INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN ACCOUNTING, FINANCE AND MANAGEMENT SCIENCES

OPEN ACCESS JOURNAL

Vol 13, Issue 3, (2023) E-ISSN: 2225-8329

Technological Innovation and Financial Performance of Small-Scale Tea Industry in Kenya

Vicky Obanyi Mobegi, Tabitha Nasieku, Samuel Obino Mokaya, Bichanga Walter Okibo

To Link this Article: http://dx.doi.org/10.6007/IJARAFMS/v13-i3/18616 DOI:10.6007/IJARAFMS/v13-i3/18616

Received: *18* July *2023, **Revised:** 21* August 2023*, **Accepted:** 09* September 2023

Published Online: *24* September 2023

In-Text Citation: (Mobegi et al., 2023)

To Cite this Article: Mobegi, V. O., Nasieku, T., Mokaya, S. O., & Okibo, B. W. (2023). Technological Innovation and Financial Performance of Small-Scale Tea Industry in Kenya. *International Journal of Academic Research in Accounting Finance and Management Sciences*, *13*(3), 130–155.

Technological Innovation and Financial Performance of Small-Scale Tea Industry in Kenya

Vicky Obanyi Mobegi, Tabitha Nasieku, Samuel Obino Mokaya, Bichanga Walter Okibo
Jomo Kenyatta University of Agriculture and Technology.

Abstract
The Agricultural sector in Kenya has been facing the challenge of increased costs as a result of outdated technology. In an attempt to reduce its costs, the tea sector has invested heavily in technology. The purpose of this study was to establish the effect of technological innovation investment on financial performance of small-scale tea industry in Kenya. The study variable was investment on fermentation innovation on the financial performance of small-scale tea firms in Kenya. This study was anchored on; Schumpeterian Theory on Innovations, Efficiency Theory, Technology Acceptance Model and Theory of Innovation Diffusion. The targeted population was 66 small scale tea factories. Secondary data for a period of 5 years was used for analysis using a panel regression model. Person correlation results indicated that investment on investment technological innovations, are positively and significantly associated with financial performance of small-scale tea industry. Innovations affect the financial performance of small-scale tea firms. The study recommends the management can consider acquiring more fermentation machinery and modern machinery that can be cost effective.
Keywords: Profits, Investment, Technology, Small-Scale Tea Farmers.

Introduction
The financial performance of the tea sectors in the country can be expressed in terms of financial and non-financial metrics. In financial performances, it focuses on the analysis of the economic indicators such as the profits; return on investments (ROI) and return on assets (ROA) as supported by (Agrawal et al., 2019). Innovation is the introduction of modern technology in production and other business activities in a firm (llinson *et al.,* 2013). Innovation is essential to firms in expanding its market share. Technological innovation is a necessary ingredient for improved yields in agricultural sector (Ahmed & Shepherd, 2010). Technological innovation is the use of new thoughts, logical expertise and innovative practices to create produce and market new or improved merchandise or benefits to improve the effectiveness of an administration. The technological innovation in agribusiness for example, agrarian biotechnology, apparatus and hereditarily created plants benefits to ranchers by boosting ranch generation.
Innovation development in tea cultivation prompts expansion income and limited work Investment (Ongonga & Ochieng, 2013). Countries that have accepted the introduction of the modern technology in the operation of farm activities have improved performance of production and the market share has increased to compete both locally and internationally such as China and Singapore (Zheng & Wang, 2011). Several technological innovations have been introduced in the tea sector and include plucking machines, weighing machines,

fermentation units, payment and credit access application systems, communication platforms, digital marketing innovations, storage (Matazarre, 2015; Takano & Kanama, 2019). In the tea subsector, for example, such technologies would perhaps include development of improved high quality clones, cost-effective methods of vegetative propagation of tea cuttings, innovative field management practices such as methods of bringing tea into bearing, plant protection, and effective fertilizer use (Monroy *et al.,* 2012). In the context of this study, some of the innovative technologies being employed in the Kenyan tea sector include fermentation technological innovation, pruning technological innovation, weighing technological innovation and information systems technological innovation. These technological innovations form the basis of this study as study objectives.

Statement of the Problem

The Tea industry continues to suffer due to heavy production costs and the net returns to the farmers are low and unsustainable in Kenya. Other global countries like China and Sri Lanka who are competing with Kenya in the tea market have embraced mechanization, which is perceived as a natural process of economic development (Wanjira et al., 2016). Tea is one of the top foreign exchange earners in Kenya alongside horticulture, coffee and tourism. The management of most tea processing firms in Kenya is done by KTDA. KTDA manages 66 tea processing firms serving more than 500,000 small scale farmers in Kenya. KTDA members produce 60% of the tea in Kenya while large scale farmers produce the rest (KTDA, 2016).

The tea sector in Kenya is the second leading foreign exchange earner and the most important agricultural sub-sector contributing twenty six percent of the total foreign exchange earnings (KTDA, 2018). Due to this contribution to the economy, the Kenyan government listed the tea sector as one of the pillars of achieving the government's Vision 2030. More than 70 countries purchase Kenyan tea (Yegon et al., 2022). Kenya's economy produces 11% of the sum aggregate of the world's production of tea and remarkably commands a 23% of world's exports of tea beyond the borders of producing countries. Kenya's tea sector accounts for up to 15% of the GDP from agriculture, which is equal to approximately 5% of GDP of Kenya's economy (KNBS, 2017). An approximately 4 million populations of Kenyan (approximately 11% of the aggregate population) earn their living from the production of tea. Presently, tea is ranked as second in Kenya's foreign exchange earners just after tourism, accounting for approximately 27% of the aggregate earnings from foreign exchange. In Kenya, tea manufacturing and growing takes place in rural areas, therefore accounting for the rural infrastructural development, at the same time boosting the well-being of the rural community's economy (Yegon et al., 2021).

The vibrant industry is characterized by two sectors that have different ownership structures: estate plantations (owned by multinationals tea firms) established in the early 1920s with production units larger than 20 ha, and smallholders (KTDA Managed tea firms) established after independence in 1964 with smaller units averaging only 0.25 ha per farmer. Smallholders continue to dominate tea production in Kenya. Small-scale production accounts for 65 % of area and about 62 % of production (Jared & Albert, 2017). However, according to Korir (2022), the average yield per hectare is higher in large estates than smallholder farms largely due to better use of technology, inputs, and economies of scale. While yields in the estates have declined/stagnated in the last decade, smallholder yields have continued to rise overtime. Although the tea industry plays a significant role in the Kenyan economy, the performance of the tea processing firms over the years has not been satisfactory to the farmers due to poor returns and wide variation of bonus payment from one firm to another.

As such, tea producing firms seek to introduce technological innovations with the aim of reaping benefits associated with some perceived benefits to be reaped with the introduction of technological innovations in the tea sector including increased tea production and reduced cost of production. However, technology comes at a heavy cost. There are other additional costs associated with technological innovations and include cost of acquiring/purchasing the innovation, cost of installing the innovative machines and equipment, cost of operating the technology and cost of maintaining the operations of the innovations.

Factories under the management of KTDA have been facing the challenge of an increase in cost of operations as a result of outdated technology (Kagira, Kimani & Kagwithi, 2012).Financial performance of the tea farmers has not been improving. For instance in Central Kenya there was uprooting of tea bushes, tea picking boycotts, destruction of factory infrastructure besides threatening the life of factory managers, once the bonuses are announced year after year (Munene, 2016).The farmers were protesting against poor payments and bonuses from the Kenya Tea Development Agency (KTDA). There has been no consensus on the impact of technological innovation on the performance of tea processing firms. Some authors indicate that technological innovations bring enormous benefits to the tea firms by stimulating productivity by cutting down cost of production (Kiai & Wambui; 2015; Wanjira et al., 2016; Takano & Kanama, 2019; Matazarre, 2015). The lack of consensus regarding cost-benefit analysis of technological innovations in the tea sector warrants further research on the effect of technological innovation investment on financial performance of the Small-Scale Tea Industry.

Previous studies have been conducted on studies relating to technological innovations and the financial performance of small-scale tea industry in Kenya. Ongonga and Ochieng (2013) conducted a study identifying the impact of technological innovation on the overall performance of tea companies in Kericho Town Kenya. The study presents a contextual gap since it focused on the tea companies in Kericho only which might not reflect the true picture of all the tea factories in Kenya. Also Kiai and Wambui (2015) conducted a study on the Impact of innovation on the financial performance of KTDA managed tea factories in Meru and Kirinyaga counties and the study variables were process innovation and organizational innovation. A conceptual gap also existed. Moreover, the study of Gichungu and Oloko (2015) on the relationship between bank innovations and financial performance of commercial banks in Kenya presented both conceptual and contextual gaps. This study filled the existing research gaps by establishing whether there is an effect of technological innovation investment on financial performance of small-scale tea industry in Kenya.

