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Technical Efficiency and its Determinants in Smallholder Tea Production: Evidence from Nyamira and Bomet Counties in Kenya

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Abstract- The smallholder tea sub-sector in Kenya has enjoyed relative growth in acreage, output, and number of growers since its inception in the early 1960s, but productivity has remained low. There are huge differentials between actual and potential yields suggesting underlying production inefficiencies. This study estimated the level of technical efficiency and analyzed its determinants among tea farmers from two selected counties in Kenya. Using data from a sample of 525 farm households, the non-parametric data envelopment analysis was applied to estimate technical efficiency scores. The scores were then regressed on a set of explanatory variables to establish their influence on efficiency. The average efficiency score of 0.46 indicates that overall productivity in Kenya's smallholder tea sub-sector is low but has a potential to increase if most of the farmers can adopt practices of the frontier farms. The intensity of family labor use, farm size, age of the tea farm, education level of the household head, access to extension services through the farmer field schools, and the sale of green leaf through alternative marketing channels have a significant influence on levels of efficiency. To exploit the existing potential for increasing productivity the smallholders should adopt labor saving technologies and replant to replace the aging tea farms. Further, government should implement actions to promote consolidation of small tea farms and expand the farmer field school extension programs to reach more farmers.

Keywords: smallholder, tea production, technical efficiency, determinants, fractional regression.

I. Introduction

Tea production in Kenya has expanded rapidly over the years with significant contribution to the country's economy. The industry accounts for about 5 percent and 25 percent of the country's GDP and foreign exchange earnings, respectively (Republic of Kenya, 2017). The sector, directly and indirectly, supports over 5 million farm families, making it one of the leading sources of livelihood in the country (The Republic of Kenya, 2015). Globally, Kenya is among the four (4) leading producers; alongside China, India and Sri Lanka, who collectively account for over 75 percent of the global tea production (International Tea Committee, 2013). Production is mainly carried out in the highlands on the eastern and western sides of the Rift Valley from 1500 - 2700 meters above sea level (Kagira *et al*., 2012; Tea Board of Kenya, 2014). The production structure is a dual system comprising of both large-scale plantations and the smallholder sub-sectors (Ogise *et al.,* 2008). The smallholder subsector is dominant with more than 500,000 farmers producing about 60 percent of the industry output. It is reported to be the largest and most successful smallholder schemes in the world (Kagira *et al*., 2012; Onduru *et al*., 2012). From the early 1960s, the planted area and output from the smallholder tea subsector are as shown in figure 1.

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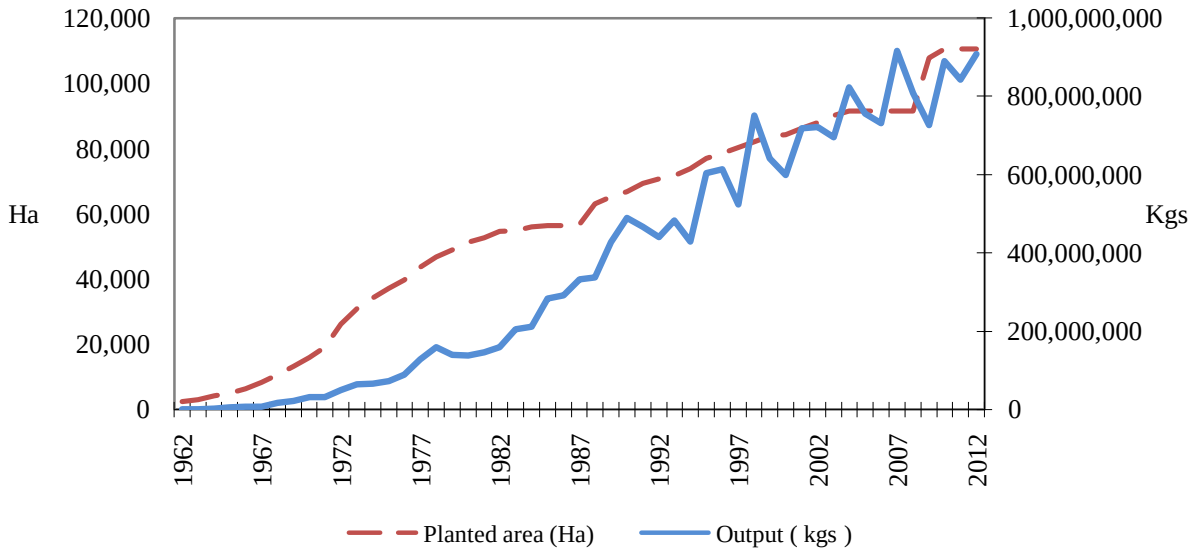

Figure 1: Trends in planted area and output in Kenya's Smallholder tea sub-sector from 1962-2012 (AFA Statistics, 2013)

As shown in figure 1, the acreage under tea expanded from less than 3000 hectares in 1962 to over 110,000 hectares in 2012; while production rose from about 1.3 million kilograms to over 900 million kgs of green leaf in the same period (Republic of Kenya, 2016). The expansion, especially in the earlier years of independence, is attributed to the land distribution policies, well-functioning extension systems, adoption of recommended technologies, attractive world market prices and release of high yielding clones (Mwaura *et al.,* 2005; Mbeche, 2012; Republic of Kenya, 2016).

