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CLIMATE CHANGE AND SUSTAINABILITY OF DONOR FUNDED DAIRY PROJECTS: A CASE OF MALAVA SUB-COUNTY IN KAKAMEGA, KENYA

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Abstract

Development partners fund projects as a means of reducing poverty, improving nutritional status and income generation for poor communities in most third world countries. This approach to livelihood improvement has over the years led to donor funded many successful dairy projects in many African countries. In Kenya, for instance success of dairy projects has been influenced by a wide variety of agro-ecological conditions conditions. For instance variability in weather patterns is one such important factor that influence success of most donor funded dairy projects. The study sought to investigate this relationship. The objective of the study was therefore to determine the extent climate change influence sustainability of donor funded smallholder farmer dairy projects in Malava Sub-County in Kakamega, Kenya. The study adopted descriptive research design and correlational research design while simple random sampling to get the desired sample size of 317 subjects selected from a study population of 1,834 elements out of which 1,800 were smallholder farmers while 34 were project staff and stakeholders spread out in 7 administrative wards in Malava Sub-County in Kakamega, Kenya. A sample of 317 smallholder farmers were selected using Krejcie and Morgan(1970) sample size determination table while the 34 project staff were selected using censors approach to give a sample of 351.

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Data was analyzed using descriptive statistical analysis into frequencies, mean scores and standard deviations while linear regression and Pearson Product Moment Correlation Coefficient analysis were used to make inferences and generalizations. Qualitative data analyses was also used to analyse narative data. *p*-value method at 0.05 significant level was used for hypothesis testing and make conclusion of the relationship between climate change and sustainability of donor funded dairy projects in Malava Sub-County in Kakamega, Kenya. Analysis showed r = 0.385, F (1,272) = 46.5, R^2 = 0.1449 at p = 0.01 < 0.05, H_0 was rejected and it was concluded that climate change has influence on sustainability of donor funded dairy project in Malava sub-county, Kakamega, Kenya. It is recommended that climate resilient mitigation starategies be adopted to cushion low income dairy farmers in sustainaing funded dairy projects against milk production losses.

Key words:

Climate change, Agroecological zones, Smallholder farmersSustainability of donor funded dairy projects.

1. Introduction

The dairy sector the world over has rapidly grown over the last fifty years due to among other reasons technological advancement. This growth is been necessitated by the demand for milk and milk products to the ever growing human population. India for instance a population of 1.35 billion people consume dairy products from 6.5% of the world's dairy animals that produces 35.9billion litres of milk per annum McBride (2010) while the US produces 14.6% of the world milk for both local and export market. Due to technological advancement, due to technological advancement, Saudi Arabia posted the highest average national milk yield per animal at 10.133 litres while Germany produced an average of 6.877 litres per cow (FAO, 2012). In africa, Nigeria is the third largest producer of milk with an output of 1.45 billion litres per annum a production level that is insufficient for its population (Watson, 2011). Post apartheid South Africa with a miriad of challenges in the dairy sector due to dairy project failure rates among its smallholder farmers recorded significant production due to changes in policy, feeding regimes and technological advancement (Kurosaki, 2003). Such advancements notwithstanding, project failure rate in the World Bank funded projects in Africa is slightly over 50% (Macaskill, 2010).

These statistics show that despite the technological advancements on milk production, sustainability of dairy funded projects is still low.

