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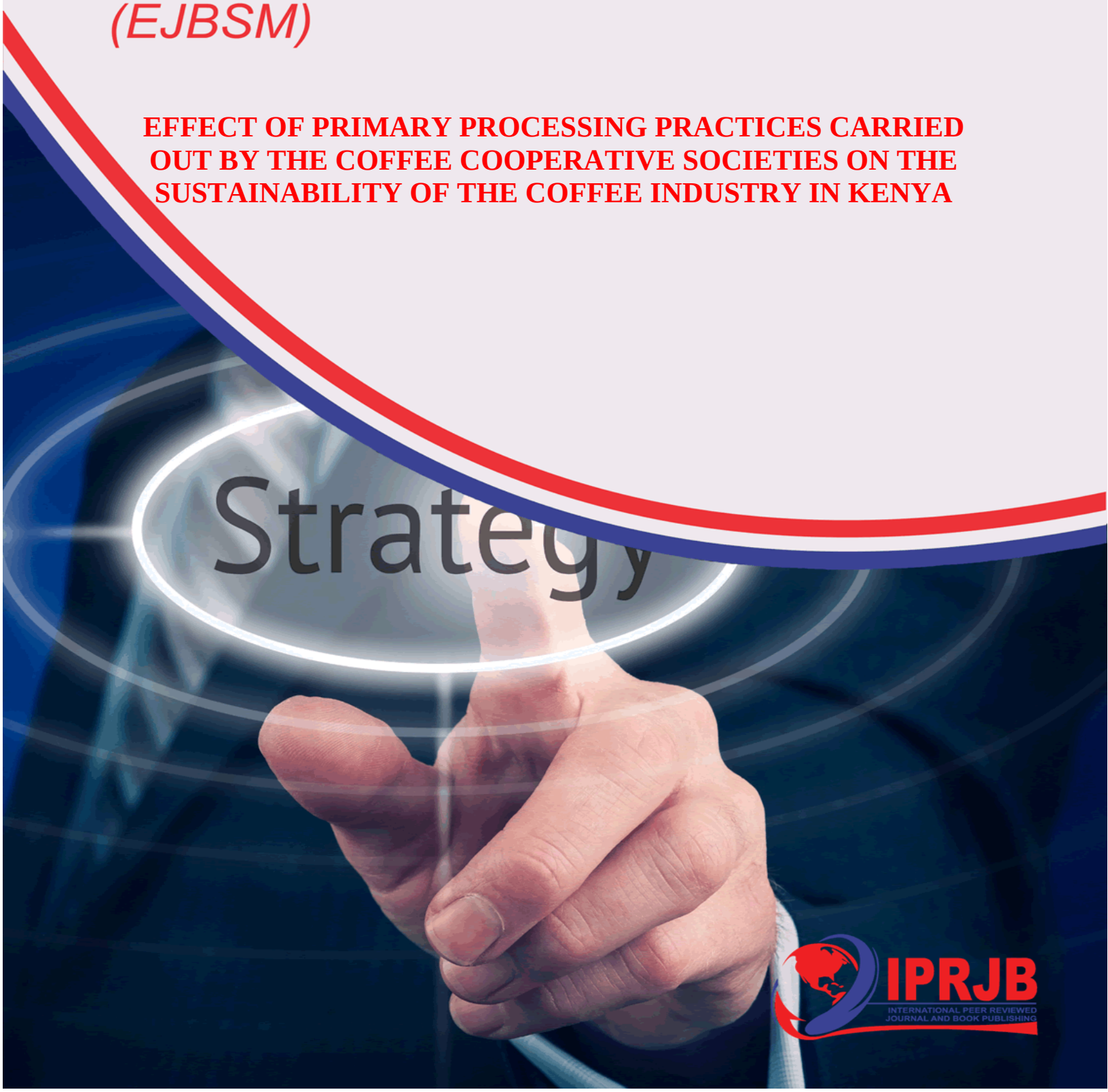

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Effect of Primary Processing Practices Carried out by the Coffee Cooperative Societies on the Sustainability of the Coffee Industry in Kenya

1*Regina Wambui Mwangi

PhD. student, Dedan Kimathi University of Technology

Email address: rw.mwangi2015@gmail.com

2* Dr. Lilian Karimi Mugambi Mwenda

Senior Lecturer, Dedan Kimathi University of Technology

Email address: lilian.mwenda@dkut.ac.ke

3* Dr. Anita Wanjugu Wachira

Senior Lecturer, Dedan Kimathi University of Technology

Email address: anita.wachira@dkut.ac.ke

4* Dr. David Kiarie Mburu

Senior Lecturer, Dedan Kimathi University of Technology

Email address: dmburu77@gmail.com

Abstract

Purpose: The study sought to analyze the effect of primary processing practices carried out by the coffee cooperative societies on the sustainability of the coffee industry in Kenya.

Methodology: The study adopted descriptive research design. From a target population of 525 coffee cooperative societies in the East and West of the Rift valley, a sample size of 295 coffee cooperative societies was drawn using stratified random sampling where the response rate was 82.71 percent. The chair persons were the key respondents. A cross sectional survey was conducted where the self-administered questionnaire. Collected data was analyzed using descriptive and inferential statistics.