Despite its growth and immense contribution to the national economy, productivity within the smallholder tea sub-sector remains low. The mean annual yield is 1785 kgs of processed tea per hectare (kgs pt/ha) which is far less than the 3038 kgs pt/ha in plantation sub-sector and an industry potential of 4745 kgs pt/ha (Kamau, 2008; Tea Research Foundation of Kenya (TRFK), 2013). Analysis of industry trends, further show impressive growth in yields in the earlier years of independence, but later setbacks were realized. The trend in Kenya's Smallholder tea Productivity in the period 1963-2011 is shown in figure 2.

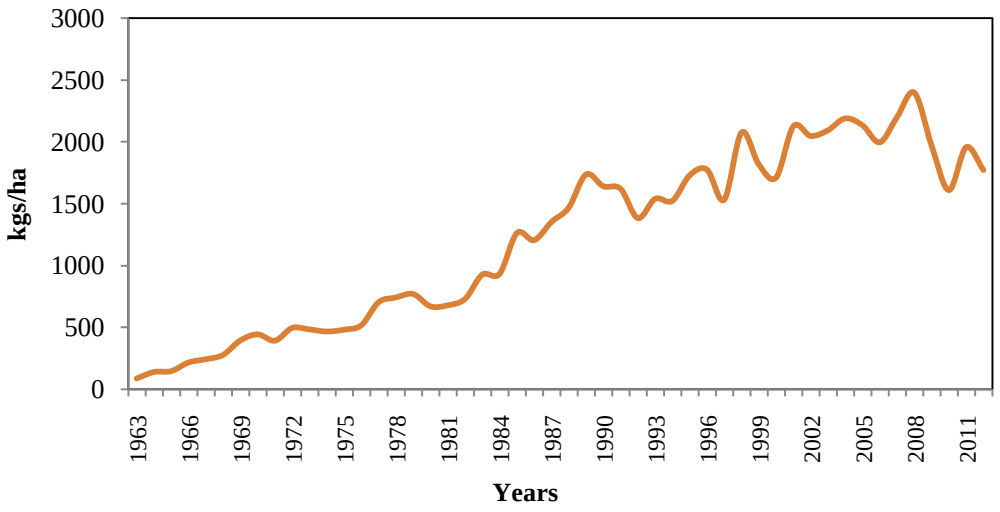

Figure 2: Kenya's Smallholder tea Productivity in the period 1963-2011(Kamau, 2008; KTDA Statistics, 2013)

As shown in figure 2, there was steady and consistent increase in yields per hectare from the 1960s through to the 1980s. However, through the 1990s and 2000s, yield fluctuations, interposed by stagnation and declines were witnessed. The unimpressive trend in tea productivity coupled with the differences between actual

and potential yields, point to existence of inefficiencies and, therefore, a potential to increase productivity. Enhancing efficiency can be an essential factor of productivity growth in the sub-sector since tea cultivation requires high investments and involves very high switching costs (Republic of Kenya, 2010). This study therefore estimated the level of technical efficiency (TE) and analyzed its determinants among smallholder tea farming households in Bomet and Nyamira counties of western Kenya. The two counties are among the leading tea producing counties in Kenya and provided a fair representation of the tea growing areas in western Kenya. The counties have relatively similar agro-ecological conditions, which was necessary to minimize the effects of geo-climatic variability in the analysis of efficiency.

II. Methodology

a) Theoretical Framework

Estimation of TE in this study follows a framework based on agricultural production theory where a typical tea farming household is assumed to use owned and purchased inputs to produce tea and other farm outputs. The household's production technology, therefore, utilizes a vector of inputs; $(x_1,...,x_n) \in \Re_+^n$ to produce a non-negative vector of outputs; $(y_1,...,x_m) \in \Re_+^m$. The household's production possibility set (PPS) which is the collection of all the feasible input-output vectors is the subset T of the space $\Re_+^{m+n}$ is therefore represented as

$$T = \{(YX) : X \text{ can produce } Y\} \in \Re_+^{m+n} \quad (1)$$

The tea farming household may select any input-output configuration in T as its production plan. Since it faces an optimization problem, based on inputs and outputs, analysis of the performance of a tea farm requires specification of a technical relationship that reflects the choice combination of inputs that leave the farm with the most output given its feasible output set (Varian, 1992). The production function which theoretically represents the maximum output that can be obtained from a given set of inputs (Jehle and Reny, 2011), can be specified as

$$Y = F\left(X^{t^i}, Z^{t^i} \middle| \sum_i Z^{t^i} \le \bar{M} \right) \quad (2)$$

Where, *Y* is a vector of agricultural outputs, *X* and *Z,* are vectors representing purchased and farmer-controlled inputs which typically include fertilizer, labor, and land respectively. The superscript, t^i reflects the seasonality and sequential nature of agricultural production stages imposed by biological characteristics. Such a recursively separable structure of the production process implies for instance that labor applied for pre-harvest activities such as planting and weeding is separable from labor applied to harvesting activities. The vector, *M* represents the maximum use or availability of services made possible by the fixed stock of farmer-controlled inputs in each stage of the production process. Equation 2 emphasizes the fact that there are some unique features that typify agricultural production and that while there are some parallels with other sectors of the economy, the extent to which the features occur in agriculture has implications on how they can be represented empirically (Debertin, 2002; Karagiannis, 2014).

The behavioral relationship between inputs and output can further be characterized by returns to scale (RTS) in production. The farm's technology can exhibit constant returns to scale (CRS) or variable return to scale (VRS). In CRS production technology, a given percentage increase in inputs leads to the same percentage rise in output. However, in the VRS, a given percentage increase in inputs could lead to a less or more than proportionate increase in output (Daraio and Simar, 2007). Representation of returns to scale in agricultural production analysis indicates whether any efficiency gains can be obtained by adjusting the scale of operation of a farm (Tolga *et al.,* 2009). The theoretical premise is that a production function represents the boundary of the PPS and a farm operating on its production function could be considered to be efficient in the use of its inputs. In this context, efficiency in tea production reflects the choice of production technology that leaves the farm with the most output given its possible output set. This corresponds to the characterization of technical efficiency (TE) in traditional economic theory.