Research Objectives

i. To evaluate the effect of investment on pruning innovations on the financial performance of small-scale tea firms in Kenya.
ii. To analyze the effect of investment on weighing innovations on financial performance of small-scale tea firms in Kenya.

Pruning Innovations

The amount and nature of yield of tea depend to a great extent on the frequency and quality of pruning activities. Pruning is the procedure of evacuation of the best clog of the hedges by the expulsion of dead, ailing and useless branches at certain interim (Ongongâ & Ochieng, 2013). This interim is known as pruning interim. Pruning likewise captures ineffective development and animates vegetative development. Manual method for pruning is rushed and insufficient (Shankar *et al.,* 2016). Laborers will in general take a long time pruning. Be that as it may, with new innovation, there are pruning machines. The machines are quick and compelling. Regardless of their adequacy, the pruning machines are not as practical as individuals as far as quality is concerned (Hong & Yabe, 2015). The machines are likewise expensive and need systems for upkeep. Thus, any investment on this innovation may have a positive or negative effect on the financial performance of the tea processing firms.

Weighing Innovations

There is a perception that weighing technological innovation can increase the efficiency, accuracy and save time to the tea farmers in taking the quantity of the products (Foster & Graham, 2015). Investments of acquiring these electronic weighing systems and e-procurement software packages are high but increases efficiency of firms (Kagira et al., 2012). Modern machinery which can handle big volumes of input can be cost effective. Wanjau and Makokha (2018) noted that an electronic weight feeder can weigh up to 6000 Kgs of tea green leaf per hour. Tea weighing machines according to Foster and Graham (2015) may help save on time and human resources and have accurate data captured once at source. However, there is a need to establish the impacts of tea weighing technologies in the context of Kenya' tea industry.

Already, manual gauging machines required somewhere in the range of eight assistants in leaf collection centers to do the record keeping, which was on occasion awkward and frequently observed records lost in the high volume of administrative work (Ongong'a & Ochieng, 2013). The electronic gauging arrangements, as the innovation is known, have changed over 40 days' work into 1 days' worth of effort for one representative (KTDA, 2016). In any case, there expenses related with the establishment and upkeep of these gauging machines.

Be that as it may, the greatest change, notwithstanding, is in the exactness of the records. While the manual machines just recorded the entire figure and excluded the figure after the decimal, the EWS records the exact weight, reestablishing to ranchers' generous misfortunes that were being brought about (Wu, 2015). The innovation guarantees exactness of information caught and saves money on time and human asset by having information caught at source, yet it additionally makes robotized compromises between processing plant loads and purchasing focus loads, guaranteeing tea isn't lost along the chain (Tiampati, 2014). The arrangement takes into account information recovery and gives dependable reinforcement accordingly guaranteeing trustworthiness of green leaf data (KTDA, 2015). It has likewise given an information framework that implies the board can deal with cultivator issues at the purchasing focus level, including enlistment, advances the board, installments and manure queries. The innovation guarantees that just legitimate producers can convey green leaf at purchasing focuses (Han *et al.,* 2014). Thus, any investment on tea weighing technologies may have a positive or negative effect on the financial performance of the tea processing firms.

Methodology

The objective population of the investigation was 66 small scale tea firms in Kenya. The study conducted a census of all the 66 registered Small-Scale Tea industries.

Data analysis involved panel data regression. Panel data contain perceptions of various phenomena acquired over different time spans for similar firms or people (Taylor & Bonsall, 2017). Panel data analysis was conducted per variable of the study, followed by a panel model that included all the variables of the study and finally tested for moderation. The study hypotheses based on the objectives of the study were tested using the p-value method. The acceptance/rejection criterion was that, if the p value is greater than the significance level of 0.05, we fail to reject the Ho but if it's less than 0.05 level of significance, the Ho is rejected.

Model Diagnostic Statistical Findings
Panel Unit Root Test

Table 1
Fisher-type test of unit root

Variable		**Inverse chi-squared(70) P**	**Inverse normal Z**	**Inverse logit t(179) L***	**Modified inv. chi-squared Pm**
Investments on pruning Innovations	test statistic	507.2555	-10.3017	-15.2769	23.0954
	p-value	0.000	0.000	0.000	0.000
Investments on Weighing Innovations	test statistic	459.8854	-8.174	-12.85	20.1799
	p-value	0.000	0.000	0.000	0.000
Return on capital employed	test statistic	274.6518	-3.7361	-5.5999	8.7796
	p-value	0.0000	0.0001	0.0000	0.0000

The stationarity results test for unit root revealed that, at level investments on fermentation technological innovations, pruning technological innovations investments, investments on weighing technological innovations, investments on information systems technological innovations, firm size investment and financial performance of small-scale tea industry in Kenya measured using return on capital employed were stationary since p-value<0.05 at P, Z, L* and Pm. This means that the results obtained are now not spurious as supported by Gujarati (2003) and so panel regression models could be generated.

Hausman Test

When performing panel data analysis, one has to determine whether to run a random effects model or a fixed effects model (Baltagi, 2005). The Hausman test provides a formal statistical assessment of whether or not the unobserved individual effect is correlated with the conditioning regressors in the model. Selection of the appropriate econometric framework is crucial for accurate estimation of the relationship between variables. Failure to account for random effects may result in biased and inconsistent estimates of the conditional mean whereas failure to account for fixed effects models will yield consistent, yet inefficient estimates (Amini, Delgado, Henderson & Parmeter, 2012). In order to make a decision on the most suitable model to use, both random and fixed effects estimate coefficients were conducted. The study used the Hausman's specification test (1978) to choose between fixed and random effect models where the hypotheses were;

H_0: Random effect is appropriate

H_1: Fixed effect is appropriate

Table 2 shows the results of the Hausman test.

Table 2
Hausman Random Test for random and fixed effects

Return on capital employed	**(b)**	**(B)**	**(b-B)**	**sqrt(diag(V_b-V_B))**
	Fixed	random	Difference	S.E.
Investments on pruning Innovations	0.026984	0.034088	-0.0071	0.002747
Investments on Weighing Innovations	0.032856	0.032116	0.000741	0.003113
chi2(4)	9.99			
Prob>chi2	0.0406			

Source: Stata 14 computations

The null hypothesis of the Hausman test is that the random effects model is preferred to the fixed effects model. The Hausman test revealed a chi-square of 9.99 with a p-value of 0.0406 indicating that at 5 percent level, the chi-square value obtained is statistically significant. Thus, the researcher rejects the null hypothesis that the random effects model is preferred to the fixed effect model for the model. The study concludes that fixed effect is an appropriate model in analyzing the effect of technological innovation investment on financial performance of the Small-Scale Tea Industry in Kenya.

Normality Test

The normality assumption (ut ~ N (0, σ2)) was required in order to conduct single or joint hypothesis tests about the model parameters (Brooks, 2008). Most of the parametric test statistics have assumption of normality which implies before the usage of such test statistic, the error factor in data must be normally distributed otherwise, the computation becomes invalid (Nosakhare & Bright, 2017). The error term in the regression analysis must be tested for normality as the error term must be normally distributed. Bera and Jarque (1981) tests of normality were performed. The test is superior in power to its competitors for symmetric distributions with medium up to long tails and for slightly skewed distributions with long tails (Thadewald & Büning, 2007). If the p-value is less than 0.05, the null of normality at the 5% level is rejected. If the data is not normally distributed a nonparametric test was most appropriate. Table 3.4 shows the normality results using for Skewness and Kurtosis test for the financial firms. The study tested the null hypothesis that the disturbances are not normally distributed.

H_0: The data are not normally distributed
H_1: The data are normally distributed

Table 3
Normality Test

Variable	**Observation**	**Skewness**	**Kurtosis**	**P-value**
Return on capital employed	330	2.2952	0.8061	0.5041
Investments on pruning Innovations	330	3.8629	0.9274	0.3095
Investments on Weighing Innovations	330	2.0155	0.2480	0.4915

Table 3 presents the normality results used for skewness and Kurtosis test. Combining skewness and kurtosis is still a useful test of normality provided that the limiting variance accounts for the serial correlation in the data. The P-values were higher than the critical 0.05 and thus we conclude that the data is normally distributed. Normality and other assumptions should be taken seriously, for when these assumptions do not hold, it is impossible to draw accurately. The assumption of normality needs to be checked for many statistical procedures, because their validity depends on it.

