East Coast Fever Effect on Smallholder Dairy Farmers' Dairy Herds' Capital Assets in Kisumu East Sub-county, Kenya

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Abstract: **East Coast Fever (*Theileriosis)* is a tick-borne disease that causes significant dairy herd capital assets loss to smallholder dairy farmers particularly in areas outside Compulsory Cattle Cleansing demarcated areas. Record of exotic dairy cattle mortality in in Kisumu County livestock production office indicated that smallholder dairy farmers lost up to 70% exotic dairy cattle to East Coast Fever (ECF) during the implementation of Livestock Development Program (LDP). This was confirmed by this study conducted among 168 smallholder dairy farmers keeping 1-5 dairy cattle on 1-4 acres land in this areas in Kisumu County which is outside compulsory cattle cleansing area. The collected data was analyzed using descriptive Statistics, Analysis of Variance (ANOVA) and Pearson Chi-square (χ^2) applied on recorded ECF cases, the outcome of mitigation processes applied against ECF, effects of ECF on farmers' Dairy Herds capital assets using Statistical Package for Social Sciences (SPSS). The study indicated that dairy farmers incurred losses in both exotic dairy herds' capital to ECF and some of the ECF endemic stable indigenous breeds to Tick Borne Diseases (TBDs) due to poor application of disease mitigation measures. During the analysis of this study, two factors significantly contributed to the dairy farmer losses: Late introduction of dairy farming to smallholder farmers in this study area outside formerly compulsory tick control; dairy farmers in this study area did not get early exposure of dairy farming like the dairy farming communities in area the white settlers introduced dairy farming as early as 1954. The other factor was breakdown of community dips following enactment of Livestock Structural Adjustment Program (SAP's) that exclusively transferred ticks control responsibility from the government provided services by veterinary department to dairy farmers in all part of Kenya**

Keywords: **East Coast Fever, Smallholder Dairy Farmers, Cattle Cleansing Policy, exotic breed, endemic stable indigenous breed, Tick Borne Diseases, dairy herd capital assets, exotic and crossbred dairy breed.**

1.   INTRODUCTION

Seventy percent (3.3 million) of the 3.5 million dairy cattle producing 4.2 billion litres of milk every year in Kenya are kept by over one million smallholder dairy farmers, earning the farmers over one hundred billion shillings annually from milk sales. The dairy sector provides over 350,000 employments at farm level and additional 400,000 informal jobs in the sector and close to 50,000 formal service provision opportunities in milk marketing sector, (Gachuiri, Lukuyu, and Ahuya, 2012). According to Via Paolo report (2011), over 800,000 rural population livelihood depends on smallholder farmers' keeping 1-5 cattle on 1-2 hectares of land.

Smallholder farmers have dominated Kenya Dairy sector over the last 30 years and has controlled 80% of milk produced and marketed in Kenya according to Mbugua, Njonge, Kariuki, Waiyaki and Mwaniki (2012), Ministry of Livestock and Fisheries Development (MoLFD) (2004), Muriuki (2003) and Muthee (2006) reports. Whereas Staal, Pratt & Jabbar (2008) and Dorward, Sabates, MacAuslan, Buckley, Kydd, & Chirwa, (2006) reports indicate that smallholder dairy

production will lead to poverty reduction and address the rising demand for livestock products; devastating loss and stagnation of dairy herd capital assets mainly attributed to effect of ECF (*Theileriosis)* described in McMillan, (2012), Rubaire et al., (2004), Swai et al., (2005) and Okuthe & Buyu, (2006) reports pose a serious threat to the expectation.