The study followed the framework developed by Farell (1957) in which inefficiency is theorized as the extent to which a farm's inputs can be contracted towards the boundary of the PPS represented by the idealized isoquant such as the CC' shown in figure 3. The isoquant assumes a production technology of the firm characterized by smooth, continuously differentiable, constant returns to scale (CRS) and a strictly quasi-concave production function.

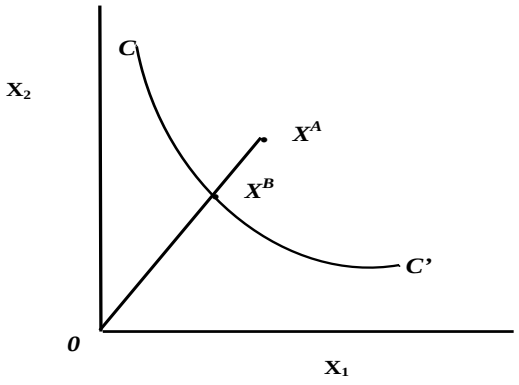

Figure 3: Conceptualization of TE Based on an Idealized Isoquant

The input vectors X^A and X^B represent the combination of inputs used by two farms A and B to produce a unit of output. If the curve CC' represents the efficient unit isoquant (EUI), then X^B represents an efficient input set for producing a unit of output while X^A is an inefficient input set. According to Farrell (1967), the level of TE of farm A would be represented by the fraction $\frac{OX^B}{0X^A}$ since it represents the proportion of inputs that an efficient farm (in this case farm B) uses to produce the same level of output (Farrell, 1957). In this manner, the measure of TE shows the possible proportional reduction of inputs that can be achieved for farm A without any reduction of its output.

Technical efficiency conceptualized in this context can be estimated using data envelopment analysis (DEA), a non-parametric linear programming (LP) specification that involves comparison of observed producers with each other. DEA is premised on the existence of a production frontier or a best practice technology and variations in performance in the transformation of inputs and outputs among producers in an industry. It involves fitting a linear quasi convex hull around the input –output data of observed farms then determining TE as each farm's distance from it (Daraio and Simar, 2007). The assumption is that any deviations from the hull are attributed to inefficiency.

Using the efficiency scores obtained from DEA, variations in the scores across small holder tea farmers can then be analyzed. Variation in the TE scores are thought to be due to agent and structural factors (Ogada *et al.,* 2014) consisting of policy and institutional variables, the internal structure of the farm and agency factors such as the levels of human capital and experience of the farmer (Yoshiko, 2011; Kiprono, 2013). Policy and institutional factors in tea production include the marketing channels for sale of green leaf, access to extension and credit services. The farm specific factors include farm size, tea variety planted, location of the farm and age of tea bushes. The farm household characteristics that could affect efficiency include age of the farmer, household type, labour structure in tea farming and education level attained by the household head.

b) Empirical Models and Estimation Procedures

i. *Estimation of Technical efficiency in smallholder tea farms*

The study estimated the TE of smallholder farms using the DEA model under an assumption of a VRS production technology to allow the determination of scale inefficiencies. The linear programming VRS DEA model was specified as;

$$\underset{\theta,\lambda}{Minimize}\ \theta \tag{3}$$

Subject to

$$-Y^q + \lambda Y \geq 0 \tag{4}$$

$$\theta X^q - \lambda X \geq 0 \tag{5}$$

$$\sum_{n=1}^{n} \lambda = 1 \tag{6}$$

where θ represents the proportion of the farm's input bundle needed to produce its own output, Y^q is tea output of the q^{th} farm, X^q is the level of the input set used on q^{th} farm for tea production (including fertilizer, labour and land) and λ is the weight given to each farm in the construction the frontier. The model is interpreted as seeking a frontier farm that can produce at least the output of the q^{th} farm, using the smallest possible multiple of its inputs. It is solved n times to obtain efficiency scores for all the farms in the sample.

The characterization of the nature of the returns to scale (RTS) was achieved by estimating an additional non-increasing returns to scale (NIRS) DEA model in which the convexity constraint in equation 6 was replaced with

$$\sum_{n=1}^{n} \lambda \leq 1 \tag{7}$$

The RTS of the individual tea farms in the sample was then determined by checking whether the TE scores obtained from the VRS and NIRS models were equal. A farm is considered to experience decreasing or increasing returns to scale if the TE score obtained from NIRS and VRS DEA models are equal or not equal, respectively (Banker *et. al.*,2004). The final step in the analysis of TE involved an extension of the VRS DEA model to account for input slacks whose values indicate the amount by which the constraints in the model are not fully satisfied. The slacks therefore, represent the amount by which inputs are overused relative to the efficient farms (Padilla-Fernandez and Nuthall, 2012).

ii. *Determinants of technical efficiency in smallholder tea farms*

Analysis of the effect of the various factors on TE was evaluated by applying the fractional Regression Model (FRM) proposed by Papke and Wooldridge (1996; 2008) to model bounded and fractional dependent variables. The model was considered appropriate for analyzing DEA scores since it is based on a functional form that imposes the restriction that the conditional mean of the dependent variable is bounded within the interval [0, 1]. The model was specified as;

$$TE_i = g(z)[X_j\beta] + \varepsilon_i \quad \text{for i} = 1,2,\ldots,N \text{ and } j = 1,2,\ldots,11 \tag{8}$$

where, the vector X consist of institutional and market factors as well as farm characteristics hypothesized to be correlated with TE and $g(.)$ is some nonlinear

function satisfying the condition that $0 \leq g(z) \leq 1$ for all $z \in R$ (Papke and Wooldridge, 1996). The function $g(.)$ is typically modeled as a cumulative distribution function and was estimated as standard normal distribution functions.