Results: The results showed that the primary processing practices and sustainability of the coffee industry are positively and significantly related. Using the regression of coefficient, the primary processing practices had a beta value of 0.462 with a *t-value* of 4.21 and p=0.000. Since p is <0.05, the null hypothesis was rejected at a significant level of 0.05.

Unique contribution to theory, practice and policy: The study recommended that there is need to invest heavily on training of employees for effective primary processing in a bid to boost the sustainability of the coffee industry. Further in order to boost the sustainability of the coffee industry, the study recommends that the coffee cooperative societies should engage in appropriate drying of the parchment coffee, invest in machinery for wet processing and use sustainable sources of energy.

Key words: *primary processing practices, sustainability, coffee cooperative societies, coffee industry*

INTRODUCTION

Coffee is an important commercial crop within the tropics; the plant is native of the tropical rain forests of Ethiopia (Kodigehalli & Wolfgang, 2011). The coffee tree originated from the province of Kaffa, Ethiopia (Kegonde, 2005). Coffee is of great significant on the world economy; being the largest single commodity in the international trade (Dimat, 2012; Kodigehalli & Wolfgang, 2011), and second in value after petroleum and petroleum products as a foreign exchange earner, contributing up to 50% in most of the developing countries (ICO, 2010; Kegonde, 2005). Coffee plays an important role in the livelihoods of an estimated 25 million small scale coffee farmers under rural settings across the developing world (Gathura, 2013; Dimat, 2012; ICO, 2010). As coffee provides moments of pleasure to millions of consumers worldwide (Kamau, 2015), it is a major source of employment and greatly contributing to infrastructural development in over 80 developing countries (Gathura, 2013; Kodigehalli & Wolfgang, 2011).

The Kenyan coffee industry is notable for its organization through the cooperative system. A 1944 law made it mandatory for all the coffee small holders to join coffee cooperative societies which were controlled by the government (Condliffe et al., 2008). The small scale coffee farmers jointly produce coffee, process and market their own coffee through these societies (Gathura, 2013; ICO, 2010). The coffee small holder sector is made up of 525 active coffee farmers cooperative societies (CFCS) with each serving an average of 2000 small scale holders (Coffee Directorate, 2016). Coffee cooperative societies comprise of one or several coffee factories depending on factors such as the geographical location or the extent and the level of production. Small scale coffee farmers deliver the coffee cherries to the coffee factories which undertake the primary processing activities before the dry parchment coffee is taken up by respective coffee cooperative societies for further processing and marketing (KCTA, 2012). The policy objective of the coffee cooperative societies is to spur sustainable economic growth while achieving the desired outcomes through the strengthening of the coffee cooperative societies, diversification of coffee products, improving access to markets and marketing efficiency (Gweyi, Ndigwa & Karagu**,** 2013).

The dependence on natural resources and semi-processed agricultural produce for Kenyan exports, traces its history back to the 1884 scrabble for Africa. As a way of integrating Africa in global trade, the continent was to produce raw materials and agricultural produce for industrial production and household consumption in European countries. Kenya became one of the best producers of coffee and tea, Ghana for cocoa and Ivory Coast for banana and pineapple. To date, Kenya still heavily depends on raw or semi-processed agricultural produce such as green coffee for her foreign exchange earnings (Chege, 2012). With this form of production, low economic value is thus generated as compared to when there are value addition practices. Adding value close to the sites of production such as primary processing practices is not only important but economically plausible. This traditional approach may however, not be sustainable in the present highly competitive age. Coffee value addition involves enhancement to coffee whose returns are higher to the coffee farmers. Value addition practices raise the value of a product in the market which enables or enhances an increase in the profit margins.

Lynch (2016) defined sustainability as the adoption of practices and the creation of products and services that are socially, environmentally, and economically stable, while addressing the needs of the present without compromising the requirements of future generation. According to Food and Agriculture Organization (FAO) (2003), sustainability of the coffee sector refers to meeting the

needs of the present generation coffee industry without compromising the ability of future generations coffee industry to meet its own needs. Sustainability is anchored on the three major pillars: environmental, economic and social. Hence for the coffee industry to remain both viable and sustainable it must meet the financial, social and environment needs of the small scale coffee farmers.

Problem Statement

The once thriving coffee sub sector, which was a steady and reliable source of livelihood for millions of small scale coffee farmers in Kenya, and which enjoyed national prominence as the biggest foreign exchange earner faces many challenges. These challenges are manifested in the steady decline in coffee production from 128,700 Metric Tonnes in 1987/1988 to 39,800 Metric Tonnes by 2013/2014; this decline has reduced Kenya's position in coffee production from 12th to 24th worldwide. This resulting in a drastic reduction of coffee earnings to the small scale coffee farmers. This has led to coffee farms being diversified and abandoned, and in the extreme cases, uprooting of the coffee trees. To address this menace the government has instituted many interventions to streamline the coffee sub sector since 1986, but the situation remains grim. Kenya plays a marginal role in the advanced stages of coffee value chain as it continues to sell raw green coffee. This raises the question, "Is marketing of green coffee tenable for a sustainable coffee industry in Kenya?" There is need for Kenya to increase the share of the cup value in favor of the small scale coffee growers. This can be realized through the adoption of value addition practices at the primary processing stage in the coffee cooperative societies. Adoption of such value addition practices would transform and adapt the coffee cooperative societies to the dynamics of the sustainable coffee industry hence enhancing their competitiveness. Previous studies on value addition analysis in the coffee sector in Kenya focused mainly on the analysis of the activities, value that was created on each stage and the profit distribution of the value chain actors. None of these studies has focused on primary processing practices carried out by the coffee cooperative societies and their effect on the sustainability of the coffee industry in Kenya. Therefore, this study sought to analyze the sustainability of the coffee industry in Kenya, specifically assessing the effect of primary processing practices carried out by the coffee cooperative societies on the sustainability of the coffee industry in Kenya.

