Influence of Knowledge and Skills Empowerment on Sustainability of Forest Conservation Projects in Kenya

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Abstract: *This research examined the influence of knowledge and skills empowerment activities on the sustainability of forest conservation projects in Kenya. In this study, the sustainability of forest conservation projects was viewed as its ability to attract more stakeholders and continuously provide benefits to the community and the ecosystem after donor funding. Community empowerment was considered to entail the ability of an individual or group of individuals to proactively take control of their daily activities as well as solve associated daily challenges with little or no external intervention. Knowledge and skills empowerment in forestry projects involves gaining competences in varied forestry activities including tree nurseries establishment, fire-fighting, agroforestry and pest and diseases management in individual tree strands and closed-canopy forests. The study was undertaken in Mbololo and Mwambirwa forests located in Taita-Taveta County of Kenya. The study used a cross-sectional survey research design and relied on mixed methods in data collection and analysis. The study sample comprised 365 respondents for quantitative data and six respondents for qualitative data. Observation and secondary data was also used in the study. Data were analysed using frequencies, mean and standard deviation as well as correlation and regression analysis. The results ($r = 0.565$, $n = 365$, $p = 0.000$) revealed a moderate positive significant relationship between knowledge and skills empowerment and sustainability of forest conservation projects. The null hypothesis that there was no significant relationship between knowledge and skills empowerment and sustainability of forest conservation projects was rejected. It was concluded that knowledge and skills empowerment activities positively contribute to the sustainability of forest conservation projects and ameliorate effects of climate change.*

Keywords: Knowledge, skills, empowerment, sustainability, forest project.

Introduction

Forest conservation projects are forest-related initiatives that are executed by stakeholders aimed at enhancing the management of forest resources (Gruber, Mbatu, Johns & Dixon, 2018). Some of the activities involved are tree nursery management, income generation, agroforestry, and general protection from unregulated utilisation. Policy development projects target the operating legal structure for the conservation and management of forest resources (Husereau et al., 2013). Forest projects may involve cross-cutting environmental issues, institutional strengthening and also socio-economic issues geared towards forest conservation (Gruber, Mbatu & Johns 2018). Forest projects are mainly funded by governments, the private sector or other funding institutions locally and internationally (Akanni, Oke & Akpomiemie, 2014). Project sustainability entails, among other factors, the ability to attract more stakeholders and continuously provide benefits to the community and the ecosystem after donor funding.

Empowerment includes increasing an individual's ability to successfully handle their daily issues. It involves enhancing community ownership, social justice and accountability (Njoroge et al., 2016). Knowledge and skills empowerment in forestry entails undertaking specific training tasks aimed at improving learner's ability to efficiently handle forestry work such as seed-harvesting and silvicultural practices (Patrick et al., 2015). Knowledge and skills acquisition is not age-specific as long as learners retain alacrity and aptitude to

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learn. In forestry, learning has continued to evolve over time with both learners and forestry experts adopting different learning styles and techniques. Variations in perceptions of forestry overtime, changing socio-economic levels, emerging environmental challenges such as climate change as well as knowledge and power dynamics have greatly influenced community learning and empowerment in forestry (Timsina et al., 2004). Changes in training and approaches in community empowerment such as the shift from top-down to bottom-up approaches and collegiate decision-making attest to new methods (Kadurenge et al., 2016; Kadurenge & Nyonje, 2017). Different empowerment strategies adopted in forestry include short training courses, exchange visits, field training and demonstrations. Most important is the need for continuous empowerment through the addition of knowledge and skills to keep up with evolving forestry requirements, emergency of new challenges such as pests and diseases as well as forestry work related dynamics (Bell et al., 2017).

New techniques are being introduced for sustainable forestry across the world to handle the ever-increasing challenges in the sector. Silvicultural practices including selective thinning and harvesting as contrasted to clear felling and mechanistic thinning and tree planting as advocated for in plantation management has continued to gain prominence (Vı́tkova', Dhubha´in, and Pommerening, 2016). Forest managers, project implementers and the local community, therefore, require continuous training to keep abreast with technological requirements in forestry. Training in forestry projects enhances forest resource management which supports biodiversity, promotes recreational activities including ecotourism apart from improving ecosystem health (Vı́tkova', et al. 2016).