c) Research design

The study employed a non-experimental cross-sectional research design to achieve its objectives. The design allowed for the collection of information on household farm, demographic, socioeconomic and institutional characteristics that was necessary for the analysis of efficiency. Data for the study was collected from a cross sectional survey of 525 sampled smallholder farmers from a target population of 528, 817 smallholder tea farming households spread across Bomet and Nyamira Counties of Kenya. The multi-stage random sampling procedure was used whereby the two counties were purposively selected, being among the leading tea producing counties in Kenya and present a fair reflection of the variability in farm size across the tea growing areas in Kenya (KTDA, 2013). Stratification of counties into administrative sub-counties was done followed by a random selection of one tea growing sub-county from each county. Two administrative divisions were randomly selected from the selected sub-counties from which farming households for the survey were selected randomly. The sample size was proportionately distributed across the selected divisions based on the population of tea farming households in each division. Data was obtained from the sampled farming households by the interview method guided by a structured questionnaire in the period between December 2015 and March 2016.

d) Study variables and their measurement

The variables covered in the study were defined and measured as indicated in table 1.

Table 1: Definition and Measurement of Variables

Variable	Definition and measurement
Output:	The quantity of harvested tea (Green leaf) in kilograms per year.
Education:	The education status of the household head measured in terms of the highest level of education attained (1= primary, 2 = secondary, 3 = tertiary 4= university)
Labour	The quantity of labour used in tea production activities, measured in man-days per year with one man-day equivalent to 6 hours
Fertilizer	The quantity of fertilizer in number of 50 kilogram bags applied on the tea farm per year
Farm size:	The total area under tea crop in acres
Labour structure	The proportion or percentage of family labour applied in tea farming
Gender	The sex of the household head, measured by a dummy: 1 if male, 0 otherwise.
Extension services (FFS)	This is participation of the household in the farmer field school (FFS) program, measured as a dummy: 1 if participating in FFS, 0 otherwise.
County dummy	Used to account for the fixed regional effects: 1if Bomet county, 0 otherwise
Age of the tea farm:	Captured how old the tea bushes are, measured by the number of years since current tea crop/bushes were establishment or planted.
(ATMC participation)	This is participation of the household in an Alternative tea market channel (ATMC) measured using a dummy: 1 for participation in ATMC, 0 otherwise.

III. Empirical Results and Discussions

a) Descriptive Summaries on Data

The descriptive summary of the data on study variables is presented in table 2 for continuous variables.

Table 2: Summary Statistics for the Continous Variables

Variable	Total sample (n = 525)		Bomet	Nyamira	
	Mean	Std dev	Mean	Mean	t score
Farm size (acres)	1.3	1.1	1.6	1.2	3.8
Fertilizer per farm (bags)	4.6	3.8	5.8	3.9	5.8
Labor per farm (Mandays)	163.9	138.5	136.2	180.1	3.5
Labor structure (%)	58.2	45.5	62.3	55.7	1.6
Age of farm (Years)	27.0	14.9	21.8	30.1	6.4
Output per farm (Kgs)	3208.3	3019.8	5035.9	1820.0	14.0
Yields per farm(kgs/acre)	2745.9	2067.6	3907.9	2064.9	10.9
Distance to market (kms)	2.90	2.73	2.84	2.93	0.39

The differences in the means are significant for values of t above 1.8

The summary shows that the operated tea farms within the sample were relatively small ranging between 0.1 and 7 acres with a mean of 1.3 acres. This was expected in the context of on-going subdivision of farms that is prevalent in the areas covered by the study (Republic of Kenya, 2014b). The average farm size under tea in the two counties was 1.6 and 1.2 acres for Bomet and Nyamira County, respectively. The statistically significant difference in the mean size of tea farms between the two counties implies that that smallholder tea farms in Bomet are relatively larger than in Nyamira, which is consistent with the demographic structure in the two counties (Republic of Kenya, 2009).

Apart from land, fertilizer and labour are the other key inputs used in tea production. The average amount of fertilizer applied was 4.6 bags of 50 kilogram (kgs) fertilizer per farm with a standard deviation of 3.8 bags. This level of fertilizer use is below the recommended annual rate of 5 bags per acre (TRFK, 2002). The average annual labour utilized per farm in the overall sample was 163.9 man-days compared to a mean of 136.2 man-days for Bomet County and 180.1 man-days for Nyamira County. The summary indicates that while the smallholder farmers in Bomet County used more fertilizer, those in Nyamira had higher levels of labour use. In terms of the structure of labour, on average 58.2 percent of the labour used was supplied by the household while the remaining 41.8 percent was hired. The difference in the average proportion of household labour between the two counties was statistically insignificant, which indicates that the labour structure in the two counties was relatively similar.

At the farm level, the age of the tea farm is an important characteristic since aging tea plantations are associated with decline in tea productivity (Kamau, 2008). The average age of tea bushes in the sample was 27 years. Comparatively, the results revealed that the difference in the mean age of tea bushes in the two counties was statistically significant. The mean age was 21.8 years for Bomet and 31.1 years in Nyamira County, which indicates that tea bushes in Bomet County were relatively younger and therefore expected to be more productive than those in Nyamira County.