Objective of the Study

The main objective of the study was to analyze the effect of primary processing practices carried out by the coffee cooperative societies on the sustainability of the coffee industry in Kenya.

Theoretical Framework

The Value Chain Model

The concept of the value chain was described and popularized by Michael Porter in 1985, while discussing the subject "Competitive advantage in creating value and sustainable superior performance". Ensign (2001) while quoting Porter (1985), described value chain practices as series of activities or processes which aimed at creating and adding value to a product at every step during the production process, and links them to the organizations competitive position .The value chain model shows the particular configuration of activities that are needed to create value in a product. These activities and the resulting product are unique to a specific firm. Thus value chain analysis is a useful tool for determining the competitive advantage of a firm.

According to Ensign (2001), Porter's value chain model included the primary activities that were directly related to the creation of a product which included inbound logistics, operations, outbound logistics, marketing and sales, and service. The support activities helped to improve effectiveness and efficiency. These included procurement, technology development, human resource management and infrastructure. These activities were described as the value chain stages as depicted in Figure 1. In the current study it was suggested that in the coffee industry, primary processing practices were used to promote competitive advantage in the industry. It was hoped that this automatically led to the sustainability of the coffee industry.

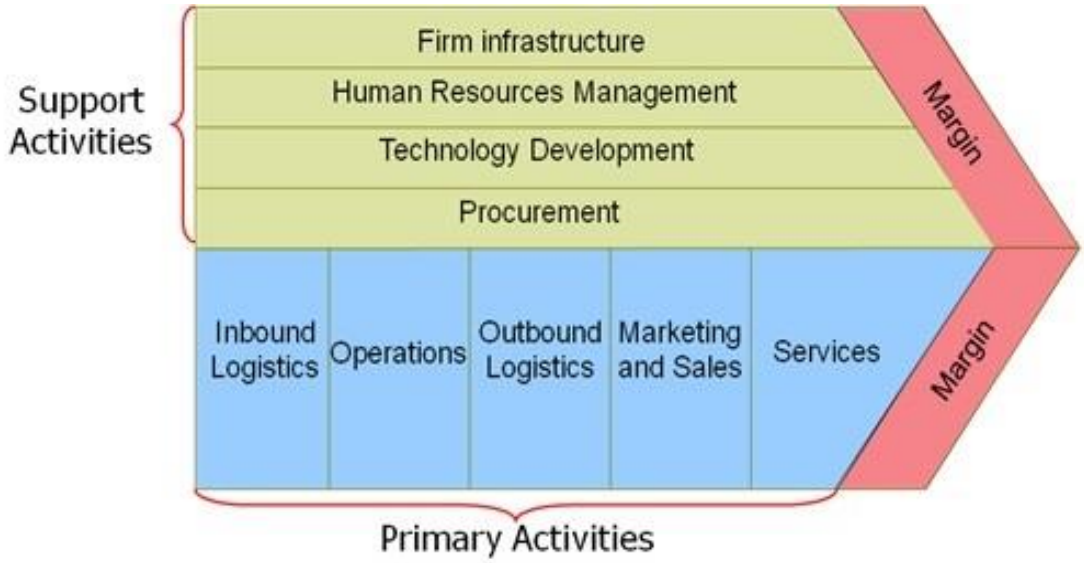

Figure 1 Porters Value Chain Model

Based on the Porters Value Chain model the preposition was that the coffee cooperative societies obtain the parchment coffee from their various coffee factories ready for processing referred by Porter as inbound logistics. In operations (also referred to as processes or practices), value was added to the product as it moved along the coffee value chain until the final stage. For this process to be successful support services required included: obtaining quality coffee parchment; trained personnel who were able to process coffee at different stages and in the right procedures; the infrastructure, which comprise of the coffee cooperative societies which through their management structures ensured efficiency and effective coffee value addition practices.

Empirical Literature Review

Primary processing is a very important stage in processing coffee in Kenya. The fruit of the coffee plant (cherry; coffee fruits harvested for wet or dry processing to parchment or naturals) is converted into the dried parchment (dry un-hulled coffee beans obtained by the wet processing method). After harvesting, ripe cherries are transported to the factories for processing (dry or wet processing). Wet processing involves the removal of the outer layer of coffee cherries also known as pulping, fermentation, washing, under-water soaking, final washing and grading, skin drying, final drying and conditioning (Chege, 2012; CRF, 2010). Over 90% of Kenya's coffee is processed by the wet method while the rest 10% is processed by dry method to produce *Mbuni* (Coffee

obtained from the drying of un-pulped coffee berries that are under ripe, over-ripe or diseased not fit for wet processing). These processes are as depicted in Figure 2.The skin of the fresh cherry is physically removed using a pulper machine with addition of water (pulping). The sugar coating (mucilage) is allowed to ferment over one to two days and then the parchment is washed thoroughly to remove all traces of fermented mucilage (ILO, 2008).

