Technical Efficiency and Productivity changes in Tea Manufacturing Companies: A Case Study of Mufindi Tea and Coffee Limited in Tanzania

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Abstract

This research study aims at examining technical efficiency and productivity changes of Mufindi Tea and Coffee Ltd (MTC) in Tanzania. The study employed Data envelopment analysis and Malmuquist total productivity index to examine efficiency and productivity changes respectively.

The results show that MTC tea estates were technically inefficient, although the efficiency changes show some positive improvement. Most of the changes in total factor productivity were the results in improvement in scale efficiency while the inefficiencies observed in technical efficiency were contributed by operating at inappropriate scales among the estates.

From the study findings, it is recommended that MTC should use advanced technologies in order to reduce operating costs and increase productivity and efficiency. The company is currently labor intensive in all activities, it is recommended that the company should invest in machines in activities which does not necessarily require labor in order to improve efficiency

Introductio

Tea is among key export products in different countries around the world contributing to the economic growth of the countries as well as well-being of individuals involved in each stage of the production process. The importance of Tea product is not only due to the fact that it has reliable market but also it involves many stakeholders from cultivation to processing hence increasing employment rate for the society nearby tea companies, increase income as well as contributing to infrastructure development in the area (Gupta & Dey 2010, Ganewatta, & Edwards, 2002). The fact that tea sector is labor intensive in most countries, it generates many employment opportunities from the stage of cultivation to the processing stage which in turn increases the income level in the societies hence contributing to poverty alleviation especially in developing countries. Tea cultivation and processing also contributes to economic growth as it is an export product which increase foreign exchange earnings, increase government revenues through taxes collected and also facilitate society's developments through social responsibility activities conducted by tea cultivation and manufacturing companies in different areas

Regardless of the importance of tea product as among key export product in different countries, tea cultivation and processing have been facing many challenges as a result of low productivity and high production and operational costs in many tea cultivating and manufacturing companies which affect their performance. Different studies on tea cultivation and processing have reported several problems relating to the efficiency, productivity and performance of the companies engaging in this line of business. Studies have reported a persisting decrease in productivity and a continuous increase in production costs in tea manufacturing companies on one side while on the other side the product has been losing its market share with a fall in in export prices. The fall in efficiency and productivity among tea manufacturing companies has been intense in the last decade to the extent that jeopardize its sustainability in some countries like Bangladesh and India, which are suspected to start importation of the tea if feasible strategies to overcome increased cost, low productivity, efficiency and performance of the companies are not implemented (Baten et al, 2010, Gupta & Dey, 2010).

In Tanzania, tea is among important export product which contribute to the economic growth and social welfare of the people in tea growing areas. Being the fourth largest grower in Africa, Tanzania tea growing involves about 30,000 smallholder farmers employing more than 10,000 people in private estates farms. Like in all other

tea manufacturing countries, Tanzania has been experiencing declining tea production due to different reasons. According to the Tanzania tea board, tea production in Tanzania declined by 25.1% in July to September 2013 and was expected to continue dropping in the future, which jeopardizes the Tanzania position in tea manufacturer rankings. The dropping in tea production in Tanzania resulted into declining in export by 12.2% in 2013, declining on labor employed in the industry by 3.5% in 2013 which was contributed by the poor performance of tea manufacturing companies (TTB, 2013). Regardless of such declining in tea production and export which affect country economic growth as well as welfare of the societies, especially in areas in which tea cultivation is the key economic activities, little have been done to understand the key causes and hence suggest a possible solution to the problems. Studies on smallholder tea production in Tanzania have concentrated on the challenges facing the farmers, tea value chain, and profitability (Nyanga et al, 2000, Baffes, 2003, Loconto & Simbua, 2010). Such studies have not addressed issues of efficiency and productivity in tea manufacturing companies and the factors that contribute to that. This study, therefore examines efficiency and productivity changes of "Mufindi Tea and Coffee Ltd" a company located in Iringa region in Tanzania.