With regard to the tea output, the mean annual output per farm was 3208.3 kgs of tea with a standard deviation of 3019.8 kgs and a range of 100 kgs to 14400 kgs. The mean annual tea output per farm in Bomet was 5035.9 kgs compared to 1820 kgs for Nyamira County. The mean annual yield for the overall sample was 2745.9 kgs per acre compared to 3907.9 kgs and 2064.9 kgs per acre for Bomet and Nyamira County, respectively. This shows that farmers in Bomet County had higher annual yields per acre than their counterparts in Nyamira County a difference that could be attributed to the application of higher fertilizer rates, younger and more productive tea bushes and differential utilization of agricultural credit. The average distance from the farm to the nearest market was 2.9 kilometres with a standard deviation of 2.7 kilometres.

Summary statistics for categorical variables are presented in table 3 which shows that 84.2 percent of the sampled households were headed by males while the remaining 15.8 percent were female headed. On education, 45.3 percent of household heads had attained primary level education, 40.2 percent had secondary level education, 9.6 percent had attained college education while only 5 percent had university education. The latter indicate that majority of the sample farmers had no training at the higher education level.

Table 3: Summary Statistics for the Categorical Variables

Variable	Measure	Combined		Bomet		Nyamira		Z test
		Freq	%	Freq	%	Freq	%	Z score
Gender	Male	442	84.2	168	86.6	274	82.8	1.16
	Female	83	15.8	26	13.4	57	17.2	1.16
Education	Primary	238	45.3	91	46.9	147	44.4	0.55
	Secondary	211	40.2	70	36.1	141	42.6	1.47
	Tertiary	50	9.6	24	12.4	26	7.9	1.70
	University	26	5.0	9	4.6	17	5.1	0.25
Tea variety	Yes	315	60.0	133	68.6	182	55.0	3.06
	No	210	40.0	61	31.4	149	45.0	3.06
Extension (FFS)	Yes	277	52.8	107	55.2	170	51.4	0.84
	No	248	47.2	87	44.8	161	48.6	0.84
market channel	KTDA	334	63.6	109	56.2	225	68.0	2.71
	ATMC	191	36.4	85	43.8	106	32.0	2.71

The differences in the means are significant for values of t above 1.8

Given that at the farm level, the variety of tea planted can have significant influence on yields, the study considered whether the household had planted improved clonal varieties or the non-improved seedling tea varieties. The summary in table 3 show that 60.0 percent of the sampled households had planted

improved tea varieties. The proportion of farms with the improved clonal varieties in Bomet County was 68.6 compared to 55.0 percent in Nyamira County. The higher rate of adoption observed in Bomet County may to some extent explain why the county had achieved better performance in terms of tea yields. The higher adoption rate of tea clones in Bomet County could be attributed to county's proximity to the Tea Research Institute (TRI) which is responsible for the release of tea clones to farmers and is.

The summary also indicates that 52.8 percent of the sampled farmers had access to the FFS extension systems with no significant difference in the two sampled counties. The study also considered whether the household exclusively sold its green leaf to a Kenya Tea Development Authority (KTDA) factory or used alternative market channels (ATMCs). The ATMCs considered in the study included the sale of green leaf through middlemen or the multinational and private tea factories. The summary reveals that the KTDA channel was used by majority of the farmers and accounted for nearly 63.6 percent of the sample. Therefore only 36.4 percent of the farmers used the alternative markets channels. However at each county level, 43.8 percent of farmers in Bomet used the alternative channels compared to only 32 percent in Nyamira County. The results imply that the ATMC which is an outcome of the liberalization of the tea sector has since grown and currently commands a sizable share of the green leaf market.

b) Technical Efficiency scores for the sampled smallholder farmers

A summary of the TE scores obtained for each of the sampled farms is presented in table 4

Table 4: Frequency Distribution of The TE scores for sampled farms

TE scores	Combined sample			Bomet			Nyamira		
	N	%	Cum %	N	%	Cum %	N	%	Cum %
0- 0.10	4	0.8	0.8	0	0.0	0.0	4	1.2	1.2
0.11-0.20	62	11.8	12.6	10	5.2	5.2	52	15.7	16.9
0.21-0.30	93	17.7	30.3	19	9.8	15	74	22.4	39.3
0.31-0.40	91	17.3	47.6	27	13.9	28.9	64	19.3	58.6
0.41-0.50	98	18.7	66.3	39	20.1	49	59	17.8	76.4
0.51-0.60	50	9.5	75.8	28	14.4	63.4	22	6.6	83.0
0.61-0.70	42	8.0	83.8	25	12.9	76.3	17	5.1	88.1
0.71-0.80	29	5.5	89.3	13	6.7	83.0	16	4.8	92.9
0.81-0.90	12	2.3	91.6	8	4.1	87.1	4	1.2	94.1
0.91-1.00	44	8.4	100.0	25	12.9	100.0	19	5.9	100.0
Total	525	100.0		194	100.0		331	100.0	

Table 4 shows that the TE scores had a wide distribution ranging between 0.07 and 1.0. Such a wide variation in efficiency among smallholder tea farmers was also reported in the studies by Kiprono (2013) and Nguyen-van and To-the (2014) who reported a distribution ranging from 0.01 to 0.74 for smallholder tea farmers in Kenya, and 0.05 to 0.95 among smallholder tea farmers in northern Vietnam, respectively. The distribution is however inconsistent with Hong and Yabe (2015) who reported a distribution ranging from 0.62 to 0.97 for Vietnamese smallholder tea farmers. The frequency distribution of the TE scores across the sample indicates that smallholder tea farmers in the study area were comparatively less efficient with majority (66.3 percent) having relatively low TE scores (< 0.5), while only 8.4 percent had scores of more than 0.9. The farmers from Nyamira County were proportionately less efficient than their counterparts from Bomet County because the proportion of farmers whose TE scores were above 0.5 was 51 percent for Bomet compared to only 24 percent in Nyamira County.