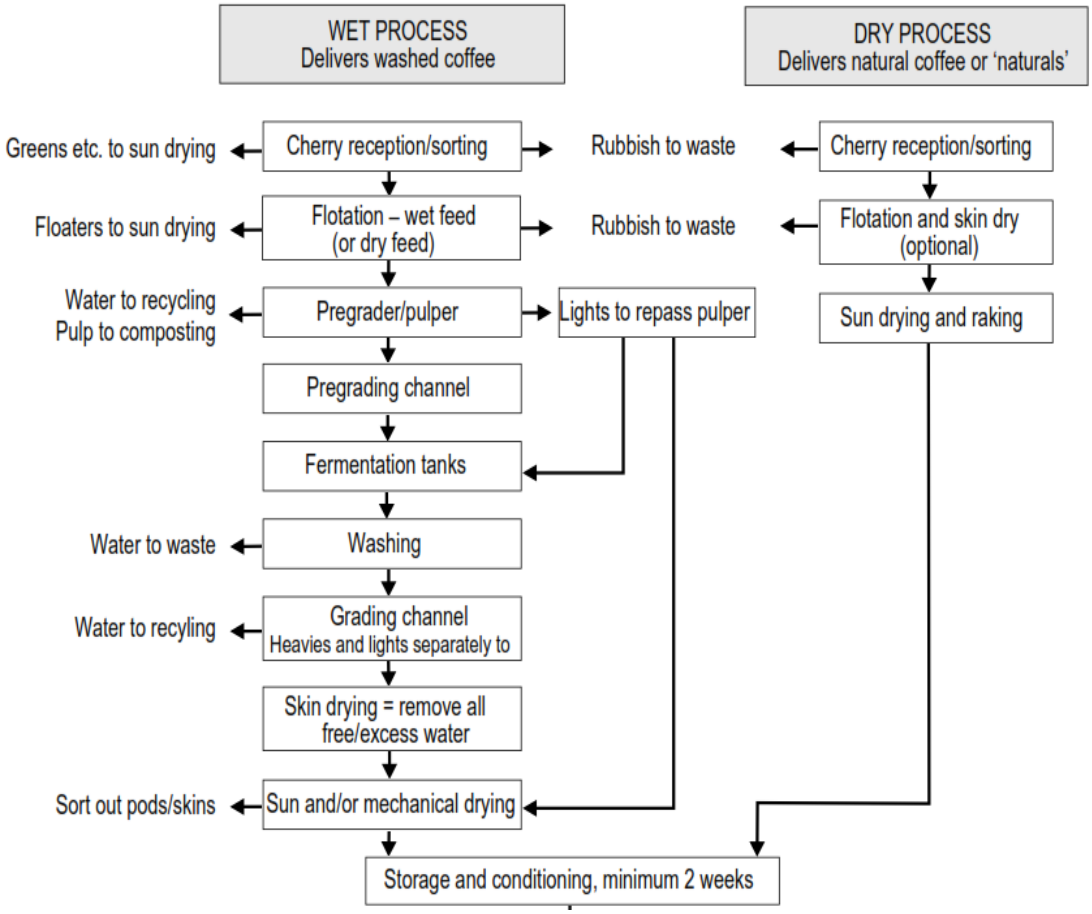

Figure 2. Coffee Primary Processing Activities

The parchment dry until the bean inside reaches 12% moisture content (MC). Mostly the beans are dried in the sun by air circulation to 12-13% moisture content before they are stable (Chege, 2012; Muturi, 2014). As per the Kenyan coffee quality standards context parchment coffee is graded into parchment one, two, three and lights on the basis of weight. The dry parchment is subsequently transported to commercial millers for hulling and grading. Chege (2012) citing the Coffee Act (2001) pointed out that all the small holder coffee farmers must process their coffee through coffee cooperative societies. According to CRF (2010), the wet processing method produces high quality coffee and requires very good management of all the unit operations to ensure the coffee flavor is not damaged in the process.

Each of these unit operations have an influence on the final quality of the coffee produced. If any link in the chain is broken (such as over-fermentation, mould contamination, taints or odors or

physical damage to the bean) then that loss in quality can never be regained. The physical quality of coffee is depended on how the primary wet processing aspects at all the stages are handled; Good manufacturing practices (GMP) the harvesting, sorting, pre-grading, pulping, fermentation, soaking, skin drying, final drying and storage (Muturi, 2014). Wet processed coffee fetches high prices in the coffee market giving the growers good rewards for their produce; this in turn will enhance competitiveness of the high quality coffee products which could lead to sustainability of the coffee industry.

RESEARCH METHODOLOGY

Based on the positivism research philosophy, the study adopted descriptive research design. From a target population of 525 coffee cooperative societies in the East and West of the Rift valley, a sample size of 295 coffee cooperative societies was drawn using stratified random sampling where the response rate was 82.71 percent. The chair persons were the key respondents. A cross sectional survey was conducted where the self-administered questionnaire was the main data collection instrument and was subjected to both the reliability and validity tests. Collected data was analyzed using descriptive and inferential statistics.

RESULTS AND DISCUSSIONS

Descriptive Statistics

Type of Processing (Wet and Dry Processing)

The type of coffee processing was grouped according to the wet and dry processing methods and the results presented in a pie chart in the Figure 3.

