 5.71%
	Margin	Improve up to 58.97%

19	Raw material	Lessen up to 40.14%
	Labor	Lessen up to 40.14%
	Margin	Improve up to 107.49%
20	Raw material	Lessen up to 47.64%
	Labor	Lessen up to 47.64%
	Margin	Improve up to 117.27%
21	Raw material	Lessen up to 32.28%
	Labor	Lessen up to 32.28%
	Margin	Improve up to 59.11%
22	Raw material	Lessen up to 11.10%
	Labor	Lessen up to 11.10%
	Margin	Improve up to 15.04%
24	Raw material	Lessen up to 41.63%
	Labor	Lessen up to 41.63%
	Margin	Improve up to 79.13%
25	Raw material	Lessen up to 12.53%
	Labor	Lessen up to 12.53%
	Margin	Improve up to 23.81%
30	Raw material	Lessen up to 43.46%
	Labor	Lessen up to 43.46%
	Margin	Improve up to 80.70%
31	Raw material	Lessen up to 24.26%
	Labor	Lessen up to 24.26%
	Margin	Improve up to 21.88%
32	Raw material	Lessen up to 22.24%
	Labor	Lessen up to 22.24%
	Margin	Improve up to 19.57%
33	Raw material	Lessen up to 36.30%
	Labor	Lessen up to 36.30%
	Margin	Improve up to 45.66%

34	Raw material	Lessen up to 25.65%
	Labor	Lessen up to 25.65%
	Margin	Improve up to 31.61%
35	Raw material	Lessen up to 6.82%
	Labor	Lessen up to 6.82%
	Margin	Improve up to 4.63%

In general, it is necessary for the businesses to decrease the raw material at 20.60% (Rp 2,830,678) and the labor at 21.29% (Rp 516,306) to achieve the efficiency level. The complete data were summarized in the table below.

Tabel 6. Input changes to production efficiently

	Raw material	Labor
Actual	30922920	4221378.57
Differences	-2830678	-516305.98
Optimal	28092242	3705072.59

5. CONCLUSIONS

Technically, there were 9 efficient small scale enterprise (25.71%) owned by female entrepreneurs in Bantul district, while 26 SSE (74.29%) were inefficient. Based on the return to scale there were 3 SSE in constant condition, 3 SSE in increasing condition and 29 SSE in decreasing condition. It was expected that the inefficient SSE could implement the recommendations given for better outcome. For further, it needs to know the effect of technology used by female entrepreneurs to technical efficiency.

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