Under VRS assumptions which the study adopted in the estimation of efficiency scores, TE can be decomposed into two mutually exclusive and non-additive components; Pure TE and scale efficiency (SE). The first component reflects the managerial performance of the farm in organizing inputs in the production process. The latter component expresses whether a farm is operating on an optimal scale and provides a measure of the farm's ability to choose the optimal size. Such decomposition is useful in providing insights about the sources of inefficiency since inappropriate size (too large or too small) may also be a cause of inefficiency in production. The comparative analysis of the average TE and SE scores for the smallholder farmers in the two counties is presented in table 5.

Table 5: The Mean TE scores for Bomet and Nyamira County

	Bomet (n =194) Mean	Nyamira (n=331) Mean	Difference		sample (n=525)	
			Difference	t statistic	Mean	Std Dev
Mean TE	0.55	0.41	0.14***	7.03	0.46	0.24
Mean SE	0.82	0.59	0.23 ***	9.38	0.67	0.28

The asterisks (***) denotes statistically significant difference at 1% level

As shown in table 5, the mean TE score obtained in the overall sample was 0.46 showing that smallholder tea farmers in the study areas were technically inefficient and are less successful in employing the production technology of the best practice farmers. Although the average TE score estimate in this study is higher compared to the 0.15 from Kiprono (2013) for smallholder tea farmers in Kenya, the result still indicates that there exists enormous opportunities for efficiency gains in tea production in the two counties. This is because, the average efficiency score of 0.46 means that by adopting the production practices of the best practice farmers, smallholder tea farmers can achieve their current tea production levels using only 46 percent of the resources currently in use under tea production. There is therefore a considerable potential in the smallholder tea sector to improve the wellbeing of tea farmers through improvement in TE.

The results further show statistically significant difference in the means of the TE and SE scores between Bomet and Nyamira with smallholder tea farmers from Bomet performing significantly better than their counterparts from Nyamira County. The better performance in TE by smallholder tea farmers in Bomet County may be attributed to the fact that the county had better adoption levels of clonal tea varieties and relatively younger tea bushes. The other probable factors would be the more intensive use of fertilizer and better access to credit and FFS extension as revealed in the summary statistics on the sample data. The difference in efficiency levels suggests that although the tea growing areas appear to have relative similarities in agro-ecological conditions, there are location specific heterogeneities that influence the attainment of efficiency in smallholder tea production. Such heterogeneities need to be considered in policy formulations targeting improved efficiency in the tea sector.

The SE scores provide empirical evidence that smallholder tea production is not scale neutral and the contribution of scale is an important source of efficiency variation in tea production. The source of scale inefficiency was analysed in terms of whether a farm was characterized by increasing or decreasing returns to scale. Understanding of returns to scale is important in indicating whether any efficiency gains can be obtained by adjusting the size or scale of operation of a farm (Tolga *et. al.,* 2009). For instance, farms experiencing increasing returns to scale can benefit by becoming larger or similarly farms at the optimal scale can suffer efficiency losses if the scale of production is adjusted. Table 6 shows the distribution of the DEA model results on return to scale among the sampled tea farms.

Table 6: The Distribution of Returns to Scale from the DEA Model

Returns to scale	Frequency	Percent	Cumulative
Decreasing (DRS)	44	8.38	8.38
Increasing (IRS)	470	89.52	97.9
Optimal scale (OS)	11	2.1	100.0
Total	**525**	**100**	**100.0**

The results revealed that only 2.1 percent of the farmers were operating at optimal scale. Majority of the farms (89.5 percent) were characterized by increasing returns to scale while 8.3 percent of the farms exhibited decreasing returns to scale. The fact that majority of the smallholder tea farms in the study area are not operating at or near to their optimal scales suggests that there are scale advantages in tea production which can be harnessed by increasing the scale of operation of the smallholders.

c) The Determinants of Technical Efficiency

To analyse the determinants of TE in smallholder tea production, the TE scores obtained from DEA were regressed on various explanatory variables hypothesised to be correlated with TE. The marginal effects from the estimated model are presented in table 7. Various model diagnostic tests were conducted on the estimated model and the results presented in table 8 indicate that the selected covariates provided good estimate of the estimated specification.

Table 7: The Marginal Effects from the Fractional Regression Model

Variable	Dependent Variable: TE Score		Z value	P value
	Coefficient	Std. error		
Farm size	-0.165***	0.031	-5.27	0.000
Square of farm size	0.021***	0.006	3.35	0.001
County dummy	0.157***	0.021	7.37	0.000
Variety of tea	0.011	0.019	0.58	0.561
Age of farm	-0.006**	0.003	-2.23	0.026
square of age of farm	0.000	0.000	1.76	0.078
Gender of household head	-0.015	0.028	-0.55	0.585
Education (primary)	0.080**	0.035	2.29	0.022
Education (secondary)	0.074**	0.034	2.17	0.030
Education (college)	0.077*	0.040	1.91	0.057
Extension (FFS)	0.053***	0.019	2.79	0.005
Distance to market	-0.002	0.004	-0.53	0.598
Labour structure	0.046*	0.024	1.91	0.055
Market channel	0.074***	0.021	-3.58	0.000

*The asterisks denotes significance (*** at 1%, ** at 5% and * at 10 %) and the marginal effects for dummy variables refer to the discrete change from 0 to 1*

Table 8: The model diagnostic tests results

Test	Test	Ratio/value	P value
Wald test : Chi ^{2} (14 df)	Goodness of fit	200.49	0.000
Link test for model specification:			
Hat coefficient	Specification	1.569	0.000
Hat^2 coefficient		-0.244	0.399
LM test : Chi ^{2} (14 df)	Heteroskedasticity	8.63	0.656

From table 8, the p-value of the Wald test statistic was less than 0.01indicating that explanatory variables are jointly statistically significant in influencing efficiency in the smallholder farms in the sample. It was therefore concluded that the model was correctly specified.