Training on tree planting and growing is to a great extent supported by government and private forest projects in Kenya. The "Miti-Mingi Maisha Bora Project" by Kenya Forest Service (KFS) for instance trained farmers on aspects of farm forestry in sections of central Kenya including Meru and Tharaka Nithi (Kenya Forest Service, 2015). At the same time, the Consortium of forests groups in Kenya supported 20 Community Forest Associations (CFA's) across Kenya to develop structures for forest management and introduction of income-generating activities including commercial tree nurseries(EAWLS, 2012). In Kenya, projects by different stakeholders have established and increased tree cover over large areas. Eucalyptus tree species, for example, is estimated to cover 100,000 hectares with 85,000 hectares being on private land owned by companies and individuals while 15,000 hectares are in gazetted forests (Oballa et al., 2010). Privately owned eucalyptus tree species have been grown by trained farmers on woodlots, boundary planting, avenue planting and also scattered on community land (Oballa *et al.*, 2010). Planting of eucalyptus requires a good understanding of the environment as different varieties perform better at different altitudes, for example, eucalyptus hybrid variety do well at altitudes up to 1,700 meters above sea level while eucalyptus regnans variety is best at 2,500 – 3,000 meters above sea level and eucalyptus grandis variety, on the other hand, do well at altitudes of 1,400 meters above sea level (Oballa et al., 2010).

Seed for tree planting is preferably harvested from trees exhibiting superior physiognomies such as tallness, healthy and general good form. Different tree species have different seed dispersal characteristics which underscore the need to

train forestry stakeholders including foresters and CFA members on some aspects of predictive modelling for planning seed collection (Kashimshetty et al., 2017). Training CFA members on seed selection enhances the chances of collecting good seed for planting. Some seed, for example of eucalyptus tree species can ripen at different times on the same branch, and the CFA members need skills to differentiate ripe seeds from those that are not ripe and plan harvesting accordingly. Training also involves helping the CFA members among other stakeholders to clean, dry and store seed correctly to preserve its viability (Oballa et al., 2010). Tree seed is collected from mature trees in forests (closed canopy, fragments and dryland forests) and trees in farmlands.

Forest fragments are exposed and affected by physical and biogeographic variations that further changes based on forest fragment size, which directly affects seed selection and harvesting. Tree species that endure in a forest fragment become dominant, thus reducing the biological abundance and tree balance within such fragments (Santos et al., 2016). To maintain seed diversity and richness, farmers need adequate knowledge and skills on forest conservation to forestall fragmentation process, which is mostly aided by an anthropogenic process. Other factors, including dispersal agents including avian populations, have been noted to be of significance in the management of tree seed as they may completely pick out seeds from specific tree species. In this regard, the CFA needs knowledge and skills to determine when the seed is ready for harvesting and such harvesting undertaken before different avian species take advantage of the seed (Pesendorfer & Koenig, 2017). However, despite the risk of completely picking out the seed from trees, forest birds serve an important ecosystem function of seed dispersal in the forest and in adjoining landscapes. Absence of different types of seed dispersers can lead to a complete stop of seed dispersal and loss of some plant species (Trianni et al., 2015).

Key aspects of knowledge and skills empowerment related to community competence in tree seed selection and management, organisation of farmlands to increase the number of trees that can be grown per unit area using the science of farm forestry holds great future for the sector (Kennedy & Gangulin, 2016). Other associated skills necessary for productivity such as bookkeeping to manage the income generated from forestry and other related activities within and outside the farmland are of great relevance in forestry as it enhances the management of available resources. Knowledge and skills on resources mobilisation at the local level as well as at higher levels through distance education as well as professional training at masters and doctoral levels are thought to contributes to the availability of much-needed resources to undertake forestry work (Gilless, 2015).

As the community in their formal and informal groupings continue to gain knowledge and skills in forestry, they also bring their personal experiences which occasionally enriches the learning process and at other times constrains it based on individual flexibility and capacity to accommodate varying views (Lundvall & Rasmussen, 2016). There is, therefore, a need for community groups to continuously reflect on new skills acquired in relation to their context (Motta, 2016). Peer learning, including taking advantage of concepts in modelling comes in handy at the community group learning level (Klinge, 2015).

This study used experiential learning theory that distinguishes four distinct learning styles that involve applied experiences that get processed into abstract

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concepts that can get verified resulting in new implications necessitating action in the form of study which leads to newer experiences. An evaluation process benefits from both internal and external processes or experiences that fit in the four stages(Steele et al., 2017).

Research Question

- How do knowledge and skills empowerment activities influence the sustainability of forest conservation projects?

Research Hypothesis

- There is no significant relationship between knowledge and skills empowerment activities and sustainability of forest conservation projects.