Autocorrelation

Serial correlation test was conducted to check for correlation of error terms across time periods. Failure to account for serial correlation amounts to the violation of the assumption that observations of the error term should be uncorrelated with each other. This study used the Wooldridge (2002) test for serial correlation to test for the presence of autocorrelation in the linear panel data (Salkind, 2010). Wooldridge (2002) is attractive because it can be applied under general conditions and is easy to implement (Drukker, 2003).

The null hypothesis of this testing is that data has no serial correlation. If the calculated p-value>0.05, there is no serial correlation in the data; otherwise serial correlation is present (Anderson *et al.,* 2007). Serial autocorrelation is a common problem experienced in panel data analysis and has to be accounted for in order to achieve the correct model specification. The test tested for the following hypotheses. The results are presented in Table 4.

Table 4

Wooldridge test for autocorrelation

Wooldridge test for autocorrelation in panel data
H_0: no first-order autocorrelation
F(1, 65) = 1.860
Prob > F = 0.4310

Source: Research Data, 2020

The null hypothesis of this test was that there is no first order serial/autocorrelation existed in the data. When Serial Correlation was conducted, the test statistic reported is F-test of 0.1.860 and a p value of 0.4310>0.05. The null hypothesis that no first order serial /autocorrelation exists is not rejected. From the serial correlation results, the study concludes that serial correlation does not exist. If the serial correlation is detected in the panel data, then the Feasible Generalized Least Squares estimation is adopted. Serial correlation is a typical issue experienced in panel data and must be represented so as to be accomplished in the right model in particular. As indicated by Wooldridge (2002), inability to check for presence of serial correlation will render the parameter estimates incorrect.

Heteroscedasticity

In a linear regression model the error term should be homogeneous in nature. Whenever that assumption is violated, then one can assume that heteroscedasticity has occurred in the data and may result in incorrect parameter estimates. Breusch-Pagan/Godfrey test used to test for heteroskedasticity. The null hypothesis in the test is that error terms have a constant variance i.e. homoskedastic, it has steady fluctuation. If the null hypothesis is rejected and a conclusion is made that heteroscedasticity is present in the panel data, then this would be accounted for by running a Feasible Generalized Least Squares model. The heteroskedasticity results are presented in Table 5.

Table 5
Breusch-Pagan test for Heteroskedasticity

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ho: Constant variance
Variables: fitted values of return on capital employed

chi2(1) = 0.33
Prob> chi2 = 0.5668

The results in the Table 5 indicate that the error terms are heteroskedastic, given that the p-value (0.5668 >0.05) confirmed that the null hypothesis of constant variance was accepted justifying the absence of heteroskedasticity in the data as supported by Poi and Wiggins (2001). Heteroskedasticity refers to the state of systematic changes in the spread of residuals or the error term of the model. The presence of residual variance in a model reveals that the scattering of the model is dependent on at least one independent variable. In the event that the error variance is not consistent, at that point there is heteroscedasticity in information. Conducting regression without representing heteroscedasticity would thus prompt impartial parameter gauges. This would result in an inefficient and unstable regression model that could yield bizarre predictions in the model estimate.

Multicollinearity Test

According to William *et al* (2013), multicollinearity refers to the presence of correlations between the predictor variables. In severe cases of perfect correlations between predictor variables, multicollinearity can imply that a unique least squares solution to a regression analysis cannot be computed (Field, 2009). A multicollinearity test helps to diagnose the presence of multicollinearity in a model and ensure that parameter estimates of the model are correct and consistent. Multicollinearity inflates the standard errors and confidence intervals leading to unstable estimates of the coefficients for individual predictors (Belsley *et al*., 1980). Multicollinearity was assessed in this study using the variance inflation factors (VIF). According to Field (2009), VIF values in excess of 10 is an indication of the presence of Multicollinearity. The results in Table 6 indicated absence of multicollinearity since the VIF of all the variables were less than 10.

Table 6
Multicollinearity Test

Variable	**VIF**	**1/VIF**
Investments on pruning Innovations	1.84	0.543687
Investments on Weighing Innovations	1.69	0.590179
Mean VIF	1.94	0.528797

The results in Table 6 indicate absence of multicollinearity since the VIF of all the variables were less than 10. When multicollinearity was tested, the VIF values for fermentation technological innovation investment, pruning technological innovation investment, weighing technological innovation investment and information systems technological innovation investment were less than 10 indicating absence of multicollinearity. Multicollinearity makes it hard to interpret your coefficients, and it reduces the power of your model to identify independent variables that are statistically significant. The absence of multicollinearity implies that the data could be used to estimate the panel model on how investments on fermentation innovations, investments on pruning innovations, investments and investments on information system innovations influenced financial performance of small-scale tea firms in Kenya using return on capital employed indicator

Correlational Analysis

In order to get an overview of the association between the dependent and independent variables, the study conducted pairwise correlation analysis. The analysis aims at testing for existence of multicollinearity and it is ideal for eliminating variables which are highly correlated. The study conducted correlation analysis between technological innovation and financial performance of small-scale tea industry in Kenya. Pearson's product-moment correlation coefficient (r) was used to examine the extent of correlation between the variables of study and to show the strength of the linear association between the variables. Pearson's correlation ranges between ±1. Where r= +0.7 and above it indicates a very strong relationship; r=+0.5 to below 0.7 is a strong association; r=0.3-0.49 is a moderate association while r=0.29 and below indicates a weak association. Where r=0 it indicates that there is no association. 1.7 presents the correlation matrix for fermentation technological innovation, pruning technological innovation, weighing technological innovation, information systems technological innovation and financial performance of small-scale tea industry in Kenya using return on capital employed.

Table 7

Correlation between Technological Innovations and financial Performance of Small-Scale Tea Industry

	Return on Capital Employed	Pruning Technological Innovation	Weighing Technological Innovation	
Return on Capital Employed	1.000			
Pruning Innovations	0.6042 0.0064***	-0.0122 0.8251	1.000	
Weighing Innovations	0.5683 0.0107**	0.3505 0.570	0.0501 0.3645	1.000

**Significant at 0.05, ***Significant at 0.01

The results found that pruning innovations and return on capital employed of small-scale tea industry in Kenya are positively and significantly associated (r=0.6042, p=0.0064<0.05). The results imply that pruning innovations and return on capital employed move in different directions. In terms of minimizing the pruning costs, the use of effective technologies like machine pruning which saves on pruning costs , is also efficient, effective and faster. Mechanization of tea plucking and pruning would tremendously reduce the costs of labor and improve the quality of tea by minimizing delays. The results agree with Ongongâ and Ochieng (2013) who conducted a study on the Innovation in the tea industry in Kericho, Kenya and established that pruning machines introduced in the firms not only were fast and effective but they also spur faster growth of the tea bushes at a uniform level. According to Wambeti (2017) the cost of production can also be cut down by measures such as minimizing plucking cost by paying pluckers based on the amount of tea plucked instead of daily rate, in terms of minimizing the pruning costs, the use of effective technologies like machine pruning which saves up to 70 percent, it is also efficient, effective and faster.

It was also found that weighing innovations and return on capital employed by small-scale tea industry in Kenya are positively and significantly associated (r=0.1403, p=0.0107<0.05). The results imply that weighing innovations and return on capital employed move in different directions. Modern machinery which can handle big volumes of input can be cost effective. The results agree with Gikunju et al (2018) that technology has improved the weighing of tea leaves. The results also align with Wanjira et al (2016) conducted a study on the effect of innovation on performance of KTDA-managed factories in Meru County and found that automation of key processes in tea processing has led to improved efficiency and reduced costs.

Regression Analysis

Regression Analysis for Pruning Innovations and Financial Performance of small-scale tea industry

Fixed effect model was estimated between pruning innovations and financial performance of small-scale tea industry in Kenya. Simple panel model was conducted to determine whether there was a significant relationship between pruning innovations and financial performance of small-scale tea industry. Table 9 presents the simple panel regression model between pruning innovations and financial performance of small-scale tea industry.