Kenyan which is the leading producer of milk in Eastern and Central Africa produces an estimated 5 billion litres of milk annually from 4 million dairy cows spread across all the agroecological zones in the country (Mugisha, 2007). Over the years, animal production programmes have increased among smallholder farmers over the last fifty years of the country's indepenence. Alongside this increased has been witnessed the growth of the dairy sector due to donor funding. Despite this growth however sustainability of donor funded dairy projects has been recorded to be barely 40% successful(Kenya Dairy Board, 2000). Some of the reasons atrributed to low sustainability of donor funded dairy projects across Western Kenya as contained in the a World Bank document as contained in (Western Kenya Community Driven Development and Flood Mititgation Programme(WKCDD&FMP, 2016) poor feeding regimes occasioned by variability in weather conditions. For instance, in Malava Sub County, Kakamega, Kenya, it was reported that out of 12 dairy Cooperative Societies revived in 2007 by the Danish International Development Agency in support 1,250 smallholder dairy farmers, not a single one of them continued to process milk after project termination due to unsustainable production of milk at farm level (Department of Livestock, 2015). This means that the high failure rate of donor funded dairy projects in Malava sub county remains a matter of grave concern. The purpose of the study therefore was to determine the extent to which variability in weather conditions influence sustainability of donor funded dairy projects in Malava Sub-County in Kakamega, Kenya.

1.1 Research objective

To establish the extent to which climate change influence sustainability of donor funded dairy projects in Malava sub-county in Kakamega, Kenya.

1.1.1 Research Hypothesis

H_1: Climate change has a significant influence on sustainability of donor funded dairy projects in Malava Sub-County in Kakamega, Kenya.

2.2 Literature Review

Theoretical and empirical literature was reviewed on variability of weather conditions to understand how it influences sustainability of donor funded dairy projects.

2.2.1 Sustainability of donor funded dairy projects

Sustainability is a concept that is conceptualized differently by experts in different fields. For instance Barasa and Tubey (2013) defined sustainability as the provision of long-term solutions to community needs that project beneficiaries are able to maintain long after external funding is over. Kaliba and Norman (2004) referred to sustainability in terms of the number of goods and services delivered or quality of benefits enjoyed after project termination. In the dairy sector project sustainability refers to the maintenance of dairy production systems in generating a stream of benefits long after external funding has stopped (IFAD, 2010). In this study sustainability of a donor funded dairy project refer to the continued production of milk by smallholder dairy farmers long after WKCDD&FMP support was withdrawn.

2.2.2 Climate change and sustainability of donor funded dairy projects

Climate change is the variability in weather conditions measured in terms of varied rainfal amounts, high or low atmospheric temperatures and extreme variability in the speed of wind. Such variations in weather conditions significantly influence the availability of animal feed and water supply to smallholder dairy animals and their welness. Burlew(2016) observes that variability in rainfall amounts, temperatures and humidity impacts on quality and quantity of animal feeds which in turn affects its availability and price and hence milk production. Backlund (2009) recorded that in the US, heat stress alone caused by high variability in temperatures affected milk production by between 68 Kg per cow per year in Wyoming to 2,072 Kg per cow per year in Louisiana. IFAD (2009) further established that dry seasons not only affected drinking water sources, but also had a bearing on livestock feed production systems and pasture yield which modified animal diets and compromised the ability of smallholders dairy farmers to manage feed deficits.

2.3 Theoretical framework

The study was based on Theory of Change in which Weiss (1990) elucidated that change is observable and occurs in several chronological steps. Regional Partnership for Resource

Development (2009) referred this change as the outcome pathways for which (Weiss and Alkin, 2004) argued that it was transformational. That is why Kritsonis (2005) referred to change in project outcomes as the basis for confirming that an initiative is effective. It is on that basis that Howarth, Parajuli, Baral, Nott, Adhikari, Gautam, and Menuka (1994) envisioned community project implementation as an expression of empowerment of the project beneficiaries. It is for that reason that WKCDD&FMP (2016) documented that climate change had the potential to influence sustainability of donor funded dairy projects unless a multi-level change processes is initiated to empower project beneficiaries. From this theoretical view point therefore it implies that theory of change explains the transformational process inherent in the variability of the weather conditions that negates the gains made through farmer empowerment in smallholder donor funded dairy projects in Malava sub-county in Kakamega, Kenya.