Materials and Methods

This study used a cross-sectional survey research design to establish the influence of knowledge and skills empowerment activities on the sustainability of forest conservation projects. The research took place in Mbololo and Mwambirwa Community Forest Association area covering two forest patches including 5 kilometres ring from the edge of the forest area within Taita-Taveta County, Kenya. The site is located in the south-eastern part of Kenya, approximately 3^0 25′S, 38^0 20′E (Himberg et al., 2009). Mixed method approach was used in the study in which sample size for quantitative and qualitative data was determined accordingly. Research respondents for quantitative data were drawn from a target of 4,138 community household heads who are members of Mbololo and Mwambirwa Community Forest Association (MWAMBO CFA). The sample size was determined using Yamane Formula;

$$ n = \frac{N}{1 + N(e)^2} $$

Where n ~ sample size; N ~ population size; e ~ confidence level taken at 95% in this study.

The total sample comprised of 365 respondents that were selected for survey questionnaire and six for interviews who were officers of Kenya Forest Service (KFS) Ecosystem Office in Taita-Taveta County, Taita-Taveta Wildlife Forum (TTWF) and Management of Arid Zones Initiatives and Development Options (MAZIDO). Two sampling techniques namely stratified sampling, and systematic sampling was used for the survey questionnaire. Purposive sampling was used for the selection of qualitative data respondents. The 5 sub-locations in the study site were each treated as distinct strata from which the respondents were picked using systematic sampling technique. The number of households per strata was selected based on the Kenya population census of 2009 figures per sub-location and guided by the formula (x/N)*n = sample of households per sub-location. Where x = Number of households in a sub-location as provided by Kenya Population Census of 2009 (GoK 2009). N = Total number of households in the study area as per Kenya Population Census 2009 (GoK 209). n = sample size arrived at using Yamane formula.

Allocation of sample per strata (Table 1) used systematic sampling where one household was skipped after every selection until a total of 365 respondents were selected. Mbololo Chief office marked the starting point, and the selection of respondents was made in a zigzag manner. The researcher's personal judgment was used to determine movement to the right or left to avoid picking respondents along a straight line.

Table 1: Sample per strata

Location	Sub location	Number of Households	Study Sample
Mbololo location	Mraru	1,413	125
	Tausa	748	66
Ngolia location	Wongonyi	500	44
	Ndome	723	64
	Ghazi	754	66
Grand Total		**4,138**	**365**

Source: (Government of Kenya [GoK], 2009)

Data was collected using 5-point Likert scale type of questionnaire with 24 different research items on each variable with the values of 05 representing "Strongly agree"; 04 represented "Agree"; 03 represented "Neither agree nor disagree"; 02 represented "Disagree"; and 01 represented "Strongly Disagree". Aggregate scores for all the 24 items in each variable were obtained using SPSS version 21.0 software and averaged.

Correlation analysis was used to ascertain the reliability of survey research instruments in which the researcher obtained a correlation of 0.64. Reliability of qualitative data collection tools was done through the use of inter-rater tests. Data were analysed using Statistical Package for Social Scientists (SPSS 21.0). Correlation analysis was done at the preliminary level and linear regression analysis at the confirmatory level. The hypothesis that there was no significant relationship between knowledge and skills empowerment activities and sustainability of forest conservation projects was tested using correlation analysis—research respondents filled in prior informed consent forms prior to participating in the research. Illiterate respondents were helped to fill in their responses after the research questions were translated into the local dialect and adequately explained to them.

Presentation of Results

Results were presented systematically, starting with results for the analysis of the sustainability of forest conservation projects succeeded by knowledge and skills empowerment activities. Descriptive and inferential statistics were used for data analysis.

Sustainability of forest conservation projects

The researcher assessed how different respondents rated the achievement of different aspects of sustainability of forest conservation projects in the research site. Table 2 presents the responses.

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Table 2: *Distribution of responses on the sustainability of forest conservation projects*

Level of achievement of different forest conservation aspects	Frequency	Percentage (%)
01: Strongly Disagree	1	0.3
02: Disagree	13	3.6
03: Neither Agree nor Disagree	190	52.1
04: Agree	159	43.6
05: Strongly Agree	2	0.5
Total	**365**	**100.0**

The results indicate the highest frequency of respondents 190 (52.1%) neither agreed nor disagreed that forest conservation projects implemented in the research area had been sustainable. A frequency of 159 (43.6%) of respondents agreed that forest conservation projects had been sustainable, while 2 (0.5%) respondents strongly agreed the forest conservation projects were sustainable. A total of 3.9% respondents disagreed or strongly disagreed that forest conservation projects in the research area were sustainable. A high percentage of 44.1% of respondents either agreed or strongly agreed that forest conservation projects in the research area were sustainable.

