

# EFFICIENCY PERFORMANCE TRENDS IN THE FOOD PROCESSING INDUSTRY IN TANZANIA.

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## ABSTRACT

**Aim:** This study aimed to examine the efficiency performance trends of food and beverage industries in Tanzania in terms of technical efficiency using a panel data of 40 selected industries over the period of 2018 to 2020.

**Material and Methods:** A longitudinal or panel design, which involved pooling cross-sectional and time series data, was utilized in this investigation. A stochastic frontier production model was applied using a linearized Translog production function to determine the performance elasticity coefficients of inputs and technical efficiency. The quantitative strategy was chosen by the researcher since it is both time and money efficient and requires less time for data collecting and processing.

**Results:** The results from estimations reveal that the overall technical efficiencies for selected food industry was 79.61%. However, the performance for food industries indicates ineffective performance with technical efficiency of 77.85%. This study concluded that an average of 22.15 percent technical potentiality were not achieved by the food in the period 2018 to 2020 respectively.

**Contribution to Policy Implication:** This study recommends the government should further investigate factors that slow down the growth of food industries. Such factors may include regulatory obstacles (external factors) and management systems (internal factors). Also, study suggests taking into account how well public and parastatal agriculture agencies are performing.

**Keyword:** *Efficiency, Input, Output, Production Changes*

## 1. INTRODUCTION

Tanzania is one of the brightest stars of the African growth miracle (Rodrik, 2014). The country had an average annual GDP growth of 5-7 percent since the turn of the century, an impressive track record that comes with a number of cautionary warnings (Kweka & Ugarte, 2013). First, the increase in GDP is less striking when adjusted to take into account rapid population growth (McMillan, 2014). Over the same period, per capita GDP growth has averaged just 2.5-3.5 percent per year, slightly higher than the sub-Saharan African average (Page J. , 2014). Second, despite its overall growth performance, Tanzania's economy has created fewer good jobs that can offer good earnings and work security. Third, despite Tanzania's tremendous economic

expansion, poverty is still dominant (Page J. , 2014).

A sector that has not played a significant role in Tanzania's success story is industry (UNIDO, 2018; UNIDO, 2012). Manufacturing, agro-industry, and tradable services which are among of components of industrial sector have the potential to absorb large numbers of modestly skilled workers, contribute to accelerated poverty reduction, and diversify the economy (Page. & Shimeles, 2015).

Recognizing of this potential, Tanzania has made considerable policy changes in the manufacturing sector since 1996 in order to establish a welcoming climate for both domestic and foreign direct investment (FDI) (URT & UNIDO, 2012). Following this, a number of foreign companies

including China, India, Turkey, and Japan are currently in the country exploring investment opportunities (URT & UNIDO, 2012)

Despite the fact that, the country has improved the investment policy and the huge potential that may accelerate the nation's industrialization process, the manufacturing sector is still underperforming (Tregenna, 2015). The industrial sector's performance has been unsatisfactory, with little contribution to GDP and employment creation (Muganda, 2004). Its contribution to GDP has remained at 10% which is still very low. In particular, the contribution of manufacturing sub-sector in the economy stayed stagnant (UNDP, 2015). Several structural barriers are preventing the sector's growth. The price of inputs is the main factor causing the slow growth of industrial sector in Tanzania (World Bank, 2013). Due to the high input costs, firms are forced to charge high prices for their goods, placing them in challenging competitive situations on both domestic and international markets (UNIDO, 2018). Other industry constraints include inconsistent electrical supply, a lack of management capacity, and a lack of operating capital (Aly, Moner-Girona, Szabo, Pedersen, & Jensen, 2019). The cumulative effect of these challenges has caused firms to underperform at their maximum production capacity (Terziovski, 2010).

Given this fact, this paper intended to assess the performance of Tanzania's manufacturing industry using a panel annual data set gathered from the management offices of the selected firms. The term performance in this study is defined as technical efficiency. The performance of firms determines the overall economic environment. For instance, there is a direct correlation between macroeconomic growth rates, unemployment, and living standards and company performance. To explain the overall performance of an economy must look at micro economic performance. Understanding the sector's potential, it is crucial to assess the performance of Tanzanian manufacturing. In particular, it is essential to evaluate industries' performance to see whether they are meeting the high expectations. Measuring a firm's efficiency is crucial since it helps to determine the causes of inefficiency and opens the door to additional research on how organizations may make the best use of their resources to increase efficiency. Given the levels of input, the efficiency measurements reveal the rate at which the

productive inputs are transformed into outputs as well as the desired output levels. Therefore, efficiency measures compare actual output levels to maximum potential production levels to indicate the level of efficiency of firms.