3. Reseach method

The research paradigm that guided the study was pragmatism because the researchers were interested in the analysis of both quantitative and qualitative data with the freedom of objectivsts and subjectivists in order to understandthe multiple realities of climate change and sustainability of smallholder donor funded dairy projects in Malava sub-county in Kakamega, Kenya. The study adopted descriptive research design and correlational research design. Descriptive research design was adopted because the researchers were interested in ascertaining and describing characteristics of variables of interest in order to establish their dependencies. The study had a target population of 1,834 elements made up of two sub-sets of populations namely, 1,800 smallholder dairy farmers drawn from seven (7) administrative units in Malava Sub-County in Kakamega, Kenya and 34 field workers involved in the implementation of the donor funded dairy project from among the collaborating stakeholder organization selected using censors approach as follows;7 staff from the Department of Livestock Development, 7 Ward Administrators from the County government of Kakamega, 10 Assistant chiefs from the Presidency within the project area and 10 field extension workers from Western Kenya Community Driven Development and Flood Mitigation Programme working in the seven administrative units under study.

The first sub-set of 1800 elements was sampled using Krejcie and Morgan(1970) sample determination table to get a desired sample size of 317 which was then selected from sample frame using simple random sampling technique. The characteristics of smallholder dairy farmers included the presence of zero grazing unit, on-farm fodder, presence of dairy anaimals in the zero grazing units, evidence of funding through WKCDD&FMP and membership of a local dairy cooperatives society. The second subset of 34 elementas in the study population was sampled through censors approach because Mugenda and Mugenda (2003) recommend that when the population is less than 100 and is characteristically diverse then census is the most appropriate technique for selection. The characteristics of the field extension workers was their affiliation to the institutions that had participated in the implementation of the World Bank funded WKCDD&FMP dairy project in Malava sub-county in Kakamega, Kenya. The sampling design of smallholder dairy farmers in from the seven (7) administrative units in Malava Sub-County, Kakamega in Kenya for the first sub-set of the population where the desired sample was drawn is as shown in the table 1.

Table 1: Sampling Design

Ward	**No. of dairy farmers**	**Proportion**	**Sample Size**
West Kabras	434	0.23	79
Chemuche	196	0.11	31
East Kabras	324	0.18	57
Butali/Chegulo	250	0.14	44
Manda/Shivanga	370	0.21	67
Shirugu/Mugai	226	0.13	39
Total	**1,800**	**1.00**	**317**

Both primary and secondary sources of data sources were considered although the main focus was on primary data sources which was gathered through questionnaires, interview guide and observation schedules. Primary data was collected from sampling units while secondary data was obtained from WCDD&FMP project documents and other records held by the farmers in Malava

sub-county in Kakamega, Kenya. Null hypothesis (H_0), that there is no significant influence of climate change on sustainability of donor funded dairy projects in Malava Sub-County in Kakamega, Kenya was tested at = 0.05 using *p*-value method and a criterion that null hypothesis not rejected if *p*-value is less than 0.05 or otherwise rejected.

4. Results and Analysis

4.1 General Information about the respondents

General Information about the respondents is that out of 317 questionnaires distributed, 274 were duly filled and returned giving a return rate of 81.3%. The return rate found to be close to 84% that Adeniji, (2011) got when he undertook a study on importance of participatory management of a community funded projects in Ghana. Nachmias and Nachmias, (2005) recommended that a return rate of over 75% is high enough for statistical generalizations. This meant that 81.3% return rate in the study was high enough for reliable statistical generalization on influence of climate change on sustainability of donor funded dairy projects in Malava Sub-County in Kakamega, Kenya. The study found that distribution of subjects across different Administrative Wards was proportional to their proportion in the study population. Similar results were demonstrated by Ndou, (2012) while investigating NGOs and beneficiary participation in donor funded agricultural development projects in South Africa in which the sample size was found to be distributed proportionately according to the size of the irrigation projects in the study population.

