Effects Of Sustainable Land Management Practices And Performance Of Agroforestry Project In Rwanda.

Jackline Mugoboka[1*], Dr. Catherine Wanjiku[2], Dr. Gatahi Njenga (PhD)[3]

[1]Master of Business Administration, Project Management, Mount Kenya University
[2,3]Senior Lecturer, Mount Kigali University

ARTICLE INFO	ABSTRACT
	The aim of this study was to examine the effects of sustainable land management techniques on the agroforestry project's performance at UNICOOPAGI. The particular goals were to ascertain the impact of afforestation on the performance of the agroforestry project in UNICOOPAGI, investigate the impact of soil erosion control on the project's performance, and ascertain the effect of land rehabilitation on the project's performance. The study used a descriptive research approach, and the sample size was 126, as was the population. The study used a census sample approach in which every unit took part in the study. The necessary data was gathered through the use of documentary and questionnaire methodologies. The data was analyzed using Statistical Product and Service Solutions version 23. Following data collection, the following conclusions were noted. Regarding the first research goal, which examined how land rehabilitation affected the UNICOOPAGI agroforestry project's performance, 37.3% strongly agreed and 46.0% agreed that applying manure improves the project's performance. Additionally, 35.7 percent strongly agreed and 47.6% agreed that mulching improves the project's performance. Additionally, there is a positive association (0.814) between the performance of agroforestry projects and land rehabilitation. Regarding the impact of soil erosion control on the UNICOOPAGI agroforestry project's performance, 34.9% strongly agreed and 56.3% agreed that building terraces enhances the project's performance. Additionally, 54.0% and 41.3% strongly agreed that creating efficient water trapping pits is done to improve the project's performance. Additionally, agroforestry project effectiveness is positively correlated with soil erosion management at a high level (0.824). Regarding the impact of afforestation on the UNICOOPAGI agroforestry project's performance, 33.3% of respondents strongly agreed, 50% agreed, and 44.4% strongly agreed that the project's performance was influenced by the availability of tree seeds. and 46.0% concurred that educating farmers about agroforestry methods results in the implementation of agroforestry projects. On the other hand, afforestation has 0.828 correlation coefficient and affects agroforestry performance. The study came to the conclusion that, through a variety of techniques used by project implementors, land rehabilitation, soil erosion control, and afforestation considerably improve the performance of agroforestry projects. The study indicated that as a preventative and mitigating approach against erosion, project sponsors give farmers access to water tanks. Additionally, farmers must to work harder at implementing drainage techniques in order to preserve the sustainability of the land.

Key words: Sustainable Land Management Techniques, Project Performance, Afforestation, Soil Erosion Control, Land Rehabilitation. |

1. Introduction

Smallholder farmers in Sub-Saharan Africa confront significant problems due to land degradation (Layton & Ellison, 2016), biodiversity loss, and climate change and unpredictability, all of which contribute to food insecurity. Land use sustainability is based on government planning. To guarantee sustainability, several stakeholders are recruited, and local and national strategies are required. Sustainable land use is an important

field of study and practice for both scholars and practitioners (For example, urban areas, soil erosion, land degradation, landscape ecology, agroforestry, agro-ecology, and habitat fragmentation) (Walter, 2021).

Crawford *et al.* (2018) conducted research about the practices contribute to land management's sustainability in Central Africa. Findings indicated that poor strategy for erosion prevention increases the extent of land loss. The research recommended the government and non-government organization to establish numerous agriculture projects responsible for sustainable land management. Further, Danga and Wakindiki (2020) revealed that 47% of agroforestry project experienced poor performance due to high erosion and deterioration of land in Somalia. Louise (2021) assessed factors impacting Rwanda's agroforestry project's performance. According to the research, 31% of agroforestry initiatives are not performed well due to poor erosion control, land rehabilitation and lack of planting the trees to maintain sustainability of land consequently low agriculture productivity and low income for farmers are appeared.

By taking into account the scholars conducted researches at global and regional level, Research on the impact of sustainable land management on project performance in Rwanda has not been conducted and it is clear that they have not fixed the knowledge gaps in Rwanda especially in projects that involve agroforestry. It is from the above points, researcher came out with idea to conduct an investigation into how land management techniques affect an agroforestry project's performance in UNICOOPAGI using land rehabilitation, soil erosion control and afforestation on performance of agroforestry project in UNICOOPAGI.