Despite African's manufacturing sectors' poor performance, it is thought that the continent has the potential to expand and become competitive on the world market (Ghani, Kanbur, & O'Connell, 2014). Recognizing of this potential, Tanzania has made considerable policy changes in the manufacturing sector since 1996 in order to establish welcoming climate of both domestic and foreign direct investment (FDI) (URT & UNIDO, 2012).

However, the country has improved the investment policy and the huge potential that may accelerate the Nation's industrialization process, manufacturing sector is still underperforming and largely, remain undiversified (Wangwe, et al., 2014). The industrial sectors performance has been unsatisfactory with little contribution to GDP and employment creation (Muganda, 2004). Its contribution has remained 10% which is still very low. In particular, the contribution of manufacturing sub-sector in the economy stayed stagnant (UNDP, 2015). Several structural barriers are preventing the sector's growth. The price of inputs is the main factor causing the slow growth of industrial sector in Tanzania (World Bank, 2013). Due to the high input costs, firms are forced to charge high prices for their goods, placing them in challenging competitive situations on both domestic and international markets (UNIDO, 2018). Other industry constraints include inconsistent electrical supply, a lack of management capacity, and a lack of operating capital (Aly, Moner-Girona, Szabo, Pedersen, & Jensen, 2019). The cumulative effect of these challenges has caused firms to underperform at their maximum production capacity (Terziovski, 2010).

Despite the importance of manufacturing industries to supporting economic growth in Tanzania, little attention has been made to consider the efficiency performance trends, therefore this study intended to examine the efficiency performance trends in the food processing industry for the period of 2018 to 2020. With focus on determining efficiency of capital factors, raw material, and labour force in the food processing industry for the period of 2018-2020.

## 2. LITERATURE REVIEW

### 2.1 Theoretical Framework Review

#### 2.1.1 Production Theory

Microeconomic theory called “Production theory” aims to explain the rules by which a business firm chooses how much of each good it will sell (its “output” or “products”) and how much of each type of labour, raw material, fixed capital item, etc. It will use (its “inputs” or factors of production”)

The production function shows the relationship as shown in Equation 2.1

$$Q = f(L_d, L, K, M, T, t) \dots \dots \dots 2.1$$

Where  $L_d$  = land and building;  $L$  = labor;  $K$  = capital;  $M$  =materials;  $T$  = technology; and,  $t$  = time.

The final processed foods and beverages are represented by  $Q$ , the output of the firm.  $R$  denotes the quantity of raw materials utilized in the manufacture of the  $Q$ , while  $L$  denotes the labor input (people and skills). Fresh produce from the agriculture industry serves as the industry’s primary source of raw materials.  $K$  is a symbol for the quantity of capital used in the production process, which could include stocks, real estate, equipment, and machinery (Varian, 1992).

A company strives to maximize profits by either producing more  $Q$  or doing so at a lower cost. The link between the number of things that can be produced technologically utilizing different combinations of labor, raw materials, and capital is given by the production function ( $K$ ). The additional output produced by using one more unit of that input while holding other inputs constant is known as the marginal productivity (also known as marginal physical product). given by the production function’s first derivative with respect to the input being studied.

$$\text{Marginal physical product of capital} = M_{p_k} = \frac{\partial q}{\partial k} = f_k \dots \dots \dots 2.2$$

$$\text{Marginal Physical Product of labor} = M_p = \frac{\partial q}{\partial l} = f_l \dots \dots \dots 2.3$$

### 2.2 Empirical Literature Review

Globally, there is a growing body of empirical research on the technical efficiency of the manufacturing sector in both developed and developing countries (for appraisals see Schmidt and Lovell, 1979; Musleh-Ud et al.,2007; Sudarin & Haung, 2013; Bhandari, 2016; Padmavathi N,2019). The empirical literature on the efficiency of the manufacturing sector focuses on developed countries and Asian economies, and a much smaller number relates to industrial performance in developing countries, especially in Africa.