The results indicated that, 148(54%) in the study were females while 126(46%) were males. This meant that the distribution of respondents by gender in the study population was skewed towards the males. This implies that there were more females than males participating in the donor funded dairy projects. The finding concurs with what Chifamba, Nyanga, and Gukurume (2013) in Zimbabwe established when they showed that females constituted 66% while males were 34% of the study population in a rural community donor funded project. This implies that sustainability of smallholder dairy funded projects in Malava sub-county in Kakamega, Kenya relied more on female involvement than their male counterparts. This observation was further confirmed by one famer from West Kabras, Ward when he stated that, *".....the allocation of land for zero grazing to women creates incentive for their labour contributions and hence their*

active involvement in feeding and milking the animals, weeding of the Napier grass plots and taking the milk to the milk collection center while the males collect the proceeds from the sale of milk....". This observation shows that women involvement more than the males determine sustainability of donor funded dairy projects in Malava sub-county in Kakamega, Kenya.

The study results indicated that farmers aged below 50 years constituted 188(68.61%) while those above 50years were 86(31.39%) with a mean age of 42.74 years. This distribution showed that respondents' ages were skewed towards below 50 years. This finding is similar to what Chifamba, Nyanga, and Gukurume (2013) established when they showed that 70% of farmers in Nyanyandzi community funded irrigation project in Zimbabwe were found to be below 50 years while those above 51 years were 30%. This means that since irrigation and dairy farming are both labour intensive, it mainly relies on participation of elderly whose labour contribution may lead to low sustainability. However this view notwithstanding, interviews revealed that although majority of famers were below 50 years, majority of males were engaged in other alternative forms of income generation activities as one farmer from Chemuche Ward arguably put it, *".....we do not entirely rely on dairy farming since the majority of the males in these households engage in other off-farm economic activities such as manual labour in the local sugar factories, motorbike transport businesses or small scale businesses, leaving behind our wives to mostly take care of the zero dairy projects at home....."* This observation partly explains why more women were more involved than their male counterparts. This meant that the involvement of male farmers alone may not ensure sustainability of donor funded dairy project in Malava sub-County in Kakamega, Kenya.

The study results indicated the distribution of farmers by their level of education showed that 243(88.8%) had at least secondary education while 31(11.2%) had only formal education. This meant that majority of farmers with at least secondary education were the majority compared to those with only formal education. This finding agree with what Chifamba, Nyanga, and Gukurume (2013) found out when they showed in their study that farmers with formal education were 86% while those without formal education were only14%. The level of farmers' education is essential because it has a bearing on farmer's ability to make decision related to the dairy enterprise. This observation was evident when one farmer with secondary education from East

Kabras Ward remarked that, *"…….unless we get involved in monitoring and recording the variability of weather conditions and its distribution over time we may never succeed in ensuring increase in the milk production through appropriate and timely mitigation measures because this kind of assessment and documentation requires knowledge in critical observation and record keeping……."*This means that farmers' level of education has influence on sustainability of smallholder irrigation schemes

4.2 Sustainability of dairy funded zero grazing projects

Indicators of sustainability of dairy funded zero grazing projects in Malava Sub-county in Kakamega Kenya were noted as farmers' ability to manage zero grazing project after funding was stopped, increase in milk production and number of dairy animals under zero grazing units upon project termination. These three sub-variables were tested using a total of 15 items in the research instruments and results of the responses summarized as shown in table 2.

Table 2: sustainability of dairy funded zero grazing projects.

No. Item	n	SA 5	A 4	N 3	D 2	SD 1	Mean	Std. Dev
Ability to manage project after funding is stopped.	274	30 (10.95%)	58 (21.31%)	36 (12.99%)	70 (25.69%)	80 (29.05)	2.593	1.140
Increase in milk production	274	83 (30.15%)	98 (35.77%)	37 (13.94%)	35 (12.63%)	21 (7.52%)	3.69	1.106
No. of dairy animals under zero grazing	274	61 (22.26%)	97 (35.40%)	36 (13.14%)	45 (16.35%)	35 (12.85%)	3.37	0.823
Composite mean of sustainability of zero grazing dairy projects	**274**	**59 (21.12%)**	**62.78 (30.83%)**	**33.33 (13.35%)**	**50 (18.22%)**	**45.33 (16.47%)**	**3.22**	**1.024**