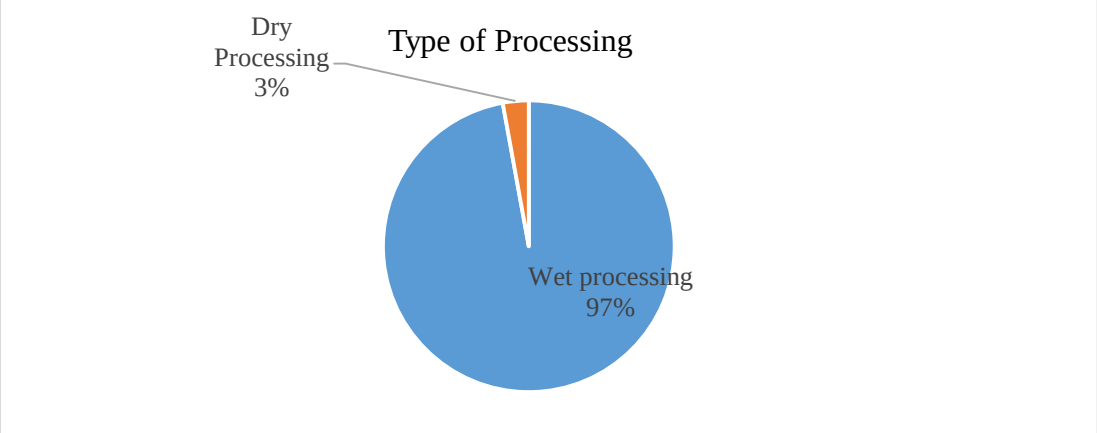

Figure 3 Type of Processing (Wet and Dry Processing)

The primary processing practices which the coffee cooperative societies had adopted were established in the study. According to Figure 3, the results revealed that majority of the coffee cooperative societies had adopted the wet processing (97%) while only 3% had adopted the dry processing method.

Coffee Production in the Coffee Cooperative Societies

The coffee production in the coffee cooperative societies was analyzed from 2011/2012 to 2015/2016 crop years and results depicted in Table 1.

Table 1 Coffee Production in the Coffee Cooperative Societies

Crop year	Less than 1 million Kgs	1 - 2 Million Kgs	2 - 3 million Kgs	3 - 4 Million Kgs	More than 4 million Kgs	Mean	Std. Dev
2011/2012	86.40%	9.20%	2.60%	1.30%	0.40%	1.20	0.59
2012/2013	87.40%	10.40%	0.90%	0.40%	0.90%	1.17	0.54
2013/2014	85.80%	9.90%	1.70%	1.70%	0.90%	1.22	0.64
2014/2015	84.70%	10.20%	3.80%	0.90%	0.40%	1.22	0.59
2015/2016	86.80%	7.20%	2.10%	2.60%	1.30%	1.24	0.73

From Table 1, the findings are very clear that the majority of the coffee cooperative societies received less than one million kilograms of coffee while on the other hand; very few coffee cooperative societies received more than 4 million kilograms. This is a clear indication that the coffee production in Kenya has been on a downward trend. From the production data available, the total output of coffee is far below the potential of 200,000 metric Tonnes (Kamau, 2015) .This therefore implies that the sustainability levels within the industry are far from being realized.

Primary Processing Practices and Sustainability of the Coffee Industry

Primary processing has been identified as the most critical and important stage of coffee processing in Kenya. This is because the primary processing practices are all aimed at achieving high quality coffee. Each of these steps has an influence on the final quality of the coffee produced and if any link in the value addition chain is broken then the impact on quality can be monumental. The primary processing explanatory variables used in this study are; wet processing and dry processing. The mode of processing employed has an impact on the quality of the final product. This is critical since the quality has a great bearing on the sustainability of the industry.

To establish the extent to which the coffee primary processing practices influence sustainability of the coffee industry, a Likert scale of 5 to 1 (5 = strongly agree, 4 = agree, 3 = Neutral, 2 = disagree and 1 = strongly disagree) was used to measure these practices. The mean response rates and the Standard Deviations from the coffee cooperative societies were calculated. The results of this study were as depicted in Table 2.

Table 2 Primary Processing Practices and Sustainability

Statement	5	4	3	2	1	Mean	Std. Dev
Cooperative society has invested in machinery for dry processing in an effort to improve sustainability	22 (9%)	82 (33.5%)	31 (12.9%)	60 (24.5%)	49 (20.2%)	2.87	1.32
The cooperative society has heavily invested in machinery for wet processing so as to boost sustainability	102 (41.6%)	88 (36.1%)	22 (9.2%)	19 (7.6%)	13 (5.5%)	4.01	1.14
The cooperative society has invested heavily on human capital for dry processing to improve sustainability	27 (11.2%)	76 (31.3%)	41 (16.7%)	64 (26.2%)	36 (14.6%)	2.98	1.27
The cooperative society has invested heavily on human capital for wet processing to improve sustainability	72 (29.4%)	101 (41.3%)	30 (12.3%)	22 (8.9%)	19 (8.1%)	3.75	1.20
The cooperative society has invested heavily on training of employees for effective dry processing in an effort to improve sustainability	23 (9.5%)	61 (25.2%)	68 (27.9%)	53 (21.6%)	39 (15.8%)	2.91	1.21
The cooperative society has invested heavily on training of employees for effective wet processing so as to boost sustainability	52 (21.3%)	74 (30.4%)	79 (32.2%)	27 (10.9%)	12 (5.2%)	3.52	1.10
The cooperative society engages in the appropriate drying of the parchment coffee so as to boost sustainability	130 (53.1%)	83 (34.1%)	21 (8.8%)	4 (1.8%)	5 (2.2%)	4.34	0.88
The cooperative society uses sustainable sources of energy to improve the gross margins of the small scale farmers	71 (29.2%)	90 (36.7%)	38 (15.5%)	28 (11.5%)	17 (7.1%)	3.69	1.21
Average						**3.51**	**1.17**