Colonial Compulsory Tick Control Policy Paper of 1954 restricted keeping of exotic breed exclusively to white Settlers and a few African farmers whom had required skills to control Tick Borne Disease as compulsory cattle cleaning act.required. When the Act was finally lifted between in 1962 by Swynnerton *Plan,* Swynnerton *(*1954), increased number of African farmers started commercial dairy farming keeping exotic and crossbred dairy breed. Although the change resulted in increased milk produced by the smallholder dairy farmers the decision resulted into increased spread of ECF and loss of vulnerable exotic breed of cattle to TBDs, where farmers kept ECF endemic stable indigenous breed of cattle together with ECF highly susceptible exotic

Table 1: Area of Dairy Farming Concentration in Kenya

Region	Area/County
Western	Lugari, Kakamega, Busia, Teso, Bungoma and Vihiga,
Central	Kiambu, Nyeri, Muranga, Kirinyaga, Nyandarua and Muranga,
Parts of Eastern	Machakos, Embu and Meru
Coast	Taita Taveta, Kilifi, Kwale
Rift Valley	Uasin Gichu, Trans-Nzoia, Bomet, Kericho, Buret, Sotik, Nandi and Ngong

breeds of cattle (Gitau, 1998); (Kariuki, 2008); (Chenyambuga et.al, 2010) and (Gachohi et.al, 2012). The situation forced the government to institute a dairy Structural Adjustment Policy (SAP) proposed by Kibaki commission. Structural Adjustment Policy liberalized dairy industry and introduced cost sharing on tick control between Kenya government and livestock keeping community (Karanja, 2003). The action resulted into collapse of communal dips operations left in the hands of farmers according to Catley (2001), especially in hot dry areas among the communities not formerly hosting exotic breed of cattle. The Smallholder resource limited dairy farmers' attempt to control fails they use poorly constituted accaricide because they are not able to regularly buy accaricide. Use of poorly constituted accaricide leads to ticks developing resistance to a number of brands of accaricide Maingi (2010) unlike in the areas dairy farmer acquired tick control skills from early introduction of the exotic breeds of cattle in Table 1.

The study was done to assess the effect of ECF disease on smallholder farmers' Dairy Herds' Capital Assets in Winam and Kadibo divisions in Kisumu East Sub-county, Kisumu County. The information obtained will inform extension workers, policy makers and farmers on measures needed to control tick population and reduce effect of ECF in areas exotic breeds of cattle were introduce after implementation Structural Adjustment Policy.

It is expected that farmers would be expected to limit loss dairy herd and realize increase in herd size for poverty reduction improved livelihood from dairy farming proceeds.

2. METHODOLOGY AND MATERIAL EXPERIMENTAL MATERIAL

The Location of the Study

The study was carried out in Winam and Kadibo divisions in Kisumu East Sub-county of Kisumu County in Kenya. This area comprised 577 km^2 with 93882 households. The area has farmers keeping 1090 Indigenous and exotic cattle with approximately 200 farmers keeping exotic and crossbred dairy cattle. The farmers in the area practice integrated mixed crop and animal production. The area receives between 560 mm and 1630 mm rainfall annually (Jaetzold, 2009), and experience temperature range of 20$^{\mathrm{O}}$C to 30$^{\mathrm{O}}$C (MoA 2008). The area was chosen for the study because livestock keeping is one of the farmers' main livelihood occupations. Extensive and zero grazed mixed dairy farming are commercially practiced by smallholder farmers to supply milk and milk products to urban centers markets within and about the study areas. Kisumu East sub-county where the study was conducted was one of the former districts where Livestock Development Program which gave exotic dairy cattle to selected women groups was implemented and was one of Livestock Development Programme (LDP) districts which registered the highest death of exotic dairy breeds to ECF according to Livestock Development Programme 2007 report (MoLD2010).

Despite the highest death of exotic dairy breeds registered during LDP implementation, the County Government of Kisumu and NGOs in the sub-county still had significant number of projects/programs implementing dairy farming to improve smallholder farmers' livelihood financial and dairy herd capital assets. This is because a well-managed dairy enterprise is perceived as one of the best paying commercial agriculture business for smallholder farmers having 1-4 acres plots.

Population of the Study, Sampling Procedure and Sample Size

This study targeted 200 smallholder dairy farmers in Kisumu East sub-county keeping at least 1-5 exotic and crossbred dairy cattle on 1-4 acres in the study location although the sub–county had 1090 dairy farmers keeping 2187 cattle at the time of this study (GoK, 2013). Study also included 20 Staffs of the State Departments of Agriculture and Livestock Development as minor group for the study.