Literature Review

Efficiency and productivity in tea manufacturing companies is very important since this sector is labor intensive, which required human capital in most of its processing stages. Tea manufacturing deals with land cultivation, farming, processing and manufacturing of tea, which are finally braded and packed ready for export and local consumption. Efficiency in general terms is the measure of resources used to achieve stated goals (Fraser, 1994) which can also be defined as the performing of tasks with reasonable efforts.

Previous studies in tea manufacturing companies have reported mixed findings, especially on efficiency and productivity of the companies. In India, Gupta and Dey (2010) measured productivity performance of the Rosekandy tea estate and reported poor resource utilization was the major reason for declining productivity. Likewise, Ananta and Ajoy (2015) examined productivity of the black tea industry in the Upper Assam district in India. The study findings revealed the total factor productivity increase with inputs increases, but the output did not increase proportionately. In Kenya, Kiprono, (2013) examined the economic efficiency of the use of resources among tea smallholder producers in Kericho and Kiambu. The study reported that land and plucking labor had significant influence on economic efficiency of the firms and tea acre-age had a significant negative impact to economic efficiency.

Evidences on efficiency and productivity of other agricultural processing firms also have reported different findings. Kibirige, (2008) examined the impact of the agricultural productivity enhancement program on the allocative and technical efficiency of maize farmers. The results show that most of the farmers were technically inefficient in Masandi district. On Coffee product, Thong, (2014) assessed factors affecting technical efficiency among small holder coffee farmers in Vietnam. The study revealed that, formal education of the household, ethnicity, level of financial credit received, experience and presence of extension services were the important factors for technical efficiency in coffee production. In Nigeria, Audu et al, (2013) examined cost efficiency of small scale cassava production in Kogi Estate. The study findings reported that both age of the farmer, education, experience, household size, access to credit, extension services and membership of farmers significantly positively affect cost efficiency.

Methodology

Research Area: The study was conducted at Mufindi Tea and Coffee Limited (MTC) located in Iringa region in Tanzania. MTC is among the companies in Tanzania dealing with the production of tea and coffee where by it contributes to the total production of tea from the southern zone by more than 70% annually. MTC owns four tea estates named Itona, Idetero, Stone valley and Maganga and also owns one tea processing factory named Itona Factory. The company has several departments categorized as finance department, stores department, engineering department and operations department.

Data Analysis: The study employed data envelopment analysis and Malmquist total productivity index in assessing the efficiency and productivity changes of Mufindi Tea and Coffee Ltd respectively.
Technical Efficiency- This was measured using DEA input oriented BCC model which be presented as;

$$MinTE = \delta_o - \rho\left(\sum_{i=1}^{m} S_i^{-} + \sum_{r=1}^{s} S_r^{+}\right) \quad (1)$$

$$SubjectTo = \sum_{j=1}^{n} v_{ij}\lambda_j + S_i^{-} = \delta x_{io} \quad (2)$$

$$\sum y_{rj}\lambda_j - S_r^{+} = y_{ro} \quad (3)$$

$$\lambda_j, S_r^{+}, S_i^{-} \geq 0, i = 1....., m, j = 1....., n, r = 1....., s$$

Where: TE is the technical efficiency ratio of the tea estate, m is the number of inputs variables, s is the number of output variables, n is the of number of estates, X_{io} and y_{ro} are values of input i and output r for Estates. *p* is a non-Archimedean quantity which is smaller than any positive real number, δo is the proportion of tea estate input which is needed to produce a quantity of output equivalent to the best performer tea estate **λ**j, Si^{-} and Sr^{+} are input and output slack variables respectively, **λ**j is a (nx1) column vector of constants indicating benchmarked tea estate.