Qualitative data obtained from six respondents (100%) indicated that forest conservation projects in the study site were sustainable. The forester in charge of Mbololo and Mwambirwa forests, as well as the Ecosystem Manager from KFS who are the legal custodians of all forest resources in the research area on behalf of Government of Kenya, said that forest conservation projects in the target area had been sustainable. The forester, for instance, said "…all the forest conservation projects have introduced or reinforced a new aspect of conservation that has helped the community to earn more from their farmlands which reduces the pressure of protected forest. The incomes aspect motivates the community to carry-on with activities indefinitely". An example of a Bamboo farming project that earned farmers adjacent the forest income had been cited as one such example of sustainable forest conservation activities. The forest conservation Project Managers from TTWF and MAZIDO, as well as the Monitoring and Evaluation Officers from the two organisations, also noted that the forest conservation projects were to a great extent sustainable. Project Manager from MAZIDO said, "…all our forest conservation projects since inception have activities still ongoing despite lapse of donor funding."

Observations made by the researcher in the community farmlands while traversing the research area during data collection showed evidence of farm forestry and income-generating activities attested by traditional and modern beehives. In total, the researcher observed seven beehives in individual community farmlands and five tree nurseries of different tree species.

Nine (9) out of 13 documents (69.2%) analysed by the researcher from the selected organisations had evidence of the sustainability of forest conservation projects in the research site. There were nine (9) monitoring and evaluation reports of which three (3) were from TTWF and six (6) from MAZIDO which attested to the continued operation of forest-related activities after project

funding. The documents showed evidence of continued income to community members from project activities such as farm forestry and beekeeping initiated by different projects within the research site.

Data indicated that responses were spread from the minimum of 01 to maximum of 05 with most responses clustered around the mean (3.41). The standard deviation obtained was 0.584, as shown in Table 3.

Table 3: *Mean and standard deviation for responses on the sustainability of forest conservation projects (SSFCP)*

	N	Minimum	Maximum	Mean	Std. Deviation
SSFCP	365	01	05	3.41	0.584
Valid N (listwise)	365				

Total responses analysed were 365.

Influence of knowledge and skills empowerment activities on the sustainability of forest conservation projects

To analyse the research question, the researcher identified indicators of knowledge and skills empowerment activities and measured the achievement of those indicators to determine how they influenced the sustainability of forest conservation projects. Data Analysis showed that respondents who neither agreed nor disagreed that knowledge and skills empowerment activities influence the sustainability of forest conservation projects were majority at 192 (52.6%) while the least number 3 (0.8%) were those who strongly disagreed. The distribution of responses was presented in Table 4.

Table 4: *Distribution of respondents based on responses on the influence of knowledge and skills empowerment on the sustainability of forest conservation projects*

Likert scale responses	Frequency	Percentage (%)
01: Strongly Disagree	3	0.8
02: Disagree	17	4.7
03: Neither Agree nor Disagree	192	52.6
04: Agree	149	40.8
05: Strongly agree	4	1.1
Total	**365**	**100.0**

To gain a clear understanding of the spread of responses on the influence of knowledge and skills empowerment activities on the sustainability of forest conservation projects, the researcher calculated the mean and standard deviation of the aggregate responses. Table 5 presents the mean and standard deviation of the responses.

Table 5: Mean and Standard deviation for responses on knowledge and skills empowerment activities (KSEA) and sustainability of forest conservation projects

	N	Minimum	Maximum	Mean	Std. Deviation
KSEA	365	01	05	3.37	0.631
Valid N (listwise)	365				

The results show the mean obtained was 3.37, which was above 03 that representing neither agree nor disagree and tends towards 04 representing agree on the Likert scale. The standard deviation obtained of 0.631 was considered small, implying the respondents were clustered around the mean (3.37). It, therefore, meant that the majority of the respondents had similar or closely related views on the influence of knowledge and skills empowerment activities on the sustainability of forest conservation projects.

Results from descriptive data analysis indicated that knowledge and skills empowerment activities have an influence on the sustainability of forest conservation projects. The researcher further sought to understand the strength and direction of the relationship using Pearson's Product-Moment Correlation Coefficient. Additionally, using correlation analysis, the researcher tested the null hypothesis that there was no significant relationship between knowledge and skills empowerment activities and sustainability of forest conservation projects. Results of Pearson's Product-Moment Correlation were presented in Table 6

Table 6: Correlation analysis of knowledge and skills empowerment activities on the sustainability of forest conservation projects

		Sustainability of Forest Conservation Projects	Knowledge and Skills empowerment Activities
Sustainability of Forest Conservation Projects	Pearson Correlation	1	.565**
	Sig. (2-tailed)		.000
	N	365	365
Knowledge and Skills empowerment Activities	Pearson Correlation	.565**	1
	Sig. (2-tailed)	.000	
	N	365	365

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

The Pearson Product-Moment, Correlation Coefficient results, indicated a moderate positive significant correlation between knowledge and skills empowerment activities and sustainability of forest conservation projects($r = 0.565$, $n = 365$, $p = 0.000$). These results meant that as knowledge and skills, empowerment activities increase so does the sustainability of forest conservation projects. Data was tested at 95% confidence level, which means the alpha applicable for this research was 0.05. The result for the significance level obtained was 0.000, which was less than the alpha level of 0.05. The null hypothesis that there was no significant relationship between knowledge and skills empowerment activities and sustainability of forest conservation projects was rejected. The alternative hypothesis that there was statistically significant

relationship between knowledge and skills empowerment activities and sustainability of forest conservation projects was accepted.