The study population was 1090 dairy farmers and the sampling frame was dairy farmers keeping at least 1-5 exotic and crossbred dairy cattle on 1-4 acres from the Division Livestock Extension Officers 2013 annual reports in the two divisions. A sample size of 168 farmers was calculated as below using by Kothari (2008) formula as follows.

$$n = \frac{z^2 . p . q . N}{e^2(N-1) + z^2 . P . q}$$

Where,

N = Target Population

N = Sample size

e = Sampling error / alpha error/ confidence interval (2% 0r 0.02)

z = 2.005 = (as per table of area under normal curve for the given confidence level of 95.5 %)

p = 0.02 (Proportion of defectives within the universe)

q = 1-p

Hence:

$$n = \frac{2.005^2 . 0.02 .(1-0.02). 200}{0.02^2(1090-1) + 2.005^2 . 0.02(1-0.02)} = \frac{85.88}{0.511} = 168$$

n (sample size) = 168 respondents

The 168 dairy farmers were randomly selected from record of dairy farmers in 17 locations in

Table 2: Proportionate Study Sampling from the 17 Location Study Units

Division	Location	Sampled (s) out of 200 (n) Target Dairy Farmers	(x) Percentage sample: $x = \frac{s}{200} 100$	(n) Sample target each of 17 Study Unit: $n = \frac{X}{100} . 168$
Winam Division	East Kisumu	6	3	5
	Kajulu East	13	6.5	11
	Kajulu West	35	17.5	29
	Kolwa central	16	8	13
	Kolwa East	5	2.5	4
	Kolwa West	6	3	5
	Kondele	1	0.5	1
	Miwani	7	3.5	6
	Town location	11	5.5	9
Kadibo	Bwanda	15	7.5	13

Division	North Kawino	10	5	8
	South Kawino	15	7.5	13
	Kanyagwal	5	2.5	4
	East Kochieng'	15	7.5	13
	West Kochieng'	15	7.5	13
	Katho	15	7.5	13
	Kombura	10	5	8
	Total	200	100	168

Winam and Kadibo Division. The division were selected because the dairy farmers had the characteristics of the interest for the study. The study adopted proportionate sampling to have logical representation of 17 locations based on the concentration of dairy herd in each sampling unit as shown in Table 2 according to Exotic and exotic cross breed dairy population recorded in the two divisions 2013 annual reports.

Data Collection Procedure

Records of Smallholder dairy farmers and State Department of Agriculture Livestock and Fisheries department staff records in the Winam and Kadiboo were used to locate and make appointments with sampled respondent smallholder farmers for interview and administration of questionnaires to target staffs. One on one interviews were held between the respondents introduced to the researcher by extension staffs during data collection.

Data Analysis

The collected data were summarized into appropriate quantitative and qualitative analyzable data and were analyzed using Statistical Package for Social Sciences (SPSS) version IBM 20.0. Descriptive statistics. Frequencies, means, standard deviation and percentages were used to summarize and describe respondents captured information.

Analysis of varriance (ANOVA) and Pearson Chi-square inferential statistics at $p \leq 0.05$ were used to determine significant incidence and effect of TBD with special reference to impact of ECF on the smallholder dairy Farmers' dairy herd capital assets. P-value ≤ 0.05 (equals or greater 0.05) was considered statistically significant results. A minor sub group data obtained from Agriculture Extension Staff Opinion was analyzed alongside the objective to provide better understanding where the respondent responses required technical information to corroborate the findings from the smallholder dairy farmers' collected information.

3. RESULTS AND DISCUSSIONS

Introduction

The socio-economic factors influencing dairy farming sustainability and productivity in the study area were considered. These were gender household participation in dairy management activities, education level of farm manager and farm owner. The technical area that were analyzed included dairy production systems targeting tick control and ECF mitigation measures and number of exotic dairy breed and indigenous dairy breed lost to ECF and other TBDs.