Productivity Changes- The Malmquist productivity index was used to calculate the productivity change for a given time and decompose the change into two parts, the technological change and the technical efficiency change. In order to use Data envelopment analysis (DEA) to estimate Malmquist distance function, we use DEA equation by Coelli (2005) to estimate the Malmquist productivity index as,

$$\left[d^{t}(x_t, y_t)\right]^{-1} = Max_{\theta\lambda}\theta$$
$$Subject: to = -\theta y_{it} + Y_t\lambda \geq 0 \text{ ----------} (1)$$
$$x_{it} - X_t\lambda \geq 0$$
$$\lambda \geq 0(CCR), \lambda = 1(VRS)$$
$$\left[d^{t+1}(x_{t+1}, y_{t+1})\right]^{-1} = Max_{\theta\lambda}\theta$$
$$Subject: to = -\theta y_{it+1} + Y_{t+1}\lambda \geq 0 \text{ ----------} (2)$$
$$x_{it+1} - X_{t+1}\lambda \geq 0$$
$$\lambda \geq 0(CCR), \lambda = 1(VRS)$$
$$\left[d^{t}(x_{t+1}, y_{t+1})\right]^{-1} = Max_{\theta\lambda}\theta$$
$$Subject: to = -\theta y_{it+1} + Y_t\lambda \geq 0 \text{ ----------} (3)$$
$$x_{it+1} - X_t\lambda \geq 0$$
$$\lambda \geq 0$$
$$\left[d^{t+1}(x_t, y_t)\right]^{-1} = Max_{\theta\lambda}\theta$$
$$Subject: to = -\theta y_{it} + Y_{t+1}\lambda \geq 0 \text{ ----------} (4)$$
$$x_{it} - X_{t+1}\lambda \geq 0$$
$$\lambda \geq 0$$

Where, θ is a scalar and λ is a NX1 vector constant, x and y are values of inputs and outputs for each tea estate, t is the time period. The models estimate Malmquist productivity index under a constant return to scale, in order to estimate the index under variable return to scale we change λ restriction on equation 9 and 10 to $\lambda = 1$.

Study Variables and Data: In assessing efficiency and productivity changes, the study employed weeding, pruning and fertilizing costs, irrigation costs and tractor costs as the input variables and tea output as the output variable. Data was collected for the four tea estates under MTC for nine periods to 2015.

Results and discussion

Results on technical efficiency show an average of 76.5% indicating that MTC does not operate at its technical frontier line, hence the company has a chance of decreasing inputs by 23.5% while maintaining the same level of output. The results on pure technical efficiency indicated that the company does not operate in its most efficiency scale due to inefficiency of about 20.5%, this was also supported by the results of scale efficiency which was on average higher that the results on pure technical efficiency.

For individual Estates, Maganga estate was found to be more efficient than other three estates and in all cases the scale efficiency was found to be higher than pure technical efficiency, suggesting that the source of inefficiency was purely related to firms not operating in their optimal scales.

Table 1: Technical Efficiency Results

EFFICIENCY			
ESTATES	Technical Efficiency	Pure Technical Efficiency	Scale Efficiency
ITONA	0.732	0.756	0.968
IDETERO	0.681	0.712	0.950
STONE VALLEY	0.648	0.711	0.918
MAGANGA	1	1	1
AVERAGE	0.765	0.795	0.959

Technical inefficiency results observed in the MTC and its estates support some previous studies in the agricultural industry. Study by Thong et al, (2014) report inefficiency among small holder coffee farmers with about 25% average inefficiency in the DarLak Province. Kibirige (2008) in Uganda also reported high inefficiency among maize farmers in terms of both technical and allocative efficiency. Likewise, Kiprono (2013), also reported low economic efficiency smallholder producers.

Productivity changes of MTC estates were assessed using Malmquist total productivity index. The results show that on average all estates experienced technical efficiency growth, as all the average scores were above 1. This implies the presence of technological advancement among in the company and its individual estates.