To confirm the results obtained using Pearson's Product-Moment Correlation analysis, the researcher conducted linear regression analysis. The results of linear regression analysis were presented in Table 7 (linear regression model summary), Table 8 (Statistical significance) and Table 9 (Estimated regression coefficients).

Table 7: Linear regression model summary for the influence of knowledge and skills empowerment activities on the sustainability of forest conservation projects

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.565[a]	.319	.317	9.099

a. Predictors: (Constant), Knowledge and Skills empowerment Activities

The R-value of 0.565 obtained in this model shows a strong degree of correlation between knowledge and skills empowerment activities and sustainability of forest conservation projects. The R^2 obtained which is the coefficient of determination of value 0.319 was interpreted to mean that at least 31.9% of variations in the sustainability of forest conservation projects were accounted for by knowledge and skills empowerment activities in the regression model. The researcher concluded that there were other factors that contributed 68.1% of variations in the sustainability of forest conservation projects that were not represented in the regression model.

To understand the appropriateness of the regression model in analysing research data on the influence of knowledge and skills empowerment activities on the sustainability of forest conservation projects, the researcher examined the statistical significance of the regression analysis output presented on Table 8

Table 8: Statistical significance of the influence of knowledge and skills empowerment activities on the sustainability of forest conservation projects

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	14102.989	1	14102.989	170.330	.000[b]
	Residual	30055.614	363	82.798		
	Total	44158.603	364			

a. Dependent Variable: Sustainability of Forest Conservation Projects
b. Predictors: (Constant), Knowledge and Skills empowerment Activities

The F-ratio shows values of $F_{(1,363)} = 170.330$, $p < 0.000$. The statistical significance (p-value) obtained in the analysis was less than 0.001. This implies there was only 1/1,000 chance that the results of the relationship realised in the model could be achieved using a different method such as comparing means. Based on the findings, the researcher considered the regression model appropriate to predict the influence of knowledge and skills empowerment on the sustainability of forest conservation projects.

The researcher's findings were that the regression model statistically significantly predicted that results. The researcher examined estimated

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coefficients and fitted the coefficients into the regression equation $y = a + \beta_1 X_1 + e$. The regression model coefficients obtained were presented in Table 9

Table 9: *Estimated coefficients for the influence of knowledge and skills empowerment activities on the sustainability of forest conservation projects*

Model		Unstandardised Coefficients		Standardised Coefficients		
		B	Std. Error	Beta	T	Sig.
1	(Constant)	28.284	3.287		8.606	.000
	Knowledge and Skills empowerment Activities	.600	.046	.565	13.051	.000

a. Dependent Variable: Sustainability of Forest Conservation Projects

Where; y = Sustainability of forest conservation projects; a = 28.284; β = 0.565; X_1 Knowledge and skills empowerment activities; e = error term.

The results indicate standardised B coefficients of 0.565 for knowledge and skills empowerment activities and a statistical significance level of 0.000. It is interpreted to mean that knowledge and skills empowerment activities are statistically significantly different from zero. Knowledge and skills empowerment influence of up to 56.5% of variations observed in the sustainability of forest conservation projects. The findings indicated that knowledge and skills empowerment activities could be used to predict the sustainability of forest conservation projects using the regression line presented as; Sustainability of forest conservation projects (y) = 28.284 +0.600X_1+0.046.

Discussion of findings

Monitoring and evaluation reports (9) from TTWF (3) and MAZIDO (6) separately indicated that forest conservation activities that were started remained viable and beneficial to farmers long after funding because they also served as income sources to the community. A success story documented by MAZIDO of the youth group who started an apiary after forest project training and were benefitting thus motivating other youth to start and sustain similar initiatives resulting in the forest activity sustainability. Descriptive data analysis showed a mean of 3.37 with a standard deviation of 0.631, which interpreted to mean the majority of respondents agreed that sustainability of forest conservation projects was influenced by knowledge and skills empowerment activities. There was spread of responses from 1 which meant strongly disagree all through to 5, which meant strongly agree on the Likert scale used. The spread of responses was interpreted to mean that respondents freely provided data according to their individual perceptions and understanding of the research questions. The information obtained was, therefore considered diverse and reflected different community member's abilities in the research site.