Respondents' representation by Units of Study Area

The two divisions of Kisumu Sub County were equitably represented at 53% and 47% respondents from Winam and Kadibo respectively with average percentage concentration of respondents of 17 locations at; 0.5% being the lowest location representation and the highest representation at 25.1%. Kondele (a location within the Kisumu City) had the least representation of 0.5% whereas Kolwa Central had the highest respondents' representation of 25.1% in the distribution curve. Generally the highest concentrations of smallholder dairy farmers were registered in the Kochieny West, Kajulu West, Bwanda, South Kawino and Kolwa Central; locations close to the dairy products market provided by Kisumu city market. This finding confirms Omore, Muriuki, Kenyanjui, Owango & Staal (1999) and De Leeuw, Omore, Staal &Thorpe (1999) observations that smallholder farmers high concentration are usually found next to urban centres for access to market.

Description of Individual Engagements in Dairy Management and Business

The study indicated that 89% of the respondents manage their own dairy farms while 11% engaged farm managers to take care of the animal on their behalf. The significant high percentage of repondent personal occupation on dairy farming agree with what is reported by FAO (2012) stating that smallholder farmers in Asia, Africa, and Latin America reliably depend on livestock as the main source of their income. The study indicated that there were more of respondents (10.8%) undertaking dairy production between the ages of 36 to 40 years and 61 to 70 years. The two divisions' main age bracket comprised, the newly married youth without formal employments seeking reliable source of income for the families and formally employed retirees who felt dairy farming provided a reliable occupation to invest their retirement benefits for continued income after retirement.

Gender Involvement in Dairy Farming

Study results indicated low female participation in dairy activities in Kisumu County representing only 17% out of 167 respondents interviewed compared to 83% males. This finding is different with Land O'Lakes Internatiol Development (2013) report indicating high involvment of women in the entire dairy value chain engagements in former Rift Valley and Central Provinces in Kenya. The report also stated that female active involvement in dairy activities significantly contributed to the good performance and success of dairy enterprise in Rift Valley and Central Province following practical experience obtained from the white settlers.

Education of the Smallholder Dairy Farmers

The representation of dairy owners by level of education was 44.9%, 28.7%, and 19.2% for primary, secondary and tertiary education holders respectively. Although the respondents agreed dairy farming ensured continuous flow of income, they considered it a technically risky venture for people with basic primary education especially where scientific explanations must be technically done.

East Coast Fever Occurrence on Smallholder Dairy Farmers' Cattle

Theileriosis (East Coast Fever) occurrence was studied against three other TBDs; *Babesiosis* (Red Water Disease), *Anasplasmosis* (Gull Disease of Red Blood Cells) and *Cowdriosis* (Heart Water). The purpose was to compare how the diseases affected indigenous and exotic dairy cattle. The findings of the study indicated that *Theileriosis* (East Coast Fever) generally affected exotic dairy breed followed by *Anaplasmosis, Cowdriosis* and *babesiosis* in that order. *Anasplasmosis* affected more indigenous dairy herd while ECF came third, (Figure 1). This result effectively reflects ECF disease economic importance as described in McMillan, (2012), Rubaire et al., (2004), Swai et al., (2005), and Okuthe & Buyu, (2006) report that the prevalence of ECF among smallholder dairy farmers in characteristic environment has negative impacts on dairy herd population and dairy performance. The study results also indicated that a significant number of smallholder farmers had not attached economic importance needed to mitigate dairy herds health problem. The findings indicated that, up to 66% did not know the cause of their cattle ailments and did not seek veterinary intervention at all. The data collected from 168 respondents keeping different breeds of cattle indicated that EFC occurred different number of times in the smallholders dairy farms. The disease occurred once in 45 farms and twice in 17 farms over a period of one year for diagnosed and reported cases. ECF cases where most of indigenous cattle infections occurred were neither reported nor diagnosed. According to Nyanza Provincial Director of Veterinary Services (2012); exotic dairy breeds are attacked by ECF three to five times a year. The cost of treating an ECF infected exotic breeds according to Wesonga (2009) is approximately Kshs. 16,000.
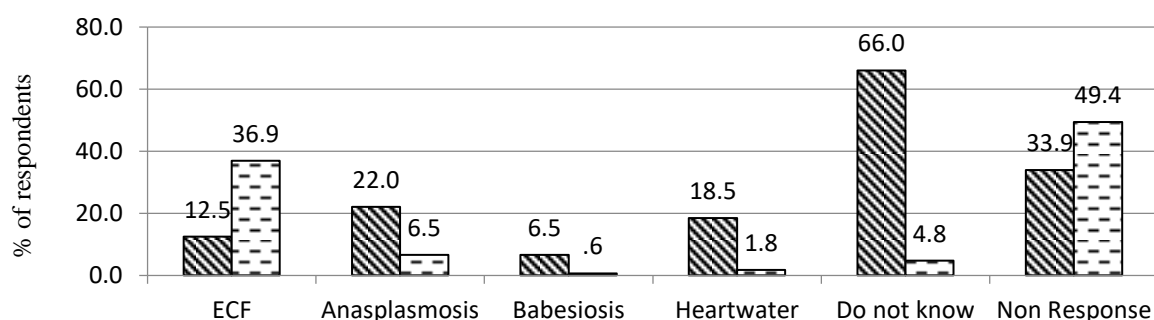