Table 9
Pruning Innovations and Financial Performance of Small-Scale Tea Industry

Return on capital employed	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Pruning Innovations	0.086947	0.007255	11.98	0.000**	0.072662	0.101233
Cons	-0.44634	0.051665	-8.64	0.000**	-0.54807	-0.34461
R-sq:						
within = 0.3532						
between = 0.4238						
overall = 0.3650						
F(1,263)	143.63					
Prob > F	0.0000					

*Significant at 0.05
**Significant at 0.01

The fitted model from the result is
Financial performance of small-scale tea industry = -0.44634+0.086947 Pruning Innovations
Model results in Table 9 reveals that the coefficient of determination, R Square is 0.3650. The model indicates that pruning innovations explain 36.50% of the variation in financial performance of small-scale tea industry in Kenya. This implies that 36.50% of the variations in financial performance of small-scale tea industry are attributed to pruning technological innovations. The findings further confirm that the relationship between pruning innovations and financial performance of small-scale tea industry is positive and significant with a coefficient of (β =0.086947, p=0.000). This implies that there exists a positive and significant relationship between pruning innovations and financial performance of small-scale tea industry since the coefficient value was positive and the p-values was 0.000<0.05. Model results imply that a unitary increase in pruning innovations results in an increase in financial performance of small-scale tea industry by 0.086947 units holding investment on other technological innovations constant.
Amount and nature of yield in a tea home depend to a great extent on pruning. Pruning is the procedure of evacuation of the best clog of the hedges by the expulsion of dead, ailing and useless branches at certain interim. Pruning is one of the most important operations, next to plucking, which directly determines the productivity and quality of tea bushes. Pruning increases the total yields of the tea and when pruning is not done at the right time or is delayed, the size and weight of growing shoots on and the plucking surface decreases, with loss of vigor of growing. However, the machines are likewise expensive and need systems for upkeeps. The results agree with Ongongâ and Ochieng (2013) who conducted a study on the Innovation in the tea industry in Kericho, Kenya and established that pruning machines introduced in the firms not only were fast and effective but they also spur faster growth of the tea bushes at a uniform level.

Regression Analysis of Weighing Innovations and Financial Performance of small-scale tea industry

Fixed effect model was estimated between weighing innovations and financial performance of small-scale tea industry in Kenya. Simple panel model was conducted to determine whether there was a significant relationship between weighing innovations and financial performance of small-scale tea industry. Table 4 presents the simple panel regression model between weighing innovations and financial performance of small-scale tea industry.

Table 10
Weighing Innovations and Financial Performance of Small-Scale Tea Industry

Return on capital employed	**Coef.**	**Std. Err.**	**z**	**P>|z|**	**[95% Conf.**	**Interval]**
Weighing Innovations	0.080167	0.006415	12.5	0.000**	0.067537	0.092798
Cons	-0.4876	0.052841	-9.23	0.000**	-0.59165	-0.38356
R-sq:						
within = 0.3726						
between = 0.2816						
overall = 0.3229						
F(1,263)	156.19					
Prob > F	0.0000					

*Significant at 0.05
**Significant at 0.01

The fitted model from the result is

Financial performance of small-scale tea industry = -0.4876+0.080167 Weighing Innovations

Model results in Table 10 reveals that the coefficient of determination, R Square is 0.3229. The model indicates that investment on weighing technological innovations explain 32.29% of the variation in financial performance of small-scale tea industry in Kenya. This implies that 32.29% of the variations in financial performance of small-scale tea industry are attributed to investment on weighing technological innovations. The findings further confirm that the relationship between weighing technological innovations and financial performance of small-scale tea industry is positive and significant with a coefficient of (β =0.080167, p=0.000). This implies that there exists a positive and significant relationship between weighing technological innovations and financial performance of small-scale tea industry since the coefficient value was positive and the p-values was 0.000<0.05. Model results imply that a unitary increase in weighing technological innovations results in an increase in financial performance of small-scale tea industry by 0.080167 units, holding investment on other technological innovations constant.

Weighing technological innovation increases the efficiency, accuracy and saves time to the tea farmers in taking the quantity of the products. Automation of business activities in companies has devoured a total reduction in manual labor space. Acquiring these electronic weighing systems and e-procurement software packages are high but increases efficiency of firms. KTDA introduced the Electronic green leaf Weighing Solutions (EWS) which are machines that allow instant data processing in the buying of green leaf thus reducing the number of employees in the leaf buying. The results agree with Tanui, Feng, Wang and Kipsat

(2012) who conducted a study on the Socio-economic constraints to adoption of yield improving tea farming technologies in Nandi Hills, Kenya and found that tea farms that use weighing machines had their financial performance improved. The results also align with those of Wanjira, Kubaison and Nzomo (2016) conducted a study on the effect of innovation on performance of KTDA-managed factories in Meru County and found that automation of key processes in tea processing has led to improved efficiency and reduced costs.

Panel Regression of Technological Innovations and Financial Performance of Small-Scale Tea Industry

The study carried out an overall panel regression analysis to establish the statistical significance relationship between the independent variables; pruning innovations investments, weighing innovations and financial performance of small-scale tea industry in Kenya measured using return on capital employed. The hypotheses of the study were also tested in this section using the p-value method of the results in the panel model. The acceptance/rejection criterion was that, if the p value is greater than the significance level of 0.05, we fail to reject the Ho but if it's less than 0.05 level of significance, the Ho is rejected.

Table 12
Panel Model on the Effect of Technological Innovation on Financial Performance of Small-Scale Tea Industry

Return on capital employed	**Coef.**	**Std. Err.**	**z**	**P>z**	**[95% Conf.**	**Interval]**
Pruning Innovations	0.026984	0.008468	3.19	0.002**	0.010309	0.04366
Weighing Innovations	0.032856	0.007203	4.56	0.000**	0.018672	0.047041
_cons	-0.86706	0.061557	-14.09	0.000**	-0.98827	-0.74584
R-sq:						
within=0.5497						
between= 0.4721						
overall=0.5085						
F(4,260)	79.36					
Prob > F	0.000					

*Significant at 0.05
**Significant at 0.01

The regression modes was;

Return on capital employed = -0.86706+0.046879104222 Fermentation innovations +0.026984 pruning innovations +0.032856 weighing innovations +0.025011 information system innovations

The R squared was used to check how well the model fitted the data. The study was supported by a coefficient of determination R square of 0.5085. This means that pruning innovations investments and weighing innovations explain 50.85% of the variations in the financial performance of small-scale tea industry in Kenya. Health performance of small-scale tea is vital in sustaining its operations. Financial performance represents a subjective measure that helps to indicate how well a tea firm can utilize its assets and be able to generate revenue and profit through its operations. The financial performance of an organization indicates the degree to which a firm's financial goals have been achieved.

There was a positive and significant relationship between pruning technological innovations and financial performance of small-scale tea industry in Kenya (β =0.026984, p=0.002<0.05). This was supported by a calculated z-statistic of 3.19 that if pruning technological innovations

is increased by one unit, financial performance of small-scale tea industry increases by 0.026984 units. This implies that a unit change in the 0.026984 is related with a change in the performance of the small-scale tea industry using return on capital employed.
Further, the results revealed that there was a positive and significant relationship between weighing technological innovations and financial performance of small-scale tea industry in Kenya (β =0.032856, p=0.000<0.05). This was supported by a calculated z-statistic of 4.56 that if weighing technological innovations is increased by one unit, financial performance of small-scale tea industry increases by 0.032856 units. This implies that a unit change in the weighing technological innovations 0.032856 is related with a change in the performance of small-scale tea industry using return on capital employed

Summary of Hypotheses

The summary test results of the hypotheses are presented in Table 14.
Table 14
Summary of Hypotheses

Objective No.	Objective	Hypothesis	Rule	p-value	Comment
Objective 2	To evaluate the effect of pruning technological innovation on the financial performance of small-scale tea firms in Kenya	H_{02}: Pruning technological innovation has no significant benefit on the financial performance of small-scale tea firms in Kenya.	Reject H_{02} if p value <0.05	p<0.05	The study rejects the null hypothesis. Therefore, a conclusion is made that pruning technological innovations has a significant benefit on the financial performance of small-scale tea firms in Kenya.
Objective 3	To analyze the effect of weighing technological innovation on the financial performance of small-scale tea firms in Kenya.	H_{03}: Weighing technological innovation has no significant benefit on the financial performance of small-scale tea firms in Kenya.	Reject H_{03} if p value <0.05	p<0.05	The study rejects the null hypothesis; therefore, a conclusion is made that weighing technological innovations has a significant benefit on the financial performance of small-scale tea firms in Kenya.

Summary of the Major Findings

The section contains a summary of findings using both descriptive and inferential results. The summary has been presented according to objectives that guided the study.