Results obtained from quantitative data analysis (descriptive and inferential statistics) indicated that knowledge and skills empowerment activities influence the sustainability of forest conservation projects. Descriptive data analysis showed that 41.9% of respondents considered knowledge and skills

empowerment activities to influence the sustainability of forest conservation projects as opposed to 5.5% who had contrary views. Correlation analysis indicated a moderate positive significant correlation of 0.565 between knowledge and skills empowerment and sustainability of forest conservation projects. Regression analysis confirmed results of correlation analysis that knowledge and skills empowerment activities had an influence on the sustainability of forest conservation projects. The findings of quantitative data analysis were in line with findings of qualitative data where all the six interviews (100%) held in the field confirmed that knowledge and skills empowerment activities influenced the sustainability of forest conservation projects. The KFS forester in charge of Mbololo forest said: "…the significance of knowledge and skills empowerment activities in the sustainability of forest conservation projects is such an important activity because it supports active community participation in forest conservation activities and ensures continued implementation of the forest-related activities long after project funding ends". This finding is in line with literature where Bell et al., (2017) noted that changing management scenarios in forestry, including emerging challenges, require continued knowledge and skills empowerment successful and sustainable forestry.

The findings of quantitative data analysis were further supported by qualitative data in which a Project Manager from MAZIDO informed the researcher that whenever any of their projects engaged on knowledge and skills empowerment its activities were understood better and practised long after forest conservation project funding lapsed. He said "… our projects have remained supporting locals long after donor exit because of the knowledge community members have gained". This underscores the significance of knowledge and skills empowerment activities on the sustainability of forest conservation projects. Additionally, the forester in charge of forest activities in the project site noted that training of community members adjacent the forest was a costly affair, but the benefits always outweighed the investment. He particularly noted that when community members were trained on the dangers of starting forest fires and also enlightened on the connection between changing climatic conditions and delayed or erratic rainfall patterns, they debunked the myth that forest fires and smoke attracted rainfall. The training on the relationship between climate change and delayed rainfall reduced incidences of accidental or deliberate forest fires that were ignited by community members whenever rainfall was not received on time. Additionally, the forest fire management practices that community members were trained on helped to contain accidental forest fires before it got out of control. These observations by the interviewed respondents supported the findings of quantitative data analysis that knowledge and skills empowerment activities contributed significantly (56.5%) to the sustainability of forest conservation projects.

Literature indicated that knowledge and skills empowerment activities facilitated conservation forest project practices of thinning, agroforestry and tree nurseries establishment which earned forest adjacent community income thus serving as motivation for continued activities even after project funding lapsed (Vı́tkova', Dhubha'in, and Pommerening, 2016). Knowledge and skills empowerment courtesy of forest conservation projects empowers the community to successfully undertake tree thinning among other activities which have a

positive influence on the sustainability of forest conservation projects. This observation supports the research findings that show knowledge and skills empowerment had some degree of influence on the sustainability of forest conservation projects (Larcher et al., 2018).

Secondary data analysis showed that knowledge and skills empowerment through training conducted by forest conservation projects enhanced appreciation of forest resources amongst community members who gained the capacity to sustain the forest conservation project activities initiated resulting in long-term sustainability. Secondary information obtained from 2 project proposals further showed knowledge and skills empowerment activities were among the budgeted items in project proposals of targeted organisations. The activity was also reflected in three project annual work plans for MAZIDO and TTWF that were accessed by the researcher. This indicated that knowledge and skills empowerment activities were valued by project managers and received adequate time and resources necessary for their implementation, which had an impact on project sustainability. These findings were supported by literature where Patrick et al., (2015) observed that continued training in forest activities contributed to the sustainability of forestry enterprise. The KFS Forester indicated that forest conservation projects targeted the whole community in knowledge and skills empowerment activities related to forest conservation practices such as seed harvesting and storage, silvicultural activities and fire fighting. This meant knowledge and skills on forest conservation projects benefitted a big percentage of the community thus explaining the clustering of responses around the aggregate mean (3.37) with a standard deviation of 0.631 obtained from quantitative data analysis. The Project Manager from MAZIDO reported that their forest conservation projects had components of knowledge and skills empowerment activities evidenced by exchange visits, training of community on tree nursery management and also application of different silvicultural practices.

The revelation was in concurrence with literature where Pesendorfer & Koenig, (2017) noted that knowledge and skills empowerment is significant to forestall losses that may accrue as a result of the late timing of forestry activities. Silvicultural practices practised increased benefits to forestry and individual farmers who benefitted from increased income levels as a result of well-managed agroforestry activities. The results obtained were further supported by literature that showed knowledge and skills empowerment activities influenced community understanding of project activities which enhances efficiency and attainment of project sustainability. In addition to training their peers, knowledgeable community members remained capable of sustaining project activities for longer periods after official project support waned (Patrick et al., 2015).