Figure 1: Comparative Analysis on TBDs Affecting Indigenous and Exotic Dairy Cattle

Cumulative cost for three to five treatments for treating one exotic cattle range between Kshs. 48,000.00 to 80,000.00. Testing of the Null hypothesis using Analysis of Variance (ANOVA) *Table 3: Analysis of Variance on ECF Occurrence and Cattle Killed by ECF in the Year 2016*

		Sum of Squares	df	Mean Square	F	Sig.
Number of exotic cattle attacked by ECF in last 1 year	Between Groups	3.776	5	.755	2.067	.135
	Within Groups	4.750	13	.365		
	Total	8.526	18			
No. of exotic cattle killed by ECF in the last 1 year	Between Groups	2.750	5	.550	.419	.817
	Within Groups	5.250	4	1.313		
	Total	8.000	9			

on occurrence of ECF and performance of dairy herd capital assets in the 17 study location indicated there was no statistically significant difference in the manner ECF disease occurred and the affected performance of dairy herd survival in the 17 locations. P values; $F_{(5, 13)} = 2.067$, $p > 0.05$), where ($p = 0.135 > 0.05$) on ECF occurrence and $F_{(5, 4)} = 0.419$, $p > 0.05$), where ($p = 0.817 > 0.05$) for death of dairy stock (Table 3). The findings hence confirmed that ECF affected dairy farming in terms of occurrence and death caused.

The Pearson Chi-Square results (Table 4); $\chi^2 = 5.143$, (df = 3, N=9), p = 0.162, where p value is greater than 0.05 Table 3. The findings thus confirmed null hypothesis that there was no

Table 4: Chi-square Test on Animal Killed by ECF and Starting Herd Size

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.143	3	.162
Likelihood Ratio	5.716	3	.126
Linear-by-Linear Association	0.000	1	1.000
N of Valid Cases	9		

satisticall statistically significant indications that there existed a relationship between stagnated dairy herd capital assets deaths of dairy cattle caused by ECF in the study area. The finding hence indicates that ECF contributed to stagnation of dairy number at 1-2 dairy herd size among 63% smallholder dairy farmers in the study area since start of dairy practicing by the farmers.

4. CONCLUSIONS

Animal farming total productivity is a product of the herd size, being derivative of animal genetic potential and the environment. The study besides socio-economic factors indicated that there is significant loss of dairy cattle to ECF leading to stagnation of dairy herd size among the smallholder farmers. The study indicated that 53% respondents herd size remained at 1-2 exotic dairy herds in the farms over the entire period the smallholder dairy farmers had kept exotic dairy breeds mainly due to problem associated with ECF disease. This is attributed to missing tick control measures and lack of instituting effective ECF mitigation processes.

5. RECOMMENDATIONS

There is need to cushion the interest of farmers operating outside cattle cleansing act areas for the country to ensure dairy farming benefit smallholder dairy farmer. This can only be achieved by ensuring the farmer understand economic importance of tick control and provision of measures to cushion the interest of farmers operating outside the areas compulsory tick control measures are enforced by law. Dairy farming is indisputable means to help in smallholder farmers' economic build up and reduction of poverty among resource limited communities in various parts of the world. Seventy five percent (75%) smallholder dairy farmers of the 3.5 million dairy farmers is indispensable way to realize the deficient milk and milk products needed for the growing human population.

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