As indicated in Table 2, when coffee cooperative societies engaged in appropriate drying beds for drying coffee parchment, the coffee defects that come as a result of poor or inappropriate drying would be avoided. This in turn ensures that high quality coffee is obtained thus boosting the profit margins. The majority of the respondents asserted that over 90% of Kenya's coffee is processed through the wet method (Chege, 2012; CRF, 2010). Therefore investing heavily in wet processing machinery and on human capital enhances the production of high quality coffee. When coffee cooperative societies used sustainable sources of energy the gross margins of the small scale farmers were improved. In the long run this enhances the sustainability of the coffee industry.

Wet Processing Waste Management

The study sought to find out how the wet processing waste management was being carried out in the wet mills in the coffee cooperative societies. Table 3 summarizes the respondents' responses according to their coffee growing regions.

Table 3 Analysis of Wet Processing Waste Management

Region	Emerging Themes	Comments
Western	Re-cycling of waste water; Solid waste used by farmers as manure	Majority of the coffee factories in the Western region manage waste water by re-cycling and using solid waste as manure
Rift Valley	Solid waste used by farmers as manure	Majority of the coffee factories in Rift Valley region manage solid waste by using it as manure
Nyanza	Pit decomposition; Digging of lagoons; Solid waste used by farmers as manure	Majority of the coffee factories in Nyanza region manage waste water by decomposing it in seepage pits, digging of the lagoons and solid waste as manure
Eastern	Through water channels; Solid waste used by farmers as manure; Digging of lagoons	Majority of the coffee factories in the Eastern region manage waste water through digging water channels, digging of lagoons and solid waste as manure
Central	Solid waste used by farmers as manure; Digging of Lagoons; Draining in seepage pits; Use of soak pits	Majority of the coffee factories in the Central region manage solid waste as manure, waste water by digging lagoons, draining in seepage pit and by using soak pits

From the results as shown in Table 3 it is evident there are different strategies employed in the waste water management in all the coffee growing regions. These included: re-cycling the waste water, draining it to the lagoons or seepage pits or soak pits. It is therefore evident that appropriate waste water management practices were in place in a bid to prevent pollution of the water sources which could lead to loss of sustainability of the coffee industry. The study findings also indicated that the coffee cooperatives also managed the solid waste by giving it to the coffee farmers for use as manure on their farms. This was one the ways of achieving sustainability of the coffee industry by providing manure which reduces the production costs and hence improve the profit margins of the small scale coffee farmers. Wet processing which is used for approximately 90% of coffee processing generates waste water which pollutes water sources, thus affecting the environment. If unchecked, this can lead to increased health risks of the communities, putting sustainability of the coffee industry at risk.

Challenges of Waste Management in Wet Processing

Waste management at the wet mills usually posed a great challenge when managing it. This led to water and soil pollution which may lead to the loss of sustainability of the coffee industry as the environment is degraded. The respondents indicated the challenges they faced in managing the wet primary processing waste management as summarized in Table 4 according to their coffee growing regions.

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Table 4 Challenges of Waste Management in Wet Processing

Region	Emerging Themes	Comment
Western	Recycling machine breakdown	Majority of the coffee factories in the Western region have old recycling machinery
Rift Valley	Inadequate recycling machinery	Majority of the coffee factories in the Rift Valley region have inadequate recycling machinery
Nyanza	Lack of resources	Majority of the coffee factories in the Nyanza region have inadequate resources
Eastern	Poor personnel; Lack of resources; Inadequate recycling machinery	Majority of the coffee factories in the Eastern region lack skilled personnel, adequate resources and adequate machinery
Central	Overflow during rainy season; Recycling machine breakdown	Majority of the coffee factories in the central region lack adequate space for waste and breakdown of recycling machinery

The majority of the coffee wet mills experienced the challenges such as: breakdown of recycling machineries leading to lack of adequate machinery to deal with the waste; outdated technologies in some of the factories; inadequate budgetary resources; lack adequate spaces/land on which to manage the waste; environmental hazards such as prolonged heavy rains, flooding, and poorly trained personnel to manage the waste.

Strategies to Overcome Waste Management in Wet Processing

Table 5 summarizes the respondents' responses according to their coffee growing regions.

Table 5 Strategies to Overcome Waste Management in Wet Processing

Region	Emerging Themes	Comment
Western	Servicing the recycling machines	Majority of the coffee factories in the Western region were servicing the recycling machines
Rift Valley	Encouraging farmers to use it as manure	Majority of the coffee factories in the Rift Valley region were encouraging farmers to use the waste as manure
Nyanza	Encouraging farmers to use it as manure; Mobilization of resources	Majority of the coffee factories in the Nyanza region were encouraging farmers to use the waste as manure and mobilizing resources to be able to manage waste
Eastern	Digging trenches; Buying machines; Digging many pits for storage; Increase number of lagoons	Majority of the coffee factories in the Eastern region were digging trenches to manage their waste, buying more machines, digging more pits and increasing the number of lagoons.
Central	Increase number of lagoons; Digging more pits; Digging more seepage pits	Majority of the coffee factories in the Central region were increasing the number of lagoons to manage waste, digging more pits to and digging more seepage pits.