Findings revealed that conservation organisations such as Kenya Forest Service continuously allocated resources for community empowerment activities because they had realised over time that it improved on delivery and sustainability of their forest conservation project activities. The resources allocated for knowledge and skills empowerment benefitted not only the community but also the forest resources because it supported conservation activities. Literature indicated that conserved forest resources supported efforts to contain effects of climate change as forests sequester carbon and store it thus

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reducing the amount of carbon dioxide in the atmosphere which is mainly responsible for climate change (Chemuku et al., 2016). Climate change not only negatively influences weather patterns, it also has a negative effect on the livelihoods of the local community who mainly rely on natural resources for food and income. Knowledge and skills empowerment activities support the community to adopt sustainable agricultural and forestry practices, including agroforestry and tree planting to protect the ecosystem. Overexploitation of forest resources leads to reduced provisioning services hence less motivation for the community to practice forest conservation activities, thus making forest conservation projects unsustainable (Kimutai & Watanabe, 2016).

Qualitative information provided by the Monitoring and Evaluation Officer from TTWF indicated that community members were ever eager to gain knowledge and skills, which was evidenced by forestry activities and technology in individual farmlands. He reported that "… there are times when it becomes very difficult to select participants to a forest training workshop or exchange visit because the number of interested individuals always exceeded available slots". Community members who were fast learners adopted different forest conservation project related technologies, including silvicultural activities and helped their peers who were possibly slow learners to understand and adopt the practices in their individual farmlands. By the time most forest conservation projects lapsed almost all community members had fully understood the skills intended and imparted by the projects hence the clustering of responses around the mean (3.37) observed from quantitative data analysis. However, adoption and implementation of forest conservation activities at different farmlands varied because of different factors, including the positioning of farmlands that affected activities like beekeeping and tree nurseries because they are water-dependent. This finding was in line with literature which established that upgrading an individual's capacity to effectively and efficiently produce forestry products and services required understanding of the environmental factors for achievement of optimal results and sustainable forest projects (Larcher et al., 2018).

Results of document analysis further revealed that forest conservation projects had different forms of training components that benefitted community members leading to sustainability of forest conservation activities. Two out of three proposals (67%) accessed by the researchers on forest conservation projects implemented by KFS had training budget components which not only involved workshops but also field monitoring visits by the field team who used those occasions to demonstrated different forestry activities like the grafting of tree seedlings, watering and transplanting. Three evaluation reports out of four reports from TTWF (42.8%) also indicated training sessions that were conducted by contracted experts as well as those done by project staff including peer learning which attested to knowledge and skills empowerment by the projects supporting forest conservation project sustainability. These findings show that sustainability of forest conservation projects was influenced by knowledge and skills which was supported by observations by Klinge, (2015) who noted that peer learning was helpful in ensuring the sustainability of project activities.

The different forest conservation practices that were being practised by the community adjacent the forests, including tree planting and silvicultural activities led to high-quality tree products from their farmlands. There were farmers who

had been involved in tree nurseries establishment and management which not only provided tree planting material to the community but also income for those involved in the activity. They, therefore, got the motivation to support forest conservation-related activities given the continued provision of benefits, including support for livelihoods. The researcher also noted well-pruned trees on farmer's pieces of land which were testimony that knowledge and skills improvement imparted through the forest conservation projects activities being utilised by the community. The activities were in line with research findings that knowledge and skills empowerment activities contributed at least 56.5% of sustainability of forest conservation projects. Training and adoption of forest-related activities is evidence of knowledge and skills empowerment amongst community members. This was supported by literature where Kashimshetty et al., (2017) noted that community training on different ripening times for seed from different tree species as well as harvesting dictates the quality of forest-related produce.

The researcher saw seven tree nurseries in private farmlands as well as agroforestry activities which attested to knowledge and skills empowerment activities within the community. Based on researcher's observations, almost every farmland practised some form of agroforestry or farm forestry as evidenced by trees intercropped with food crops and also around homesteads serving as windbreaks in addition to providing shelter and wood products. Some of the agroforestry techniques observed in the farmlands included an agri-silvicultural system that uses the farm for the production of crops and forest products and silvopastoral system that reared farm animals and also cultivated trees as fodders and for provision of wood products. A mixed garden system seeks to integrate trees, crops, and animals on small plots aimed at providing soil nutrients, wood and non-wood products and benefits to farmers were also observed on farmlands. The different systems adopted by farmers indicated to the researcher that knowledge and skills empowerment had benefitted the community and contributed to the sustainability of forest conservation activities since they were incorporated in the agricultural practices. This was in line with literature that showed training and field demonstrations of forestry practices built a knowledge base of forest adjacent community to adopt different agroforestry practices leading to activity sustainability (Muoria et al., 2013).