Lundvall and Battese (2000) estimated a Translog production function for the Kenya manufacturing sector. Variables used were all output produced by the firm in a given year and input variables consisted of capital which was defined as the replacement cost of existing machinery and other equipment employed in the production process, multiplied by the degree of capacity utilization, wages which included the total wage bill including all allowances for the firm in one year. This study reported average technical efficiencies of 77 percent, 80 percent, 76 percent and 68 percent for the food, metal, textile and wood subsectors respectively.

Ngui and Muniu (2012) empirically investigated technical efficiency of firms in the Kenyan manufacturing food, metal and textile sub-sectors using data covering two periods: 1992/1993 - 1994/1995, and 2000/2001 - 2002/2003. The results showed that the technical efficiency point varied among the sampled firms in each period. The average technical efficiency of 52 percent, 58 percent, and 60 percent for the food, metal and textile sub-sectors, respectively, imply that nearly 48 percent, 42 percent, and 40 percent technical potentialities were not achieved in the 1992/1993 -1994/1995 period. On the other hand, the average technical efficiency of 48 percent, 42 percent, and 68 percent for the food, metal and textile sub-sectors, respectively, imply that nearly 52 percent, 58 percent, and 32 percent technical potentialities were not achieved in the 2000/2001 - 2002/2003 periods.

Harron and Chelakumar (2012) determined the efficiency performance of Kenya manufacturing companies over the period of 2009 to 2011. Three critical inputs variables (raw materials, staff expenses and plant and machinery) and two output variables (net sale and earnings after tax) were used to evaluate the relative efficiency of 30 manufacturing companies in Kenya. The results indicated that small-sized company has the highest relative efficiency compared to medium-sized and large size company. In addition, the study finds that 1 large-sized company, 2 medium-sized companies and 3 small-sized companies operate under the most productive scale size throughout the three-year period.

Essmui, Berma, Shahadan, Ramlee (2013) examined the performance of manufacturing firms in Libya. Specifically, their study aim into evaluating firm level technical efficiency. The study used an econometric approach based on a stochastic frontier production function to analyze 207 firms from survey conducted from March to May 2013. The results from estimations revealed that technical efficiencies of Libyan manufacturing firms ranging from 37.77 percent

to 95.27 percent, with an average of 71.27 percent. While, the percent of firms that considered technically efficient is only 17.87 percent of the total firms.

Ndicu (2015) examined the efficiency analysis of the agro-processing industry and analyzed the trend in efficiency changes during the period under consideration. Panel data covering three years (2011, 2012, and 2013) for 41 firms in the agro-processing industry was collected from the Ministry of industrialization, Kenya Daily Board, Kenya Sugar Board, KTDA, KNBS and EPZ departments for the said periods. Econometric production frontiers were estimated for the agro-processing industry in each period. The findings showed that the agro-processing industry had an overall efficiency score of 44 percent. The efficiency score was distributed as 53 percent, 60 percent and 57 percent for the food, beverage, and non-food subsectors. The study findings reveled that an average 56 percent technical potentiality was not achieved by the agro-processing industry in the period 2011, 2012 and 2013.