The general objective of this study was to evaluate how the UNICOOPAGI agroforestry project performed in relation to sustainable land management methods.

Specific objectives:

i. To determine how the UNICOOPAGI agroforestry project performs in relation to land restoration.
ii. To assess how the UNICOOPAGI agroforestry project performs in relation to soil erosion control.
iii. To ascertain how afforestation affects UNICOOPAGI's agroforestry project's performance.

The study guided by the following null hypotheses;

i. Ho1: land rehabilitation has no discernible impact on performance of agroforestry project in UNICOOPAGI.
ii. Ho2: Soil erosion control has no discernible impact on performance of agroforestry project in UNICOOPAGI.
iii. Ho3: Afforestation has no impact on performance of agroforestry project in UNICOOPAGI

2. Literature review

Land Rehabilitation

Masila *et al.* (2016) investigated implications of soil degradation for Planning, use, and management of agricultural land in Machakos County's Kalama Division. An uphill, mid slope, and downslope road transect was used to gather data through a questionnaire. Forty families were surveyed in three zones along a transect. The survey found that Crop farming, cattle and poultry raising, and farm forestry were the most prevalent uses of agricultural land in the area, and beekeeping. In terms of land use, beekeeping was difficult. The top zone had the least amount of land degradation (7%), while the intermediate zone had the most (15%). According to the research, most families were found to be familiar with and able to characterize land degradation signs in their local area using indigenous environmental knowledge. By using practices including natural organic manures, tree planting, mixed cropping, stone edging, and gabions, smallholder farmers halted the soil degradation process.

Saowanee (2016) conducted on danger of desertification in Due to changes in the location and use of the land, Huay Sai Royal Development Study Centre is located in southern Thailand. Using spatial analysis and the medalus model, the degree of land degradation, changes in land use, and the risk of desertification in the research region were investigated between 1990 and 2010. The study examined soils, climate, and human activity as three categories of elements to quantify the harm posed by desertification. 74.4% of the Huay Sai region was at high risk of becoming desertified and that danger persisted in 2010 (77.2%), according to the study's results. However, annual decreases of 4.2% were seen in the percentage of land that was considered to be in extreme danger of desertification. According to the results, desertification risk was affected by changes in land use.

Niang *et al.* (2015) evaluated the degradation of the soil, vegetation, and atmosphere on water flow in the Tougou watershed in northern Burkina Faso. Data collection in the field was done using an experimental design with 1 m2 panels at each of the three watershed sites: an erosion crust, a desiccation crust supported by herbaceous vegetation, and an area planted in sorghum. Tensiometric and neutron tubes were installed at each location to determine the soil pressure head and moisture levels. The research demonstrated that PZN had a limited infiltration capacity, which facilitated runoff. Since most of the precipitation is absorbed by the top 30−40 centimeters of soil, drying out via evaporation occurs rapidly in the days after a rainstorm. Both PZD and PZC have fast penetration rates and strong hydraulic conductivity. During significant downpours, infiltrating water was crucial, and drainage was shown to extend below the 70-centimeter mark. The average daily evapotranspiration was between 3 and 4 millimeters at all locations.

Soil Erosion Control

Julian et al (2019) assessed the impact of soil erosion on the Brazilian agroforestry project's success. Determining the soil erosion practices used in agroforestry projects was the study's goal. Both qualitative and quantitative methods were used to acquire the data. The study used a 321-person sample size and examined a population of 789. The results demonstrated that the majority of respondents—72% strongly agreed and 25% agreed—agreed that building terraces is the most essential practice for preventing soil erosion. This agreement had a strong mean of 4.7 and a low standard deviation of 0.1. Further, 43% strongly agreed and 45% agreed that crop rotation minimize erosion. The study concluded that to prevent erosion various practices are needed to ensure erosion has been prevented. The study suggested that effective preventing measures for erosion contribute significantly to the farmers production as well as agriculture production.