Knowledge and skills empowerment activities such as training workshops normally have a relatively small number (≤40) of community participants (learners) expected to share knowledge and skills gained from the workshop with their peers who fail to get training opportunity. Given the varying levels of respondent's education and experiences, the likelihood of some trainees misinterpreting and sharing inaccurate information with their peers leading to distorted views and understanding of the relationship between knowledge and skills empowerment activities and sustainability of forest conservation projects was real. Further, when information is transmitted from one individual to another, there is an element of exaggeration of facts or sometimes loss of some information. This implies a second person failed to receive forest information as initially intended by trainers leading to distorted understanding. This scenario could be a possible explanation for the high number of respondents (192 or 52.6%) who neither agreed nor disagreed that knowledge and skills empowerment

activities influenced the sustainability of forest conservation projects. This view is in line with literature indicating that personal experiences affect the quality of forest-related information and knowledge transmitted (Lundvall & Rasmussen, 2016).

The high percentage (41.9%) of respondents who agreed or strongly agreed that knowledge and skills empowerment activities influenced the sustainability of forest conservation projects attested to training activities by forest conservation projects. The activities empowered community members to sustainably apply knowledge and skills gained from forest conservation-related activities on their farmlands, including farm forestry and tree nurseries development. Community members, therefore, benefitted from the forest conservation project activities by having additional income sources apart from their daily activities, including farming thus improving livelihoods. Improved livelihoods serve as a motivating factor for community members to continue with forest conservation project activities. Observations by the researcher in the field witnessed farm forestry activities where farmers were involved in alley tree planting, boundary tree planting and woodlots within their farmlands. Such activities served to increase income sources to individual community members. This observation was corroborated by information obtained from interviews which indicated that indeed farmers benefitted from knowledge and skills empowerment activities which also served as income sources, thus motivating farmers leading to sustainability of forest conservation activities. The Project Manager from MAZIDO, for example, reported " …in the year 2015 the Kenya Forest Service purchased many tree seedlings from community-owned tree nurseries to plant on different degraded water catchment areas within the Taita-Taveta County. The purchases earned farmers income that motivated other farmers to engage in the activity leading to increased tree seedlings production in the succeeding years". The achievement was attributed to knowledge and skills empowerment courtesy of forest conservation projects in the research site. In literature, it was noted that knowledge and skills empowerment activities lead to improved productivity per unit area hence improved livelihoods that contribute to sustainability (Gilless, 2015; Kennedy & Gangulin, 2016).

The moderate positive significant correlation (r = 0.565) in this study implies that forestry management activities are performed better by the community with adequate knowledge and skills of the specific tasks leading to improved outcomes and sustainability of forestry projects. This can be interpreted to mean that as knowledge and skills in forestry projects increase, the projects become more sustainable and the provisioning and regulating services of the forest resources are enhanced and sustained. The positive correlation shows that knowledge and skills empowerment activities strengthen the sustainability of forest conservation projects.

The result of P = 0.000 < α = 0.05 lead to rejection of null hypothesis. The alternative hypothesis that there was a statistically significant relationship between knowledge and skills empowerment activities and sustainability of forest conservation projects was upheld. This was in line with findings of qualitative information provided by field managers that whenever training took place during project implementation, level of community participation increased, and so was the achievement of project sustainability. The positive correlation, therefore,

shows that in the absence of community empowerment through knowledge and skills, forestry outcomes are likely to be depressed.

Conclusion and Recommendation

This research concluded that community in the target area had been actively involved in forest conservation project activities, including knowledge and skills empowerment. The knowledge and skills empowerment activity took different forms, including field visits, peer learning and training workshops. Community members clearly understood the value of forest conservation projects and invested their time and resources towards its success hence the varied responses indicating different levels of understanding and interpretation of situations. The knowledge and skills empowerment activities are crucial to the sustainability of forest conservation projects as the community are best positioned to sustainably conserve and protect the forest resources that they interact with more frequently than any other stakeholder. Investment in knowledge and skills empowerment activities will not only enhance forest project sustainability but also contribute towards ameliorating the effects of climate change. This research ascertained that knowledge and skills empowerment activities account for 56.5% of variations in the sustainability of forest conservation projects. The researcher recommends that further research be commissioned to establish the factors apart from knowledge and skills empowerment that account for 43.5% of the sustainability of forest conservation projects.

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