**Conceptual Framework**

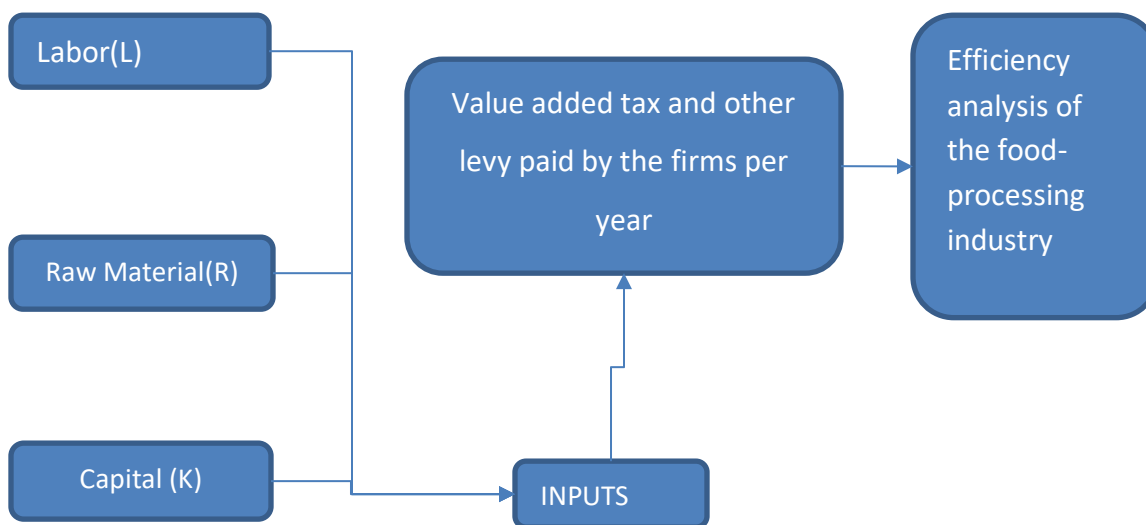


Figure 1: Conceptual Framework

**3. RESEARCH METHODOLOGY**

The main research approach used was quantitative, by featuring a longitudinal or panel research design, which involved pooling cross-sectional and time series data. A total of 40

industries were chosen at random from the 60 foods and beverage industries; where secondary data were collected based on their market participation and food processing strategy. The analyses were carried out in accordance with the study's goals. First, the SFA technique was used

to calculate the performance levels of the various companies. Second, using the SFA approach's data, the trend of enterprise performance levels was established during the study time. Finally, the performance levels within the subsector were looked at. The third step was to test the premise of these studies.

### 3. RESULTS ANALYSIS and DISCUSSION

#### 3.1 Descriptive Analysis of Results

With consideration of the industry diversity under the study, it is important to first examine the characteristics of the sample through the statistical features of the dataset such as mean, median and standard deviation. Table 1 provides the descriptive statistics of all the variables employed in this study, these statistics reinforce the heterogeneity of the food and beverages industries in Tanzania.

**Table 1: Descriptive Statistics from Sample Data**

Year	Unit	Gross Value	Capital	Raw materials	Labor
2018	Mean	2,155,806,000	1,407,197,000	1,742,334,000	509,715,200
	Std.Dev	2,189,375,000	1,590,776,000	1,743,326,000	665,237,700
	Min	397,923,900	124,827,400	302,512,700	34,038,630
	Max	9,321,582,000	6,615,824,000	7,437,830,000	3,355,812,000
2019	Mean	2,639,654,000	1,581,447,000	2,007,219,000	638,114,400
	Std.Dev	2,488,182,000	1,794,383,000	1,823,136,000	921,163,600
	Min	407,012,800	141,872,000	332,918,300	46,028,540
	Max	10,866,920,000	7,538,977,000	7,759,401,000	4,591,567,000
2020	Mean	3,281,296,000	1,795,458,000	2,391,651,000	753,931,600
	Std.Dev	2,739,146,000	2,145,205,000	2,158,199,000	1,101,179,000
	Min	630,341,200	143,028,800	340,624,100	54,983,210
	Max	11,658,920,000	8,649,036,000	8,991,891,000	5,000,427,000

From the descriptive statistics in table 1, it can be seen that some of the variables have higher standard deviations than mean. This is not surprising considering the heterogeneity of the industries under study, which range from inputs variables with the smallest capital investment of 124,827,400Tsh to the largest capital of 6,615,824,000 Tsh in 2018. The higher standard deviation which caused by the variability in capital investment was also seen in the study year of 2019 and 2020. Similar to capital, the other explanatory variables such as raw materials and labor show large variability due to different levels or size of the industries under study. Large

variation is also found for gross value as the dependent variable, with the standard deviation larger than the mean.

#### 3.2 Classical Assumption Test Results

Classical assumption test is conducted in conjunction with the process of regression that measures taken in the classical assumption test using the same working step by regression. There are four assumption tests that must be done on the regression model; multicollinearity, heteroscedasticity, and normality.

**Multicollinearity Test;** Based on the output of results in Table 2, shows that there is no

multicollinearity among the input variables (capital, raw materials, and labor) in regression for the value of VIF > 10. Following this multicollinearity result it is evidence that, all the explanatory variables are found to be not correlated hence MLE gave unbiased and consistent results.

**Heteroscedasticity test:** From Table 2 shows that the p-value is greater than 5% level of significance. Thus, there the null hypothesis is not rejected which imply that there is no heteroscedasticity problem on data.

**Normality test;** From Table 2 shows that the p-value is greater than 5% level of significance. Thus there the null hypothesis is not rejected which imply that the data are normally distributed.

**Production Frontier Estimates;** From table 2 the Cobb-Douglas function is rejected therefore trans-log model is chosen based on the LR value of 5.15 which is greater than the critical value of 0.35 based on a Chi-square distribution table, tested at 5% level of significant.