Items that interrogated sustainability of donor funded zero grazing projects in Malava Sub-county in Kakamega, Kenya sought to determine whether farmers had the ability to manage the projects after funding was stopped and 30(10.95%) respondents strongly agreed, 58(21.31%) agreed, 36(12.99%) were neutral, 70(25.69%) disagreed and 80(29.05%) strongly disagreed giving a mean score of 2.593 with a standard deviation of 1.140. This meant that majority of farmers were not sure of managing the zero grazing units after funding was stopped. Interviews

further confirmed that farmers were not able to manage the project after external support was stopped as one farmer in West Kabras Ward replied that, *"……non delivery of milk through the local cooperatives by dairy farmers is the single most important reason why milk marketing is weak leading to unsustainable production of milk at the farm level....."*This observation demonstrates farmers' inability to manage the dairy projects and sell milk through their local cooperatives in order to facilitate the growth of the dairy sector. This finding agrees with what Bonabana-Wabbi, (2002) found out While assessing determinants of agricultural technologies in integrated pest management in Kumi district, Eastern Uganda where he established that only 15% of respondents were willing to invest in IPM technologies for control of animal diseases while 85% were not willing. This meant that when farmers were able to self- manage dairy projects then sustainability was guaranteed.

Items that interrogated increase in milk production sought to determine whether farmers experienced any increase in the yield of milk after funding was stopped and results indicated that 83 (30.15%) strongly agreed, 98 (35.77%) agreed, 37(13.94%) were neutral, 35 (12.63%) disagreed and 21(7.52%)strongly disagreed giving a mean score of 3.69 and standard deviation of 1.106. This meant that majority of the respondents were undecided whether or not there was milk increase after the donor funding was stopped. This view was further confirmed through interviews when farmers observed that although they continued with the project after donor funding stopped, the amount of milk produced did not increase as one farmer from Chemuche Ward ably observed that, *"……although I have been engaging in dairy production for over one year now since the donor left, my milk production has not significantly increased……".* This means that farmers generally believed that there was no significant increase in milk yield as a result of the introduction of the donor funded dairy project. The implication of this observation is that successful implementation of the dairy project in Malava sub-county in Kakamega, Kenya did not result in any significant increase of milk production. This observation however did not seem to agree with what Vandersypen, Keita, Coulibaly, Raes, and Jamin (2007) showed when they found that continued use of project outcomes by beneficiaries upon termination of funding led increased outputs.

Items that interrogated the number of dairy animals under zero grazing upon funding of the project sought to determine whether the number of livestock units increased over time upon project completion and results indicate that 61(22.26%) strongly agreed, 97(35.40%) agreed, 36(13.14%) were neutral, 45(16.35%) disagreed and 35(12.85%) strongly disagreed giving a mean score of 3.37 and standard deviation of 0.823. This meant that majority of dairy farmers were not sure whether or not the number of dairy animals had experienced an increase or decrease upon project closure. This view was confirmed through interviews when farmers expressed fear that the number of livestock units had not risen even as one farmer from East Kabras Ward stated that, *"……although zero grazing has enabled me to produce more milk in comparison with keeping animals under free range the number of livestock units have remained the same because of the cost associated with feeding, spraying and purchase of concentrates……."*. These sentiments were further confirmed by the researchers through observation when they noted that out of 57 smallholder dairy farmers sampled in East Kabras Ward, 50 had 2 animal units originally issued at the inception of the project, 3 had 3 animal units while only 4 had more than 4 livestock units three years after the project was terminated. The main reason for livestock population not increasing significantly over time was attributed to variability in amounts of feeds and veterinary costs. The implication of this finding is that several years after donor funding ended the little growth in project output had been experienced. This finding however differs with what Vandesypen *et* al, (2007) showed when they established that continued operation of community project by beneficiaries long after external funding was stopped led to increase in project output.