Investments in Pruning Technological Innovations and Financial Performance

The second objective of the study was to evaluate the effect of pruning technological innovation on the financial performance of small-scale tea firms in Kenya. From the descriptive results, the average total costs (initial costs and operating costs) invested on pruning innovations across all the small-scale tea firms was KES 7.024 million. The tea processing firm that spent the highest total costs on pruning innovations (initial costs and operating costs) was KES 10.842 million with smallest tea processing firm spending KES 3.320 million in total costs on pruning innovations.

Correlation analysis revealed that pruning technological innovation and financial performance of small-scale tea industry in Kenya are positively and significantly associated. Pruning technological innovation was found to be satisfactory in explaining financial performance of small-scale tea industry. Further, results indicated that pruning technological innovation is a good predictor of financial performance of small-scale tea industry. Multiple regression of coefficient results revealed that there was a positive and significant relationship between pruning technological innovations and financial performance of small-scale tea industry in Kenya (β =0.026984, $p=0.002<0.05$). This means that, a unitary increase in pruning technological innovation leads to a unit increase in financial performance of small-scale tea industry by 0.026984.

Weighing Technological Innovations and Financial Performance

The third objective of the study was to analyze the effect of weighing technological innovation on the financial performance of small-scale tea firms in Kenya. Descriptive results revealed that the average total costs spent on weighing innovations was KES 17.099 million. The tea processing firm that spent the highest total costs on weighing innovations (initial costs and operating costs) was KES 22.265 million while a tea processing firm that spent the smallest amount on weighing innovations used KES 11.898 million.

Correlation analysis revealed that investment on weighing technological innovation and financial performance of small-scale tea industry in Kenya are positively and significantly associated. Weighing technological innovation was found to be satisfactory in explaining financial performance of small-scale tea industry. Further, results indicated that weighing technological innovation investments is a good predictor of financial performance of small-scale tea industry. Panel regression of coefficient results revealed that there was a positive and significant relationship between weighing technological innovations and financial performance of small-scale tea industry in Kenya (β =0.032856, $p=0.000<0.05$). This means that a unitary increase in weighing technological innovations results in a unit increase in financial performance of small-scale tea industry by 0.032856.

Conclusions of the Study

Pruning Innovations and Financial Performance

A conclusion is further made that investment on pruning innovations was highest at inceptions in 2014, but slowly declined thereafter. It was further concluded that pruning technological innovations positively affects financial performance of small-scale tea firms. Proper pruning stimulates the production of new sets of fast growing branches which in turn helps to yield a good harvest. Pruning tea in longer cycles along with the process of skiffing in most of the times, the productivity rises. In terms of minimizing the pruning costs, the use of effective technologies like machine pruning which saves on pruning costs, is also efficient, effective and faster. Mechanization of tea plucking and pruning would tremendously reduce the costs of labor and improve the quality of tea by minimizing delays. However, discussion on the use of mechanical pruners may cause serious misgivings on the part of local unions, as hand pruning employs people in rural communities. The financial benefits to farmers, who should be able to source for quality pruning (creating bushes that are less liable to infection and that start yielding well soon after pruning) at a much lower cost, are high.

Weighing Innovations and Financial Performance

The study concluded that weighing innovations positively affects financial performance of small-scale tea firms. From descriptive results, costs invested on weighing innovations in the tea sector were lowest at inception in 2014, but the value rose in the subsequent years. There are claims by tea farmers against middle men that the weighing scales at the tea collection centers are either faulty. Measurements done at the tea collection centers do not tally with on-farm measurements. The falsification of green leaf weights is a clear indication of theft and results in losses to the farmers. In 2007, a task force report by the ministry of agriculture on the tea industry in Kenya recommended introduction of new technology to curb weight falsification at the collection centers. Modern machinery which can handle big volumes of input can be cost effective. An example in the tea processing activity is an electronic weight feeder which can weigh up to 6000 Kgs of green leaf per hour. The use of weighing machines has improved the weighing of tea leaves. KTDA accordingly introduced Electronic Weighing Solution (EWS) (KTDA, 2014). The technology uses electronic weighing scales that measure green leaf to the gram. The data is then transmitted instantly via Safaricom's mobile network, using a Personal Data Assistant to a farmer's factory. A printer relying on Bluetooth churns out a receipt for the farmer on the spot. EWS has, therefore, helped in saving on time and human resources and having accurate data captured once at source. Automated reconciliation between weights of green leaf delivered to the factory and weights of the leaf at the buying center has also been made possible.

Recommendations of the Study

Recommendations for Management

It was noted that pruning technological innovations positively affects financial performance of small-scale tea firms. The study recommends that management of tea firms can consider investing on pruning machines to fasten tea pruning so as to give the plant a low, wide framework of branches that will produce many leaves each year. Pruning is essential to direct the tea plant's energy into leaf production. In terms of minimizing the pruning costs, the use of effective technologies like machine pruning which saves on pruning costs, it is also efficient, effective and faster. Mechanization of tea plucking and pruning would tremendously reduce the costs of labor and improve the quality of tea by minimizing delays. However, it is also important to note that mechanization of tea pruning may minimize tea quality and also lead to massive job losses. Pruning needs to be conducted at the right time of the season and as advised by tea production experts so as to enhance quality and productivity.

It was also noted that weighing innovations influences financial performance of small-scale tea firms. Tea firms can consider acquiring electronic weighing machines that are accurate and efficient. Modern machinery which can handle big volumes of input can be cost effective.

Electronic green leaf Weighing Solutions which are machines that allow instant data processing in the buying of green leaf thus reducing the number of employees in the leaf buying. It was recommended that the tea processing firms carry out more sensitization among farmers on the use of the automated weighing based solution so as to increase farmer confidence with the tea development authorities.

Policy Recommendations

The introduction of mechanization in the tea sector increased productivity and efficiency in tea farming and processing. However, technological innovation including introduction of continuous fermentation units and pruning machines resulted in massive job losses to most Kenyans who worked in the tea sector. The policy implication of these scenarios toward Kenya Tea Development Agency, Ministry of Labor and tea workers association is to strike a balance between technological innovations in the tea sector and sustainability without threatening livelihoods of many Kenyans dependent on the tea sector.

Academic Recommendations

The current study has contributed to the knowledge on technological innovation and financial performance of small-scale tea industry. It is evident that technological innovation has varying implications both positive and negative to the growth of the tea sector. The impacts emanating from tea technologies and innovations were not exhaustive. The study recommends that the academicians and scholars may further investigate the implication of technology in the growth of the tea sector.

References

Abbasi, A., & Malik, Q. A. (2015). Firms' Size Moderating Financial Performance in Growing Firms: An Empirical Evidence from Pakistan. *International Journal of Economics and Financial Issues*, *5*(2), *334-339.*

Ahmed, P. K., & Shepherd, C. (2010). *Innovation Management: Context, Strategies, Systems and Processes*. Harlow: Financial Times Prentice Hall.

Aikens, K., McKenzie, M., & Vaughter, P. (2016). Environmental and sustainability education policy research: A systematic review of methodological and thematic trends. *Environmental Education Research*, *22*(3), 333-359.

Al Sawalqa, F. A. (2011). *The changing role of management accounting: assessment of the impact of financial and non-financial performance measures usage on organizational performance in Jordan* (Doctoral dissertation, Murdoch University).

Ali, M. J., Mukulu, E., Kihoro, J. M., & Nzulwa, J. D. (2016). Moderating Effect of Firm Size on the Relationship between Functional Integration and Firm Performance. *International Journal of Academic Research in Business and Social Sciences*, *6*(9), 38-57.

Al-Saraireh, S. I. (2013). The role of investment in information technology on the performance of industrial companies listed on the Amman financial market. *International Journal of Business and Social Science*, *4*(12), 184-195.

Amini, S., Delgado, M. S., Henderson, D. J., & Parameter, C. F. (2012). *Fixed vs Random: The Hausman Test Four Decades Later. Advances in Econometrics, 479–513.* doi:10.1108/s0731-9053(2012)0000029021.

Aron, J. (2012). Virtual economy looms as digital cash grows up. *New Scientist*, *216*(2892), 22–23.

Atkotiya, K. N. (2005). *Analysis of financial performance of Tea Industry in India* (Doctoral dissertation, Saurashtra University).

Baffes, J. (2014). Tanzania's Tea Sector: Constraints and Challenges'. *Africa Region Findings & Good Practice.* World Bank, Washington*,*

BasuM, A., Bera, B., & Rajan, A. (2010). Tea statistics: global scenario. *Inc. J. Tea Sci, 8*(1), 121-124.

Bongoye, G. M., Banafa, A., & Kingi, W. (2016). Effect of Firm Specific Factors on Financial Performance of Non-Financial Firms Listed at Nairobi Securities Exchange. *Imperial Journal of Interdisciplinary Research*, *2*(12), 253-265.