**Table 2; Assumption Test Results**

<b>Multicollinearity Test</b>	Input Variable	VIF	Tolerance (1/VIF)	
	Log(Capital)	3.09	0.323264	
	Log(Raw materials)	2.65	0.377107	
	Log(Labor)	2.49	0.402413	
<b>Heteroscedasticity test:</b>	Hypothesis	Test Statistics	P-Value	
	Ho: Constant variance	chi2(1) = 2.78	Prob > chi2 = 0.0954	
<b>Normality test;</b>	Hypothesis	JB test statistic	P-Value	
	Ho: normality	4.305	0.1162	
<b>Production Frontier Estimates;</b>	Null Hypotheses	Test Statistics	Critical value	Decision
	$H_0 = \beta_1 = \beta_2 = \beta_3 = 0$ (Cobb-Douglas function)	LR = 5.15	0.35	Reject

**3.3 Pairwise Correlation**

The objective of this step is to determine if there are variables that are highly correlated as this makes the regression parameters less precise Gujarati (2003), this problem is known as multicollinearity. In practice, correlation among explanatory variables is a common occurrence, particularly for macroeconomic variables. However, in the presence of high correlation or severe multicollinearity among regressors, a few problems may arise. First, high multicollinearity

results in large variance and standard errors, which make the regression coefficients imprecise Gujarati (2003), and second, high multicollinearity makes it difficult for regression to assess the individual impact of an explanatory variable on the dependent variable (Studenmund, 2011). Therefore, before proceeding to the regression analysis, it is necessary to examine the correlation among the independent variables. Pairwise correlation is employed, and the result is presented in Table 3

**Table 3. Correlation Matrix, 2018 to 2020**

Variable	Gross Value	Capital	Raw materials	Labor
Gross Value	1			
Capital	0.7137	1		
Raw materials	0.8533	0.7532	1	
Labor	0.6521	0.5550	0.7592	1

The positive correlation between the inputs and output variables as shown in table 3 indicate that, as the industry increase inputs (capital, raw

materials, and workers' salary in production), the output (gross value) increases as well. Value of pairwise correlation higher than 0.8 (in absolute

value) as an indication of high multicollinearity. Following this rule of thumb, all the explanatory variables are found to be not highly correlated hence MLE gave unbiased and consistent results.

### 3.4 The Maximum-Likelihood Estimates of Parameters of the Translog Stochastic Frontier Production Function

The ordinary least square estimates of the parameters are used as initial values (to estimate) for the maximum-likelihood estimates of the parameters. The adjusted R-squared for the ordinary least square estimates is 0.87, which indicates that 87 percent total variation of the output is explained by the input variables. Tables 4 show the estimation results of the Translog production function on the basis of the stochastic frontier model.

**Table 4; OLS and MLE estimates of Translog Stochastic Production Frontier Model**

Variables	Parameters	Estimated OLS Coefficients	P-Value	Estimated MLE Coefficients	P -Value
Constant	$\beta_0$	1.513064	0.000	1.9347	0.000
logcapital	$\beta_1$	0.0573	0.163	0.0661	<b>0.071</b>
lograwmaterials	$\beta_2$	0.7014	0.000	0.6809	0.000
loglabor	$\beta_3$	0.0995	0.005	0.08984	0.007
Variance parameters					
Sigma - squared	$\sigma_s^2$			0.1457	
Log likelihood function				--7.414	

The result in table 4 shows that, the value of log likelihood function for OLS and MLE allow to test whether technical inefficiency exists or not. In case technical inefficiency does not exist then technically there will be no difference in the parameters of OLS and MLE. From the analysis what we have observed that the coefficients of raw material) and labor are statistically significant. These results indicate that these input variables significantly affect the gross value of food and beverage industries in Tanzania. Reasonably enough, for a capital, has the positive output elasticity and is found to be insignificant in the gross value revenue. This implies that capital does not affect the gross value of the food industries in Tanzania significantly.

From the MLE analysis what we have observed independently that all the variables except capital are significant in affecting the gross value of food and beverage industries in Tanzania. It implies that capital does not affect the gross value of the selected industries. We observe that the variable

labor and raw materials shows significant affect for both OLS and MLE estimation of the Translog production function.