The results on pure technical efficiency also show improvement on average for the four estates of about 6%, 42.1%, 0% and 1.3% for Itona, Idetero, Stone Valley and Maganga respectively. Likewise, the results on total factor productivity also indicate positive change on average for the nine periods. The results show an average increase in total productivity of 34.7% for Itona, 20.6% for Idetero, 36.2% for Stone Valley and 32.9% for Maganga estates. Most of the changes in total factor productivity and technical efficiency were found to be contributed by scale efficiency, since on average the scale efficiency was found to be higher than pure technical efficiency.

Table 2 Summary of Malmquist Total Productivity Results

ESTATES		PRODUCTIVITY CHANGE								
		2	3	4	5	6	7	8	9	AVERAGE
	TEC	1.000	0.908	1.101	0.883	1.132	1.000	0.258	2.199	1.060
	TC	0.524	0.447	4.156	0.643	1.531	0.610	1.586	0.887	1.298
	PTEC	1.000	1.000	1.000	0.958	1.044	1.000	0.808	1.238	1.006
	SE	1.000	0.908	1.101	0.922	1.084	1.000	0.320	1.776	1.014
ITONA	TFPC	0.524	0.406	4.577	0.568	1.733	0.610	0.410	1.949	1.347
	TEC	1.000	0.870	0.656	0.427	0.623	0.731	1.049	3.695	1.131
	TC	0.304	1.783	1.509	0.641	1.526	0.703	1.550	0.931	1.118
	PTEC	1.000	1.000	0.606	1.651	1.000	0.111	3.000	3.000	1.421
	SE	1.000	0.870	1.083	0.259	0.623	6.581	0.350	1.232	1.500
IDETERO	TFPC	0.304	1.551	0.990	0.274	0.950	0.514	1.625	3.442	1.206
	TEC	1.000	1.000	1.000	1.000	1.000	0.916	1.092	1.000	1.001
	TC	1.163	2.868	0.655	0.601	0.679	0.954	2.419	1.419	1.345
	PTEC	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	SE	1.000	1.000	1.000	1.000	1.000	0.916	1.092	1.000	1.001
S.VALLEY	TFPC	1.163	2.868	0.655	0.601	0.679	0.873	2.641	1.419	1.362
	TEC	0.859	1.164	1.000	1.000	0.657	1.523	1.000	1.000	1.025
	TC	0.300	1.895	1.000	1.000	0.000	1.391	2.832	1.218	1.205
	PTEC	0.896	1.116	1.000	1.000	0.743	1.345	1.000	1.000	1.013
	SE	0.960	1.042	1.000	1.000	0.883	1.132	1.000	1.000	1.002
MAGANGA	TFPC	0.258	2.206	1.000	1.000	0.000	2.118	2.832	1.218	1.329

The results of this study were contrary to the results reported by Gupta &Dey, (2010) on tea industry, which reported declines productivity in labor productivity and material productivity although total factor productivity was found to increase for the period. Among the causes of the differences between this study and Gupta study is the use of different input and output indicators, this study used wedding, pruning and fertilizer costs, irrigation costs and Tractor costs as inputs while a study by Gupta used labor costs, material costs, capital costs, energy cost and subsidized ration costs. On the other hand, a study by Ananta & Ajoy (2015) on tea estates, observed a mixed trend on productivity changes for the period reviewed. These findings also support our results as we observe a mixed trend on both technical efficiency changes and total factor productivity changes for the nine periods under review.

Conclusion and Recommendations

MTC tea estates were found to be technically inefficient, although the efficiency changes show some positive improvement for the nine periods reviewed. It was also found that the company as well as individual estates has positive average changes in total factor productivity for the period reviewed. Most of the changes in total factor productivity were the results in improvement in scale efficiency while the inefficiencies observed in technical efficiency were contributed by operation at inappropriate scales among the estates.

From the study findings, it is recommended that MTC should use advanced technologies in order to reduce operating costs and increase productivity and efficiency. The company is currently labor intensive in all activities, it is recommended that the company should invest in machines in activities which does not necessarily require labor in order to improve efficiency.

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