As indicated in Table 5 the majority of the coffee factories dug more pits, seepage pits and lagoons in order to overcome the challenges of waste water management. The results also indicate that, in the Rift Valley and Nyanza regions they were encouraging their farmers to use the solid waste as manure in their coffee farms.

Correlation Analysis

A Pearson moment correlation analysis was carried out on the test items of primary processing practices to establish the extent to which the items influenced sustainability of the coffee industry in Kenya as indicated in Table 6.

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Table 6 Correlation Analysis of Primary Processing Practices

		Sustainability	machinery DP	machinery WP	human capital DP	human capital WP	training for DP	training for WP	Drying parchment	energy sources
Sustainability	Pearson Correlation	1								
	Sig. (2-tailed)									
machinery DP	Pearson Correlation	.209	1							
	Sig. (2-tailed)	0.1								
machinery WP	Pearson Correlation	0.44**	-.181**	1						
	Sig. (2-tailed)	**0.01**	0.005							
human capital DP	Pearson Correlation	.454	.251**	-0.101	1					
	Sig. (2-tailed)	0.32	0	0.117						
human capital WP	Pearson Correlation	0.44**	-.207**	.695**	-0.029	1				
	Sig. (2-tailed)	**0.003**	0.001	0	0.653					
training for DP	Pearson Correlation	.174	.417**	-.160*	.325**	-.161*	1			
	Sig. (2-tailed)	0.6	0	0.013	0	0.012				
training for WP	Pearson Correlation	.292**	-0.077	.420**	-0.001	.482**	.172**	1		
	Sig. (2-tailed)	**0.003**	0.228	0	0.985	0	0.007			
drying parchment	Pearson Correlation	0.62**	-0.067	.164*	0.002	.173**	-0.045	.160*	1	
	Sig. (2-tailed)	**0.00**	0.3	0.01	0.975	0.007	0.49	0.012		
energy sources	Pearson Correlation	.256**	.395**	0.084	0.009	0.039	.360**	.191**	.167**	1
	Sig. (2-tailed)	**0.02**	0	0.194	0.887	0.55	0	0.003	0.009	

*** Correlation is significant at the 0.05 level (2-tailed).**
**** Correlation is significant at the 0.01 level (2-tailed).**

The results in Table 6, revealed that investing heavily in machinery for wet processing and sustainability are positively and significantly related (r=0.44, p=0.01); investing heavily on human capital for wet processing and sustainability are positively and significantly related (r=0.44, p=0.003); similarly investing heavily on training of employees for effective wet processing and sustainability are positively and significantly related (r=0.292, p=0.003); appropriate drying of the coffee parchment and sustainability are positively and significantly related (r=0.62, p=0.000) and using sustainable sources of energy and sustainability (r=0.256, p=0.02) are positively and significantly correlated.

However, the investing in machinery for dry processing (r=0.209, p=0.10), the investing heavily on human capital for dry processing (r=0.454, p=0.32) and the investing heavily on training of employees for effective dry processing (r=0.174, p=0.60) did not have any influence on the sustainability of the coffee industry.

Regression Analysis

The objective of the study was to analyze the effect of primary processing practices carried out by the coffee cooperative societies on the sustainability of the coffee industry in Kenya. Regression analysis was used to examine whether primary processing practices can be used to explain sustainability of the coffee industry. The results presented in Table 7 present the fitness of model used for the regression analysis in explaining the study phenomena.

Table 7: Model Fitness for Primary Processing Practices

Variables	Coefficients
R	**0.569**
R^2	**0.324**
Adjusted R^2	**0.301**
Std. Error of the Estimate	**1.185**

Primary processing practices were found to be satisfactory in explaining sustainability of the coffee industry. This is supported by coefficient of determination also known as the R^2 of 0.324. This means that the model fitness found out that primary processing practices explain 32.4% of the variations in the dependent variable which is sustainability of the coffee industry.

Table 8 Analysis of Variance for Primary Processing Practices

	Sum of Squares	df	Mean Square	F	Sig.
Regression	132.001	8	16.5	10.924	**0.000**
Residual	354.962	235	1.51		
Total	486.963	243			

Table 8 provides the results on the analysis of the variance (ANOVA). The results indicated that the model was statistically significant. Further, the results implied that the independent variable is a good predictor of sustainability. This was supported by an F statistic of 10.924 and the reported p value (0.000) which was less than the conventional probability of 0.05significance level. Regressions of coefficient results were presented in Table 9.