The composite mean score for sustainability of sustainability of donor funded zero grazing dairy projects in Malava sub-county showed that 59 (21.12%) strongly agreed that the project was sustainable, 62.78 (30.83%) agreed, 33.33 (13.35%) were neutral, 50 (18.22%) disagreed and 45.33 (16.47%) strongly disagreed giving a mean score of 3.22 and standard deviation of 1.024. These results meant that majority of respondents were not sure whether donor funded dairy project in Malava sub-county in Kakamega, Kenya were sustainable or not. This analysis was further confirmed through interviews when a farmer from Butali/Chegulo Ward intimated that, *".....our continued raring of dairy animals through this system doesn't make much difference in milk production from the traditional free range methods that we have always practiced....."* This

means that smallholder farmers acknowledged that zero grazing for dairy animals in Malava sub-county in Kakamega, Kenya is hardly sustainable. This observation however differs with a study for on a community agricultural project by Olubode-Awosola, Idowu, and Van Schalkwyk, (2007) who while assessing performance of 17 donor funded irrigation schemes for policy reforms in Lower Oshun Basin Lagos State, Nigeria, found out that access project resources upon completion and handing over to beneficiaries was the basis of sustainability of the project. This implies that donor funded community projects may or may not be sustainable upon withdrawal of funds upon project termination.

4.3 Climate change and sustainability of donor funded dairy projects

Indicators of climate change were identified as extreme variations in the speed of wind, temperature variations and rainfal variations over time. These sub-variables were tested using a total of 15 items in the research instruments and the results of the responses summarized as shown in table 3.

Table 3: climate change and sustainability of donor funded zero grazing dairy projects

No. Items	n	SA 5	A 4	N 3	D 2	SD 1	Mean	Std. dev.
Wind speed variations	274	82 (29.78%)	106 (38.83%)	33 (11.9%)	25 (9.27%)	28 (10.22%)	3.71	0.638
Temperatures variations	274	87 (31.97%)	120 (43.87%)	37 (13.43%)	20 (7.37%)	10 (3.36%)	3.93	0.814
Rainfall variations	274	79 (28.98%)	101 (36.72%)	48 (17.45%)	34 (12.55%)	12 (4.31%)	3.65	0.729
Composite mean for climate change	**274**	**83 (30.24%)**	**109 (38.91%)**	**39 (14.26%)**	**27 (9.73%)**	**16 (5.96%)**	**3.76**	**0.630**

Items that interrogated wind speed variations sought to determine whether it affected milk yields in Malava sub-county in Kakamega, Kenya and results showed that 82 (29.78%) strongly agreed, 106 (38.83%) agreed, 33 (11.9%) were neutral, 25 (9.27%) disagreed and 28 (10.22%) strongly disagreed with a mean score of 3.71 and standard deviation of 0.638. This meant that majority of farmers were of the view that wind speed variations affected milk production. Interviews however revealed that farmers were of the view that variations in the intensity of wind speed

affected production indirectly. These sentiments were best captured by a farmer from Manda/Shivanga Ward who remarked that, *"…..strong winds especially in during dry months of the year lead to further reduction in availability of fodder due to plant moisture stress. This makes such feeds scarce the result of which is less animal feed intake that further leads to reduction in milk production…."*.This finding was however at variance with what IFAD (2009) study findings established when it showed that strong winds in the tropics is ideal for reducing the moisture content of the feed ingested by the animals thus enabling animals to take in more dry matter the result of which is increased milk production. The implication of this is that whereas other studies show otherwise, strong winds has influence on milk production of donor funded zero grazing dairy project in Malava sub-county in Kakamega, Kenya.