Celli, M. (2013). Determinants of Economies of Scale in Large Businesses--A Survey on UE Listed Firms. *American Journal of Industrial and Business Management*, *3*(3), 255.

Croitoru, A. (2012). Schumpeter, JA, 1934 (2008), The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest and the Business Cycle, translated from the German by Redvers Opie, New Brunswick (USA) and London (UK): Transaction Publishers. *Journal of comparative research in anthropology and sociology*, *3*(2), 1-13.

Damanpour, F., Szabat, K. A., & Evan, W. M. (2009). The relationship between types of innovation and organizational performance. *Journal of Management studies*, *26*(6), 587-602.

De Villiers, C., Hsiao, P. C. K., & Maroun, W. (2017). Developing a conceptual model of influences around integrated reporting, new insights and directions for future research. *Meditari Accountancy Research*, *25*(4), 450-460.

Drukker, D. (2003). Testing for Serial Correlation in Linear Panel Data Models. Stata Journal. 3. 168-177. 10.1177/1536867X0300300206.

Dutta, S., Geiger, T., & Lanvin, B. (2015). The global information technology report 2015. *In World Economic Forum*, 1(1), 80-85.

Eckstein, O. (1958). Water resource development-the economics of project evaluation. *Water resource development-the economics of project evaluation,* 56(7), 300-308).

FAO. (2015). *Analysis of price incentives for tea in Malawi. Technical notes series*. Mafap: Cameron,

Firouzi, S., & Azarian, F. (2019). Propellants of mechanical pruning and plucking of tea (a case of developing countries). *Information Processing in Agriculture*, *6*(4), 454-461.

Food and Agriculture Organization Statistics (FAOSTAT), available at http://faostat.fao.org/ (accessed between June and September 2014).

Foster, C., & Graham, M. (2015). Connectivity and the Tea Sector in Rwanda: Value Chains and Networks of Connectivity-Based Enterprises in Rwanda.

Gichungu, Z. N., & Oloko, M. A. (2015). Relationship between bank innovations and financial performance of commercial banks in Kenya. *International journal of education and research*, *3*(5), 443-456.

Gikunju, C. K., Gakure, R. W., & Orwa, G. O. (2018). Technology Innovation as a Strategic Management Practice and Determinant of Performance of Tea Industry in Mount Kenya Region. *Journal of Agriculture*, 2(1), 1-18.

Gikunju, C., Gakure, P. R., & Orwa, D. G. (2018). Technology Innovation as a Strategic Management Practice and Determinant of Performance of Tea Industry in Mount Kenya Region. *Journal of Agriculture*, *2*(1), 1 - 18.

Gitau, S. (2013). *Effect Of financial innovations on the financial performance of commercial banks in Kenya.* (Unpublished Master of Science Thesis, University of Nairobi).

Gunarathne, A. N., & Peiris, H. M. P. (2017). Assessing the impact of eco-innovations through sustainability indicators: the case of the commercial tea plantation industry in Sri Lanka. *Asian Journal of Sustainability and Social Responsibility*, *2*(1), 41-58.

Gunatilake, J., Shyamalie, H. W., & Wellala, N. N. K. (2012). Use of Geographic Information System in Tea Plantation Management: A Case Study at St. Coombs Estate. *Talawakell*e. 77 (2), 70-82.

Gunday, G., Ulusoy, G., Kilic, K., & Alpkan, L. (2011). Effects of innovation types on firm performance. *International Journal of production economics*, *133*(2), 662-676.

Han, Y., Xiao, H., Qin, G., Song, Z., Ding, W., & Mei, S. (2014). Developing situations of tea plucking machines. *Engineering*, *6*(06), 268-273

Hasan, M. N. (2016). Positivism: to what extent does it aid our understanding of the contemporary social world? *Quality & Quantity*, *50*(1), 317-325.

Herath, H. M. U. N., & De Silva, S. (2011). Strategies for competitive advantage in value added tea marketing. *Tropical Agricultural Research* 22(3), 251 – 262.

Hong, N. B., & Yabe, M. (2015). Resource use efficiency of tea production in Vietnam: Using translog SFA model. *Journal of Agricultural Science*, *7*(9), 160-172

Ismail, K., Omar, W. Z. W., Soehod, K., Senin, A. A., & Akhtar, C. S. (2013). Role of innovation in SMEs performance: A case of Malaysian SMEs. *Mathematical Methods in Engineering and Economics*, 145-149.

Jamali, D. (2008). A stakeholder approach to corporate social responsibility: a fresh perspective into theory and practice. *Journal of Business Ethics*, 82 (10), 213-231.

Jayamanne, V. S., Wijeratne, M., & Wijayaratna, C. M. (2002). Adoptability of New Technology in the Small-Holdings Tea Sector. *Journal of Agriculture and Rural Development in the Tropics and Subtropics (JARTS)*, *103*(2), 125-131.

Jayamanne, V. S., Wijeratne, M., & Wijayaratna, C. M. (2002). Adoptability Of New Technology In The Small-Holdings Tea Sector In The Low Country Of Sri Lanka. *Journal of Agriculture and Rural Development in the Tropics and Subtropics (JARTS)*, *103*(2), 125-131.

Jayasekera, S., Kaur, L., Molan, A. L., Garg, M. L., & Moughan, P. J. (2014). Effects of season and plantation on phenolic content of unfermented and fermented Sri Lankan tea. *Food chemistry*, 15 (2), 546-551.

Johnson, R. B., Russo, F., & Schoonenboom, J. (2019). Causation in mixed methods research: The meeting of philosophy, science, and practice. *Journal of Mixed Methods Research*, *13*(2), 143-162.

Jomo, F. (2010). Benchmark Tea Price in Malawi Advances 1.4% at Blantyre Auction on Demand. Bloomberg. Retrieved from http://www.bloomberg.com/news/2010-07-21/benchmark-tea-price-inmalawi-advances-1-4-at-blantyre-auction-on-demand.html. [Accessed on 12th February 2021].

Jones, T. M., & Felps, W. (2013). Shareholder Wealth Maximization and Social Welfare: A Utilitarian Critique. *Business Ethics Quarterly*, 23(2), 207-238.

Kagira, E. K., Kimani, S. W., & Githii, K. S. (2012). Sustainable methods of addressing challenges facing the small holder tea sector in Kenya: A supply chain management approach. *J. Mgmt. & Sustainability*, *2*, 75.

Kagira, E. K., Kimani, S. W., & Githii, K. S. (2012). Sustainable methods of addressing challenges facing the small holder tea sector in Kenya: A supply chain management approach. *J. Mgmt. & Sustainability*, *2*, 75.

Kalunda, E. (2014). Financial inclusion impact on small-scale tea farmers in Nyeri County, Kenya. *World Journal of Social Sciences*, *4*(1), 130-139.

Keen, P. (2018). Innovation in Kenyan Teas. Available at https://worldteanews.com/tea-industry-news-and-features/innovation-in-kenyan-teas. [Accessed in February 2021].

Kennedy, A. M. (2017). Macro-social marketing research: philosophy, methodology and methods. *Journal of Macromarketing*, *37*(4), 347-355.

Kerr, W. R., & Nanda, R. (2015). Financing innovation. *Annual Review of Financial Economics*, *7*, 445-462.

Kiai, R. M., & Wambui, J. W. (2015). Impact of innovation on the financial performance of KTDA managed tea factories: A case of Meru and Kirinyaga counties.

Kiai, R. M., & Wambui, J. W. (2015). Impact of innovation on the financial performance of KTDA managed tea factories: A case of Meru and Kirinyaga counties.

Kiai, R. M., & Wambui, J. W. (2015). Impact of innovation on the financial performance of KTDA managed tea factories: A case of Meru and Kirinyaga counties (Unpublished Thesis, Kirinyaga University).

Kimathi, C. K., & Muriuki, F. M. (2013). A showcase of Smallholder Agriculture in the EAC: The case of the Smallholder tea sector in Kenya. In *International Symposium and Exhibition on Agricultural Development in the East African Community, Kampala, Uganda*.

Kiwanuka B., Ahmed M. (2012). Analysis of incentives and disincentives for tea in Uganda. *Technical notes series*, 46(1), 154-193

Kothari, C. (2004). *Research Methodology*: Methods & Techniques, 2nd edition. New age International Publishers, New Delhi, India.

KTDA report. (2014). 2014 - 2015 Annual Report and Financial Statements**.** https://ktdateas.com/wp-content/uploads/2020/07/KTDA-Annual-Report-2015-Final-version.pdf.