Table 9 Regression of Coefficients for Primary Processing Practices

	B	Std. Error	t	Sig.
(Constant)	1.1	0.499	2.206	0.028
machinery for dry processing (PP1)	0.044	0.075	0.586	0.559
machinery for wet processing (PP2)	0.652	0.097	-1.566	**0.009**
human capital for dry processing (PP3)	0.102	0.062	0.155	0.070
human capital for wet processing (PP4)	0.319	0.096	0.196	**0.035**
training for dry processing (PP5)	0.18	0.078	-2.298	0.072
training for wet processing (PP6)	0.298	0.085	3.491	**0.001**
appropriate drying of the parchment (PP7)	0.748	0.075	-1.968	**0.000**
sustainable sources of energy (PP8)	0.296	0.069	4.314	**0.003**

Regression of coefficients of primary processing practices showed that machinery for wet processing and sustainability had a positive and significant relationship (r=0.652, p=0.009).These findings agreed with that of CRF (2010) who argued that investing on machinery for wet processing boosts the sustainability of coffee industries. The results also revealed that human capital for wet processing and sustainability had a positive and significant relationship (r=0.319, p=0.035). The results also revealed that training of employees for wet processing and sustainability had a positive and significant relationship (r=0.298, p=0.001). The results also revealed that appropriate drying of the parchment coffee and sustainability had a positive and significant relationship (r=0.7488, p=0.000). The results also showed that sustainable sources of energy and sustainability had a positive and significant relationship (r=0.296, p=0.003). These findings agreed with that of CRF (2010) who argued that having sustainable sources of energy boosts the sustainability of the industry.

The aggregate mean score of primary processing practices was regressed against sustainability index to give the optimal model for primary processing practices. The results were as presented in Table 10

Table 10: Optimal Regression Model for Primary Processing Practices

	B	Std. Error	t	Sig.
(Constant)	0.734	0.438	1.676	0.095
Primary processing practices	0.650	0.124	5.244	**0.000**

Regression of coefficients showed that primary processing activities and sustainability had a positive and significant relationship (r=0.65, p=0.000). The results thus do indicate that the equation for establishing whether primary processing practices has a statistically significant effect on sustainability of the coffee industry was:

$$S = 0.734 + 0.65\,PP + \varepsilon$$

S - Sustainability of the coffee industry

PP - Primary Processing practices

ε - error term

This model shows that when coffee cooperative societies engage in primary processing practices, it would lead to a 65% increase in sustainability of the coffee industry.

The impact of primary processing practices on sustainability of the coffee industry is thus statistically significant at a significant level of $p<0.05$, $t=5.244$. This means that there is a statistically significant relationship between the computed primary processing practices and sustainability of the coffee industry.

Hypothesis testing for primary processing practices was done.

The Hypothesis to be tested was:

H_{01}: There is no effect of primary processing practices carried out by the coffee cooperative societies on the sustainability of the coffee industry in Kenya.

Table 11 Hypothesis Testing for Primary Processing Practices

	Sum of Squares	Df	Mean Square	F	Sig.
Regression	49.685	1	49.685	27.497	**0.000**
Residual	437.278	242	1.807		
Total	486.963	243			

The hypothesis was tested by using simple linear regression (Table 11). The acceptance/rejection criteria was that, if the p value is greater than 0.05, the H_{01} is not rejected but if it's less than 0.05, the H_{01} fails to be accepted. Therefore the null hypothesis that there is no effect of primary processing practices carried out by the coffee cooperative societies on the sustainability of the coffee industry in Kenya.

The null hypothesis was that there is no relationship between primary processing practices and sustainability of the coffee industry in Kenya. Results in Table 11 show that the p-value was 0.000 while F statistics was 27.497. This indicated that the null hypothesis that there is no effect of primary processing practices carried out by the coffee cooperative societies on the sustainability of the coffee industry in Kenya was rejected.

Summary of Findings

The objective was to analyze the effect of primary processing practices carried out by the coffee cooperative societies on the sustainability of the coffee industry in Kenya. To achieve this objective the respondents indicated their level of agreement to various primary processing practices particularly in wet and dry methods. The study hypothesized that there was no statistically significant relationship between primary processing practices and sustainability of the coffee industry. The results showed that the primary processing practices and sustainability of the coffee industry are positively and significantly related. Using the regression of coefficient, the primary processing practices had a beta value of 0.462 with a *t-value* of 4.21 and p=0.000. Since p is <0.05, the null hypothesis was rejected at a significant level of 0.05. This therefore implies that the primary processing practices have a positive and significant effect on the sustainability of the coffee industry.

Conclusion

The study concluded that primary processing practices affects the sustainability of the coffee industry positively. Holding other factors constant, primary processing practices account up to 46.2% of the sustainability of the coffee industry. The most significant aspect of the primary processing practices was the engagement in appropriate drying of the parchment coffee with a beta value of 0.748 which boosted the sustainability of the coffee industry. This was closely followed by investment of machinery for wet processing with a beta value of 0.652 which also boosted sustainability of the coffee industry. The study also concluded that the coffee cooperative societies that invest heavily on human capital for wet processing (with a beta value of 0.319), training their employees for effective wet processing (with a beta value of 0.298) and uses sustainable sources of energy (with a beta value of 0.296) improved the gross profit of the small scale coffee farmers, hence boosting sustainability of the coffee industry.

Recommendations of the Study

The study recommended that there is need to invest heavily on training of employees for effective primary processing in a bid to boost the sustainability of the coffee industry. Further in order to boost the sustainability of the coffee industry, the study recommends that the coffee cooperative societies should engage in appropriate drying of the parchment coffee, invest in machinery for wet processing and use sustainable sources of energy. This improves the gross profit of the small scale coffee farmers, hence boosting sustainability of the coffee industry

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