Items that interrogated Temperatures variations sought to determine whether high and low temperatures affected milk yields in Malava sub-county in Kakamega, Kenya and the results showed that 87(31.97%) strongly agreed, 120 (43.87%) agreed, 37 (13.43%) were neutral, (7.37%) disagreed and 10 (3.36%) strongly disagreed with a mean score of 3.93 and standard deviation of 0.814. This meant that majority of farmers were of the view that high temperature variations impacted negatively on milk production. This finding supports a study by Backlund (2009) who found out that high temperature variations led to rapid multiplication of vector-borne diseases, parasites and emergence and circulation of new diseases which in turn depressed dairy animals potential to produce milk. These observation were however desputed by a farmer from Shirugu/Mugai Ward when he stated that, *"…….temperature variations not withstanding, what influences milk output from my cows in the level of feeding, stage of lactation and the potential of the animal in question..... "*. This meant that some farmers were of the view that temperature variations affects milk yields, while other were of the view that quality of feeds and animal genetics significantly had influence on the level of milk production. This finding is however different from what Burlew (2016) established when he demonstrated that temperature variations in the US caused stress to dairy cows that further reduced milk production from 68 Kg to 2,072 kg. per cow per year. The implication of this is that temperature variation may or may not have significant influence on milk yields of donor funded dairy project in Malava sub-county in Kakamega, Kenya.

Items that interrogated rainfal variations sought to determine whether rainfal amounts affected milk production of funded zero grazing dairy projects in Malava sub-county in Kakamega, Kenya and 79 (28.98%) strongly agreed, 101(36.72%) agreed, 48(17.45%) were neutral, 34(12.55%) disagree, 12(4.31%) strongly disagreed with a mean score of 3.65 and standard deviation of 0.729. This meant that majority of respodents felt that rainfall variations affected milk production. This finding concur with what Burlew (2016) established when he showed that variability in rainfall patterns and amounts led to the spread of vector-borne diseases and parasites that subsequently led to reduction in milk yields. These observation were further supported by interviews when one farmer from West Kabras Ward stated that, *".....variations in the rainfall amounts is the single most important contributor to milk production levels; when it rains, animal feed is in plenty leading to an incresed milk yield whereas when it is dry milk output reduce drastically..... ".* This meant that rainfall variations had direct implication on the milk yield of donor funded dairy project in Malava sub-county in Kakamega, Kenya. This finding is in agreement with what Burlew (2016) reported when he showed that variability in rainfall amounts impacts on the quality and quantity of feeds with direct influence on milk production. The implication of this is that rainfall variations has influence on milk production of smallholder donor funded zero grazing dairy project in Malava sub-county in Kakamega, Kenya.

The composite mean score on whether climate change had influence on sustainability of donor funded dairy project in Malava sub-county in Kakamega, Kenya.showed that 83 (30.24%) strongly agreed, 109(38.91%) agreed, 39 (14.26%) were neutral, 27(9.73%) disagreed and 16(5.96%) strongly disagreed with a mean score of 3.76 and standard deviation of 0.630. This meanT that majority of respondents were of the view that climate change had influence on sustainability of smallholder donor funded dairy project in Malava sub-county in Kakamega, Kenya. This observation was confirmed when a farmer from Chemuche Ward remarked that *"…….climate change is real with effects beyond our control; that is why variations in temperatures, rainfall and winds negatively impact on our milk production leading to loss in capital gain……".* These views are supported by what Burlew(2016) established when he showed that variability in rainfall amounts, temperatures and strong winds impacts on quality and quantity of animal feeds which in turn affects its availability leading to a decline of milk

production at farm level. This observations goes to show that climate change has influence on sustainability of donor funded dairy projects in Malava sub-county in Kakamega, Kenya.