KTDA report. (2015). KTDA Holdings Annual Report-2015**.** Available at https://ktdateas.com/wp-content/uploads/2020/07/KTDA-Annual-Report-2015-Final-version.pdf.

KTDA report. (2016). Annual Report and Financial Statements for the Year ended June 2016**.** https://ktdateas.com/wp-content/uploads/2020/07/KTDA-Annual-Report-2016-final-for-email.pdf.

Latif, A., Amjad, S., Hussain, A., Shah, F. A., & Hussain, J. (2012). Cost/Benefit Analysis of Tea Production in Pakistan. *IOSR Journal of Business and Management*, *3*(5), 48-57.

Lazonick, W. (2013). The theory of innovative enterprise: A foundation of economic analysis. *University of Massachusetts: The Academic Industry Research Network*. Cambridge, Massachusetts. USA

Lins, K. V., Servaes, H., & Tamayo, A. (2017). Social capital, trust, and firm performance: The value of corporate social responsibility during the financial crisis. *The Journal of Finance, 72*(4), 1785-1824.

llinson, V., Nkonya, E., Schroeder, T. & Norman, D. (2013). Factors Affecting Adoption of Improved Production Technologies and Interface of Out-Reach Efforts with Farmers. *Journal of Agricultural Resources*, 46(1), 54-93.

Loconto, A., & Simbua, E. F. (2016). *Tinkering with Tea: Science, technology and innovation policies in Tanzania's agricultural research system.* Research Handbook on Science. Tanzania

Lopez-Valeiras, E., Gomez-Conde, J., & Fernandez-Rodriguez, T. (2016). Firm Size and Financial Performance: Intermediate Effects of Indebtedness. *Agribusiness*, *32*(4), 454-465.

Mahamood, C. M. & Malik, N. (2011). Effect of financial innovations on the financial performance of commercial banks in Pakistan. *The empirical evidence. Journal of Finance*, 11(7), 189 –231.

Makori, D. M., & Jagongo, A. O. (2013). *Working Capital Management and Firm Profitability: Empirical Evidence from Manufacturing and Construction Firms Listed on Nairobi Securities Exchange, Kenya* (Doctoral dissertation, University of Nairobi).

Marangunic, N., & Granic, A. (2015). Technology acceptance model: a literature review from 1986 to 2013. *Universal Access in the Information Society*, *14*(1), 81-95.

Matazarre, H. (2015). The Effect of the Applying Modern Methods of Tea Cultivation on the Quality of Iranian Produced Tea. Journal of Business and Management, Volume 17, Issue 5, PP 58-61.

Maudu, M., Mudau, F. N., & Mariga, I. K. (2010). The effect of pruning on growth and chemical composition of cultivated bush tea (Athrixia phylicoides DC). *Journal of Medicinal Plants Research*, 4(22), 2353-2358.

Melican, N. J. (2004). Processing Tea for Lower Cost and Better Quality. *International Journal of Tea Science*, *3*(3and4).

Mishan, E. J. (2015). *Elements of Investment-Benefit Analysis (Routledge Revivals)*. Gorge and Unwin Limited. Routledge. New York. USA

Momanyi, B. K. (2015). *Effect of innovations on therisk management of commercial banks in Nairobi County*. (Unpublished MBA Thesis of University of Nairobi)

Monroy L., Mulinge W., Witwer M., (2012). *Analysis of incentives and disincentives for tea in Kenya*. Technical Notes Series, MAFAP, FAO, Rome

Morchain, D., Weinmann, W., Kachepa, C., Jeans, H., Lefu, H., Mtegha-Kawamba, L., & Thole, E. (2016). MALAWI2020: Vulnerability and risk assessment in the tea industry. *Journal of Agriculture 32*(12), 43-77

Mose, G. N., Mbeche, R., & Ateka, J. (2016). Institutional Innovations for Smallholder Agricultural Production Systems in Kenya: A Case of Smallholder Tea Subsector. *European Journal of Sustainable Development*, *5*(3), 461-475.

Mucheke, C. M. (2015). *Capacity Utilization, Quality of Tea and Returns to Ktda Factories In Kenya*. (Unpublished Thesis, University of Nairobi).

Muda, I., Maulana, W., Sakti Siregar, H., & Indra, N. (2018). The Analysis of Effects of Good Corporate Governance on Earnings Management in Indonesia with Panel Data Approach. *Iranian Economic Review*, *22*(2), 599-625.

Muigai, R. G. (2016). *Effect of capital structure on financial distress of non-financial companies listed in Nairobi Securities Exchange* (Doctoral dissertation, COHRED, Finance, JKUAT).

Mukherji, P., & Albon, D. (2018). *Research methods in early childhood: An introductory guide*. Sage. United Kingdom

Muma, B. O., Nyaoga, R. B., Matwere, R. B., & Nyambega, E. (2014). Green supply chain management and environmental performance among tea processing firms in Kericho County-Kenya. *International Journal of Economics, Finance and Management Sciences*, *2*(5), 270-276.

Munene, N. K., & Kasamani, B. S. (2018). A Mobile-based Tea Farming Information System. *International Journal of Computer Applications*, *975*, 8887.

Munene, N. K., & Kasamani, S. B. (2017). Analysis and Design of a Tea Farming Information System. *Analysis*, *4*(12), 56-67

Mustari A., & Shammi A. (2015). Tea Production and Trade Advances in Bangladesh: A Comparative Analysis in Global Market. *Journal of Business and Management*, 17 (6), 10-20

Mwihaki, K. I. (2015). *Factors Influencing Performance of Small and Medium Enterprise Tea Firms In Mombasa County, Kenya*. (Unpublished Thesis, University of Nairobi)

Namu, N. N., Kaimba, G. K., Muriithi, D. K., & Nikari, I. M. (2014). Impact of Investment Reduction Strategies on performance of Tea Factories in Embu Country, Kenya. *European Journal of Business and Social Sciences*, *3*(9), 26-48.

Nawaiseh, R. I. (2015). Do Profitability and Size Affect Financial Leverage of Jordanian Industrial Listed Companies? *European Journal of Business and Innovation Research,* 3(5), 1-12

Nell, C., & Zimmermann, S. (2011). Summary based on chapter 12 of Baltagi: Panel unit root tests. *Department of Economics at University of Vienna*.

Niresh, J. A., & Velnampy, T. (2014). Firm Size and Profitability: A Study of Listed Manufacturing Firms in Sri Lanka. *International Journal of Business and Management*, 9(4), 57-64

Nosakhare, U. H., & Bright, A. F. (2017). Statistical analysis of strength of W/S test of normality against non-normal distribution using Monte Carlo simulation. *American Journal of Theoretical and Applied Statistics*, *6*(5-1), 62-65.

Ofoegbu, A. D. (2010). Effect of Product Innovation on the financial performance of commercial banks in Nigeria.The empirical evidence. *Journal of finance*, 20, 16-57

Oladele, A. J., & Olagunju, A. (2013). Determinants of capital structure in Nigeria. *International Journal of Innovation and Applied Studies*, *3*(4), 999-1005.

Oluoch, J., & Osida, J. (2015). ICT and technological development in advancing tea research in Kenya. A Sustainable Tea Industry for Social, Economical and Technological Development- Proceedings of the First International Conference on Tea Science and Development, 53-59.

Oluoch, J., & Osida, J. (2015). *ICT and technological development in advancing tea research in Kenya*. (Unpublished Thesis, Karatina University).

Oluoch, K. W. (2010). Institutional innovations for smallholder farmers' competitiveness in Africa. *African Journal of Agricultural and Resource Economics*, *5*(311-2016-5541), 227.

Omboi, B. M. (2011). *The Effect of Performance Appraisal Systems on Employees in Kenya Tea Development Agency: A Survey of Selected Tea Factories in Meru County-Kenya*. (Unpublished Thesis. United States International University).

Ondego, M. A. (2016). *Lean Manufacturing Practices and Performance of Tea Processing Firms in Kisii, Kenya Global Journal of Management and Business Research 14(5), 132 -156*.

Ongonga, J. O. (2013). Innovation in the tea industry: the case of kericho tea, Kenya. *Global Journal of Management and Business Research* 176 (3)155 -195.

Ouellette, P., & Vierstraete, V. (2004). Technological change and efficiency in the presence of quasi-fixed inputs: A DEA application to the hospital sector. *European Journal of Operational Research*, 154(3), 755-763.

Parvaiz, G. S., Mufti, O., & Wahab, M. (2016). Pragmatism for mixed method research at higher education level. *Business & Economic Review*, *8*(2), 67-79.