The results in table 7 show that farm size, age of the farm, level of education attained by the household head, access to extension services, the labour structure and use of alternative marketing channels other than KTDA have significant influence on the level of efficiency attained by smallholder tea producers in the study area. The coefficients for variety of tea planted, gender of household head, and distance to the nearest market were statistically insignificant. The latter suggests that variations in efficiency scores across the sampled farms cannot be attributed to observed differences in tea varieties planted, gender of household head or distance travelled to markets.

The results of the regression confirm significant difference in efficiency across the different counties because of the positive and statistically significant coefficient of the county dummy, which was included to capture the effects due to location specific or regional heterogeneities. The results indicated that on average smallholder tea farmers in Bomet were technically more efficient than those in Nyamira County as had been reported in the data summaries in table 5. Findings of Kavoi *et al.* (2001) and Kiprono (2013) had also indicated regional heterogeneities in smallholder tea productivity between farms on the west and east of the Rift Valley.

The coefficient for farm size was negative while that of its quadratic term which was introduced to examine whether the negative effects of farm size on TE would persist at all levels of farm size was positive and also statistically significant. The finding indicate that the effect of farm size on efficiency is non-linear with TE first falling and then rising with increase in farm size. This result is at variance with the inverse productivity relationship that is reported among various agricultural enterprises in various countries (Rios and Shively, 2005) but is consistent with the tea farm consolidation and enterprise diversification programs envisaged in the proposed National Tea Policy (Republic of Kenya, 2014a).

The age of the tea farm was considered in the study guided by the fact that peak yields for tea are obtained between ages of 25 to 40 years after planting, followed by a decline to a level where the tea gardens may become moribund (Kamau, 2008). The coefficient for the variable was negative with a magnitude indicating that increase in the age of the tea farm by one year about the average age of 27 in the sample, would lead to a reduction in TE by 0.006. However, the coefficient of the square of age of the firm was statistically insignificant indicating lack of empirical evidence for a non-linear relationship with efficiency achievements among the sampled smallholder tea producers. The results are consistent with experimental studies that have shown that younger tea plantations are generally associated with higher productivity in most tea growing regions in the world (Bore, 1996) and are also in conformity with tea industry's assertions that aging tea gardens were causing stagnation in tea productivity (Republic of Kenya, 2014a). To reverse the decline in yields due to aging of tea bushes, other countries such as Sri Lanka, India and Malawi are implementing tea replanting programs for their smallholder farmers.

On the level of education attained by the household head, the results show significant differences in efficiency levels of farm household heads with tertiary, secondary or primary levels of education when compared to those with university education. Smallholder farms whose household heads have lower than university education had higher levels of TE than farm households headed by individuals with university education. The result is inconsistent with the expectation that education should improve access to information and understanding on the importance of proper farming practices. However, a plausible explanation could be related to the fact that more educated farmers have a higher opportunity cost of labour as they can earn higher returns outside farming (Yoshiko, 2010). This leads to differential allocation of time to tea farming activities where the farmers with university education although deriving some incomes from tea farming, could be allocating less time to tea production activities.

The positive coefficient for the FFS extension suggests that tea farms household that had participated in the FFS program were more efficient than the non-participating ones. This is similar to the results in Onduru *et al.* (2012) who found that participation in FFS had a positive and significant influence on tea yields in selected tea growing regions in Kenya. The FFS is a new approach to extension which was adopted by the tea sector to address the weaknesses of the conventional training and visit (T&V) approaches (Mose *et. al.,* 2016). The attractiveness of FFS is associated with its use of participatory adult leaning approaches and emphasis on stronger linkages between research, extension and farmer experimentation (Friis-Hansen, 2004).

For labour structure, the coefficient was positive implying that an increase in the share of family labour applied in tea production is associated with higher levels of efficiency. Ogada *et al.* (2014) found a similar outcome on food crops production in Kenya where households that utilized hired labour had lower TE scores than households that used family labour. Regarding the marketing of green leaf, the coefficient for market channel was positive with a value of 0.074. This means that on average, the TE of farm households that had participated in the alternative tea market channels was higher compared to those households that had not participated.

Although the adoption of high yielding crop cultivars is thought to be one of the major sources of productivity growth in agriculture, the study found a statistically insignificant influence. The results suggest that the variety of tea planted was not an important source of difference in the TE scores of the sampled households. Kiprono (2013) also found that tea variety was not an important source of efficiency variation in tea production in Kenya. The finding may be due to the possibility that gains from the improved varieties are countervailed by the fact that traditional varieties are more adaptable to climatic variability and adverse growth conditions. The traditional seedling varieties have the ability to develop a vertically descending tap root unlike the clonal varieties which have a tendency to develop a spreading root system within the fertile and upper layers of the soil (Wickramaratne, 1981).