Despite some degree of divergence between study findings and literature reviewed on influence of predictor variables on depended variables, descriptive analysis and interview showed majority of farmers believed that climate change is the main cause of low sustainability of dairy projects . Statistical analysis further showed that sustainability of donor funded dairy project moderately correlates with climate change; (r = 0.385, p = 0.01), the corresponding regression model for the hypothesis was identified and formulated as follows;

Sustainability of donor funded smallholder dairy project = f (climate change)

$Y=\beta_0+\beta_1 X_1 +\varepsilon$

Data for testing this regression model was collected using items summarized in table 2 and table 3 measuring the influence of climate change on sustainability of donor funded dairy projects. Before undertaking the regression analysis, tests for collinearity and heteroscedasticity was undertaken on data collected on climate change and sustainability of donor funded smallholder dairy projects using Breusch-Pagan/Cook-Weisberg test. The Breusch-Pagan/Cook-Weisberg test for heteroscedasticity showed that χ^2 (1) = 5.97 p = 0.0145, indicating that assumption of homoscedasticity could not be upheld. To correct this violation of the assumption of homoscedasticity, robust regression (generalized equation model) was used. The test for collinearity for the regression residuals, VIF = 1.00 indicated that multicollinearity was not encountered. Analysis of variance statistics on influence of climate change on sustainability of donor funded dairy project is shown on table 5.

Table 5: ANOVA statistics on climate change on sustainability of donor funded smallholder dairy projects

Model	**Sum of Squares**	**df.**	**Mean Square**	**F**	**Sig**
Regression	15.004	1	15.004	F(1,272) = **46.50**	0.00
Residual	88.545	272	.326		
Total	103.549	273	.379		
R-squared = 0.1449		Adj. R-squared = 0.1418		Root MSE = .571	

The statistic, F (1, 272) = 46.50 at $p < 0.05$, shows that the regression model is statistically significant in predicting the dependent variable. The $R^2 = 0.1449$ indicate that 14.49 per cent in sustainability donor funded dairy projects was explained by climate change. Regression analysis result for the influence of climate change on sustainability of donor funded dairy projects is shown in table 6.

Table 6: Coefficients for Climate change on sustainability of donor funded smallholder dairy project

Project sustainability	Unstandardized Coefficient.	Standardized beta	Std. Err.	T	P>t
Constant	1.906		.209	9.13	0.000
Project identification	.372	.381	.0548	6.79	0.000

The regression equation indicates that the predicted sustainability of donor funded dairy project = 1.906 + 0.380(climate change).

The results indicate that a unit increase in climate change results in 0.380 unit increase in sustainability of smallholder donor funded dairy project.

Inferential statistical analysis further indicated that a moderate positive correlation of 0.385 existed between climate change and sustainability of smallholder donor funded dairy projects. While 14.49 per cent in sustainability of smallholder donor funded dairy projects was explained by climate change. Null hypothesis was tested using *p*-value method at 0.05 significance level to reject or not to reject the nul hypothesis. Null hypothesis, H_0 F (1,272) = 46.5, $R^2 = 0.1449$ at $p = 0.01 < 0.05$ was rejected and it was concluded that climate change has a significant influence on sustainability of smallholder donor funded dairy project in Malava Sub County in Kakamega, Kenya. Null hypothesis, H_0 F (1,272) = 46.5, $R^2 = 0.1449$ at $p = 0.01 < 0.05$ was rejected and it was concluded that climate change has a significant influence on sustainability of smallholder donor funded dairy project in Malava Sub County in Kakamega, Kenya.

5. Conclusion

Null hypothesis was rejected and it was concluded that climate change has a significant influence on sustainability of smallholder donor funded dairy project in Malava Sub County in Kakamega,

Kenya. This finding could be generalized to other donor funded dairy projects in Western Kenya in particular and Kenya with similar agro-climatic conditions. The study therefore recommends that climate change strategies and technologies could be adopted through the involvement of project beneficiaries in mitigating climate change to build resilience and thereby reducing the impact of its effects to milk production of donor funded dairy project in Malava sub-county in Kakamega, Kenya. It is recommended that climate resilient mitigation strategies be adopted to cushion low income dairy farmers in sustaining dairy projects against milk production losses. The adoption of such technologies would adapt the dairy animals and farmers to variability in weather conditions.

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