Penrose, E. T. (1959). The theory of the growth of the firm. *New York: Sharpe*.

Pollock, J. L. (2017). Procedural Epistemology—at the Interface of Philosophy and AI. *The Blackwell Guide to Epistemology*, 383-414.

Porter, M. E. (1985). *Competitive strategy*. New York, New York: Free Press.

Rahi, S. (2017). Research design and methods: A systematic review of research paradigms, sampling issues and instruments development. *International Journal of Economics & Management Sciences*, *6*(2), 1-5.

Rogers, E. M. (1995). *Diffusion of Innovations* (4 Ed.). New York: The Free press.

Rutatina, S., & Corley, R. (2018). Effect of Mechanical Harvesting On Yield And Quality Of Tea In Tanzania. *Experimental Agriculture*, 1-15.

Salkind, N. J. (2010). *Encyclopedia of research design* (Vols. 1-0). Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781412961288.

Samansiri, B. A. D., & Wanigasundera, W. A. D. P. (2014). Use of information and communication technology (ICT) by extension officers of the tea small holdings development authority of Sri Lanka. *Tropical Agricultural Research*, *25*(4), 360-375.

Sarkar, S., Chowdhury, A., Das, S., Chakraborty, B., Mandal, P., & Chowdhury, M. (2016). Major tea processing practices in India. *International Journal of Bioassays*, *5*(11), 5071-5083.

Saunders, M., Lewis, P. &Thornhill, A. (2009). *Research methods for business students*. (5th Edition). London: Prentice Hall.

Schumpeter, J. A. (2017). *Theory of economic development*. Routledge.

Schumpeter, J. A. (2004). *The theory of economic development*. Cambridge, Massachusetts: Harvard University Press.

Sewang, P. S. Winder, K., & Zhang, S. B. (2014). Effect of Innovation on the Financial Performance of Small and Medium Sized Enterprises in China. Empirical Evidence. Journal Of Finance, 10, 25-59.

Shannak, R., Obeidat, B., & Almajali, D. (2010, June). Information technology investments: A literature review. In *Proceedings of the 14th IBIMA conference on global business transformation through innovation and knowledge management: An academic perspective, Istanbul-Turkey, 23rd-24th June* (pp. 1356-1368).

Shi, X., & Chen, T. E. (2013). Interactive Information Service Technology of Tea Industry Based on Demand-Driven. In *International Conference on Computer and Computing Technologies in Agriculture* (pp. 434-442). Springer, Berlin, Heidelberg.

Silberston, A. (1972). Economies of scale in theory and practice. *The Economic Journal*, *82*(325), 369-391.

Singh, J. Y., & Yadav, D. P. (2013). Return on Capital Employed-A Tool for Analyzing Profitability of Companies. *International Journal of Techno-Management Research*, *1*(01), 1-13.

Sledzik, K. (2015). Schumpeter's theory of economic development: an evolutionary perspective.

Snapir, B., Waine, T. W., Corstanje, R., Redfern, S., De Silva, J., & Kirui, C. (2018). Harvest monitoring of Kenyan Tea Plantations with X-band SAR. *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, *11*(3), 930-938.

Stigler G., J. (1958). The Economies of Scale. *Journal of Law and Economics*, 1(1), 54-71. Doi: 10.1086/466541

STIPRO. (2011). ATPS-Tanzania: Rationale, Past, Present and Future Strategies. Dar-es-Salaam, TZ: Science, Technology and Innovation Policy Research Organization (STIPRO).

Takano, R., & Kanama, D. (2019). The growth of the Japanese black tea market: how technological innovation affects the development of a new market. *Journal of Economic Structures*, *8*(1), 1-13.

Takano, R., & Kanama, D. (2019). The growth of the Japanese black tea market: how technological innovation affects the development of a new market. *Journal of Economic Structures*, *8*(1), 1-13.

Tanui, J. K., Feng, W., Li, X., Wang, Y., & Kipsat, M. J. (2012). Socio-economic constraints to adoption of yield improving tea farming technologies: A study of small holder tea farmers affiliated to estates in Nandi Hills, Kenya. *African Journal of Agricultural Research*, *7*(16), 2560-2568.

Thadewald, T., & Büning, H. (2007). Jarque–Bera test and its competitors for testing normality–a power comparison. *Journal of applied statistics*, *34*(1), 87-105.

Thirtle, C., Lin, L., &Piesse, J. (2013).The impact of research-led agricultural productivity growth on poverty reduction in Africa, Asia and Latin America. World Development, 31(12), 1959-1975

Thushara, S. C. (2015). Sri Lankan Tea Industry: Prospects and Challenges. Proceedings of the Second Middle East Conference on Global Business, Economics, Finance and Banking (ME15Dubai Conference) ISBN: 978-1-941505-26-7 Dubai-UAE, 22-24 May, 2015 Paper ID: D533

Timmis, K., De Lorenzo, V., Verstraete, W., Ramos, J. L., Danchin, A., Brüssow, H., & Timmis, J. K. (2017). The contribution of microbial biotechnology to economic growth and employment creation. *Microbial biotechnology*, *10*(5), 1137-1144.

Tita, D. (2016). The Effect of Firm Size, Profitability, Tangibility, Non-Debt Tax Shield and Growth to Capital Structure on Banking Firms Listed In Indonesia Stock Exchange from 2007 – 2012. *South East Asia Journal of Contemporary Business, Economics and Law*, 10 (1), 37-44

Trit. (2013a). 4 New Tea Clones In Tanzania Retrieved 15 September, 2013, from http://www.trit.or.tz/research-programmes/4-new-tea-clones-in-tanzania/

Uganda Tea Development Agency UGATEA (2011). The tea Industry in Uganda. Uganda Tea Development Limited (UTDAL).

Venkatraman, N. (1989). The concept of fit in strategy research: Toward verbal and statistical correspondence. *Academy of management review*, *14*(3), 423-444.

Wambeti, N. S. (2017). Challenges Facing Small Scale Tea Farmers In Kenya: A Case Study Of Rukuriri Small Scale Tea Farmers.

Wanjau, K. F., & Makokha, E. N. (2018). Effects Of Technology On Tea Factories Project Perfomance: A Case Of Trans Nzoia County, Kenya. International Journal of Recent Research in Social Sciences and Humanities Vol. 5, Issue 3, pp: (113-122).

Wanjira, M. W. J., Simon, K., & Mathias, M. N. (2016). Effect Of Innovation On Performance Of Ktda Managed Factories In Meru County, Kenya. *International Journal Of Advanced Research in Engineering & Management*, 2(4), 44-52.

Wanjira, W. J., Kubaison, S. & Nzomo, M. (2016). Effect Of Innovation On Performance Of KTDA Managed Factories In Meru County, Kenya. *International Journal Of Advanced Research in Engineering & Management*, 2(4), 44-52.

Wiener, J. B. (2013). "The Diffusion of Regulatory Oversight". In Livermore, Michael A.; Revesz, Richard L. *The Globalization of Investment-Benefit Analysis in Environmental Policy*. New York: Oxford University Press. ISBN 978-0-199-93438-6.

Windsor, D., & Boatright, J. R. (2010). Shareholder wealth maximization. Finance ethics: Critical issues in theory. *Practice Journals*, 10(5) 437-455.

World Bank. (2010), Doing Business Report, World Bank Washington DC

Wu, C. C. (2015). Developing Situation of Tea Harvesting Machines in Taiwan. *Engineering, Technology & Applied Science Research*, *5*(6), 871-875.

Xiao, H. R., Qin, G. M., & Song, Z. Y. (2011). Study on Developing Strategy of Mechanization of Tea Producing. China Tea. *Global international journal* 2 (6), 7-10.

Zahra, S. A. (1986). A Canonical Analysis of Corporate Entrepreneurship Antecedents and Impact on Performance. In *Academy of management proceedings* (Vol. 1986, No. 1, pp. 71-75). Briarcliff Manor, NY 10510: Academy of Management.

Zariyawati, M. A., Annuar, M. N., & Pui-San, N. (2016). Working Capital Management Determinants of Small And Large Firms In Malaysia. *International Journal of Economics & Management*, *10*(2), 76 -88

Zhang, B. C., & Hua, J. (2013) Tea Machine Base, Control Method Thereof and Tea Machine. US Patent No. 2013059049

Zheng, N. H., and Wang, Z. K. (2011). Mechanization of Tea Picking: Break Out the Bottleneck of Tea Industry. *Chinese country Technology and Science*, 12 (9) 14-17