The coefficient for gender of the household head was insignificant implying that the TE of farm households headed by females was not statistically different from the TE of the farm households headed by males. Although the finding is in contrast with Hong and Yabe (2015) who found that male headed households had higher levels of TE than the female headed households, it is not a strange occurrence. Quisumbing (1996) in a survey on differences in TE between male and female farmers in agricultural production across various studies found that six in seven studies had insignificant dummies for gender of the household head. Chirwa and Kydd, (2006) also found no statistical evidence of gender differences in tea productivity in Malawi.

The distance to markets was included as an indicator of market related transaction costs since an increase in the distance to markets can act as an economic disincentive to the farmers. The estimated coefficient for distance to nearest market was not statistically significant. This might be explained by the recent improvements in road infrastructure in the country and the emergence of motorbikes as a popular mode of transport in rural areas. The improved access to market as a result of these developments would have diminished the influence of distance to markets as a variable explaining TE in tea farming.

IV. Conclusions and Policy Implications

This study has revealed that smallholder tea farmers are technically inefficient with an estimated TE efficiency score of 0.46 which indicates an opportunity for many farmers to enhance their technical efficiency and productivity. Analysis of the determinants of efficiency scores provide information that TE in smallholder tea production can be improved through policies that promote adoption of labour saving technologies, consolidation of management in the small tea farms in order to benefit from the scale advantages, expansion of the FFS extension program and tea replanting to replace the aging or moribund tea gardens. The policy formulation in the tea sector should also accounts for the county specific heterogeneities in the different tea growing counties. This would require measures that foster adequate participation of all the key stakeholders at the county level during the policy formulation process.

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Plagiarized content will not be considered for publication. We reserve the right to inform authors' institutions about plagiarism detected either before or after publication. If plagiarism is identified, we will follow COPE guidelines:

Authors are solely responsible for all the plagiarism that is found. The author must not fabricate, falsify or plagiarize existing research data. The following, if copied, will be considered plagiarism:

- Words (language)
- Ideas
- Findings
- Writings
- Diagrams
- Graphs
- Illustrations
- Lectures

- Printed material
- Graphic representations
- Computer programs
- Electronic material
- Any other original work

Authorship Policies

Global Journals follows the definition of authorship set up by the Open Association of Research Society, USA. According to its guidelines, authorship criteria must be based on:

1. Substantial contributions to the conception and acquisition of data, analysis, and interpretation of findings.
2. Drafting the paper and revising it critically regarding important academic content.
3. Final approval of the version of the paper to be published.

Changes in Authorship

The corresponding author should mention the name and complete details of all co-authors during submission and in manuscript. We support addition, rearrangement, manipulation, and deletions in authors list till the early view publication of the journal. We expect that corresponding author will notify all co-authors of submission. We follow COPE guidelines for changes in authorship.

Copyright

During submission of the manuscript, the author is confirming an exclusive license agreement with Global Journals which gives Global Journals the authority to reproduce, reuse, and republish authors' research. We also believe in flexible copyright terms where copyright may remain with authors/employers/institutions as well. Contact your editor after acceptance to choose your copyright policy. You may follow this form for copyright transfers.

Appealing Decisions

Unless specified in the notification, the Editorial Board's decision on publication of the paper is final and cannot be appealed before making the major change in the manuscript.

Acknowledgments

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

Declaration of funding sources

Global Journals is in partnership with various universities, laboratories, and other institutions worldwide in the research domain. Authors are requested to disclose their source of funding during every stage of their research, such as making analysis, performing laboratory operations, computing data, and using institutional resources, from writing an article to its submission. This will also help authors to get reimbursements by requesting an open access publication letter from Global Journals and submitting to the respective funding source.

Preparing your Manuscript

Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.

Manuscript Style Instruction (Optional)

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11'", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

Structure and Format of Manuscript

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

a) A title which should be relevant to the theme of the paper.
b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
d) An introduction, giving fundamental background objectives.
e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
f) Results which should be presented concisely by well-designed tables and figures.
g) Suitable statistical data should also be given.
h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.

Format Structure

It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

All manuscripts submitted to Global Journals should include:

Title

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

Author details

The full postal address of any related author(s) must be specified.

Abstract

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Keywords

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, “What words would a source have to include to be truly valuable in a research paper?” Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods

Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

Formulas and equations

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

Tables, Figures, and Figure Legends

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.

Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

Preparation of Eletronic Figures for Publication

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

Tips for Writing a Good Quality Science Frontier Research Paper

Techniques for writing a good quality Science Frontier Research paper:

1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of science frontier then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.

6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10. Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.

Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

The Administration Rules

Administration Rules to Be Strictly Followed before Submitting Your Research Paper to Global Journals Inc.

Please read the following rules and regulations carefully before submitting your research paper to Global Journals Inc. to avoid rejection.

Segment draft and final research paper: You have to strictly follow the template of a research paper, failing which your paper may get rejected. You are expected to write each part of the paper wholly on your own. The peer reviewers need to identify your own perspective of the concepts in your own terms. Please do not extract straight from any other source, and do not rephrase someone else's analysis. Do not allow anyone else to proofread your manuscript.

Written material: You may discuss this with your guides and key sources. Do not copy anyone else's paper, even if this is only imitation, otherwise it will be rejected on the grounds of plagiarism, which is illegal. Various methods to avoid plagiarism are strictly applied by us to every paper, and, if found guilty, you may be blacklisted, which could affect your career adversely. To guard yourself and others from possible illegal use, please do not permit anyone to use or even read your paper and file.

Criterion for Grading a Research Paper (Compilation) by Global Journals

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals.

Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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or email us at helpdesk@globaljournals.org

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