The MLE provide estimates of the variance parameters sigma – squared ( $\sigma^2$ ) and gamma ( $\gamma$ ). The first variance parameter ( $\sigma^2$ ) determines whether there is technical inefficiency or not. If  $\sigma^2$  is equal to zero, all firms are fully efficient. If  $\sigma^2$  is larger than zero, then all firms are not fully efficient. Table 5 shows that the value of  $\sigma^2$  is 0.3729, indicating that all firms in the sample are not fully efficient. The second variance parameter,  $\gamma$ , determines whether all deviations from the frontier are due to random error or technical inefficiency. If  $\gamma$  is equal to zero then all deviations from the frontier are caused by random error. If  $\gamma$  is equal to one, then all deviations from the frontier are caused by technical inefficiency. Gamma ( $\gamma$ ) is estimated at 0.4150 that imply over 41.5 percent of the total variation from the frontier is due to technical inefficiency. The result also

reveals that technical efficiency (TE) of the sector is equal to 60 percent.

On average, this sector produces 60 per cent of the total gross value output. This further suggests that sector needs to increase their gross value output by 40 per cent to attain the optimal efficiency level.

### 4.3.2.2 The efficiency performance of food and beverage industries in Tanzania for the time period 2018 to 2020

The efficiency of industries' gross value is depicted in the Table 5.

**Table 5 The efficiency estimates for food and beverage industries in Tanzania**

Subsector	Year	Efficiency estimate
Food	2018	0.8051
	2019	0.7557
	2020	0.7746
<b>Mean</b>		<b>0.7785</b>

From the analysis it is observed that for gross value, the overall mean technical efficiency of Tanzania food industries during the period 2018 to 2020 is found to be 0.7785 and the technical efficiencies ranges from a minimum of 0.7557 to a maximum of 0.8051 for the selected food industries in Tanzania. This implies that the gross value of 77.8% has been achieved by the selected industries in Tanzania. In the present study none of the food industries had achieved

100% level efficiency for gross value. The findings also suggest that 20% technical inefficiency exists. There is wide variation in the technical efficiencies among the selected industries.

In addition, Table 6 lists the ranking of subsectors generated by ordering the subsectors according to the average efficiency levels of the period 2018 - 2020

**Table 6 Subsectors Rankings by Average Efficiency Scores, and Minimum and Maximum Efficiency Score by Subsectors and by Year**

By Subsector					By Year		
Subsector	Minimum	Maximum	Average	Rank	Year	Minimum	Maximum
Food	0.7557	0.8051	0.7785	2	2018	0.776	0.8051
					2019	0.7557	0.7634
					2020	0.7746	0.9013

On the whole, table 6 shows the beverage subsectors are more efficient than the food subsectors. Efficiency scores for beverage subsector were ranked the first in efficiency performance. Food subsector was found to be the second behind beverage subsector in generating industries gross value.

## 4. CONCLUSION AND RECOMMENDATIONS

The general performance level based on the average technical efficiency level for the food and beverage industries was 79.61%. This result indicates the underperformance of the Tanzania's food industries because the average of 20.39% of the technical potentialities of food

processing industries was not achieved for the period 2018-2020. The results supported with several literature such as Sheperd & DeTienne, (2005) assessed trends in job creation and found that government should focus considerably more on encouraging the development of agro-processing businesses because they are crucial for generating income and creating jobs in emerging agricultural economies. Other writers, such as (Pierre, et. al., 2009), examined the performance of labor productivity in places with electricity, while the growth of firms was analyzed by Mathur and Gill (2011); Kinda and Loening (2010); Mohnen and Nasev (2006).

The underperformance of food industries has caused inefficiency to succeed in the sector, the main problem cited by firms as contributing to them are a lack of raw materials and capital, therefore, any policy reforms should address the underlying factors contributing to the underutilization of each firm's production capacity. In addition, efficiency variation may also be explained by such other factors as the use of obsolete technologies, poor product design, lack of management skills, lack of exposure to international markets, and the production of non-competitive products. Firms need to adjust to the changing environment, for example, by investing in training workers so that they can acquire necessary management skills. Also, the firm should use more funds to invest in new production technologies. In addition, the role of the government in providing advisory support regarding training, market information, and technology choice is also recommended. Also, the study recommended for the government to further investigate factors that slow down the growth of food industries. Such factors may include regulatory obstacles (external factors) and management systems (internal factors).

Furthermore, the effectiveness of autonomous agriculture firms is one area that needs more study. Two, taking into account how well public and parastatal agriculture agencies are performing.

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