Félicien and Umaru (2022) analyzed influence of soil erosion on the output of farmers in the western province of Sebeya. Descriptive and correlational research designs were both used in this study. Purposive sampling techniques were employed to select a sample of 75 farmers, and their perceptions regarding current and future efforts to adopt Soil Erosion Control (SEC) measures in the Sebeya catchment located in the Western Province of Rwanda were analyzed through structured interviews, field observations, and focus groups. According to a binary logistic regression model, access to social media (B = 2.107; p = 0.027) and agricultural experience (B = 0.749; p = 0.020) were the two most important socioeconomic traits for farmers.
 were positively connected, but the adoption of SEC measures was inversely correlated (p < 0.05) with age (B = -0.642; p = 0.035) and gender (B = -2.034; p = 0.032). The government must assist and educate farmers in order to reduce high rates of soil erosion and boost food production. It would be beneficial to assemble a highly qualified technical team to help carry out SEC measures in the Sebeya catchment.

Ikponmwosa *et al.* (2016) did studies on how the agricultural performance and potential of Sheshegu community farmers in South Africa's Eastern Cape are affected by 3W3W3W3W soil erosion. 50 respondents were selected at random and data was gathered through structured interviews. The results showed that the majority of respondents (62%) are men over the age of 46 (68%). 72% of whom had completed more education than grade 7. Moreover, 50.8 percent of them rely on social grants as their primary source of income. The majority of respondents acknowledged that erosion happens naturally as a result of intense rains and protracted droughts, but that human activity—such as farming, deforestation, and careless bush burning—also contributes to erosion by exposing soil to the effects of rainfall. Respondents confirmed that the loss of grazing ground, poor regrowth of shrubs, and lack of pasture grass all led to the poor health of animals. The study suggested that farmers be encouraged to employ basic soil erosion management technology and that awareness of the detrimental effects of human causes of erosion be raised. Finally, in order to prevent random bush burning, an edict prohibiting it should be enforced.

Dinesh *et al.,* (2021) examined the impact of soil erosion on Nepal's hill country's agricultural output. In order to gather information about people's perceptions of soil erosion and its effects on agricultural output, a focus group discussion (n = 2) and a household questionnaire survey (n = 120) were conducted in areas classified as at risk. The study approach chosen was descriptive. 92.32%, 4.96%, and 2.73%, respectively, are covered by the erosion risk areas under very low to low, moderate to moderately high, and high to very high. It suggests that whereas soil erosion increased in arid places, it decreased in forest areas. Topsoil removal (weighted mean = 4.19) and gully formation (weighted mean = 3.56) were the most commonly cited variables contributing to the loss in production.

According to the study's findings, agricultural and arid lands appear to be more prone to erosion than other types of land. For this reason, long-term conservation and management efforts that provide protection, restoration, and socioeconomic support in these areas are crucial to the Rangun watershed's land rehabilitation. They also mentioned that soil erosion poses a severe danger to agricultural productivity and is a big worry for the environment and natural resources. Thus, the study suggested that protecting the land's soil should be the first priority in order to increase agricultural output in hilly areas.

Afforestation

Roberto (2020) studied The study used a double hurdle regression for various social, economic, and productive data to capture the decision to adopt and the intensity of the adoption as a collective decision of such practices. This allowed for the analysis of the drivers of cattle producers' behavior with regard to adopting afforestation. He used data from a survey that was conducted among 1605 cattle farmers spread across five agro-ecological areas of Colombia as part of an international study for this aim. The four types of afforestation—spread trees, trees and shrubs for fodder production, forestry plantations, and native forest management—define dependent variables. 75% acceptance rate of the livestock system, location, and credit availability and utilization all had an impact on the decision to plant trees. The adoption and intensity of afforestation were positively impacted by herd size and involvement in tree-planting development programs (r=0.69), but the existence of water springs was found to positively influence adoption intensity (r=0.65). Farmers who have embraced or are considering adopting these technologies may be more likely to do so. The study also found that networking and social capital are essential for promoting tree planting as a sustainable activity.

Mabel (2017) aimed at assessing the benefit of growing trees for farmers' wellbeing, with a focus on assessing how the Rakai district's agroforestry initiative has affected farmers. Data was gathered from the homes of agroforestry project participants in three parishes in the Rakai region, as well as from a control group made up

of households with comparable socioeconomic backgrounds that were not involved in the agroforestry project (Non-houses). Families possessed a greater area of land and a notably greater quantity of trees per hectare (P=0.000). In comparison, they also shown better fuel-wood sustainability (p=0.003), agroforestry revenue (0.0016), and assets like livestock (p=0.0004) and agricultural production per hectare (p=0.0018).

However, in terms of the variety of sources of income, non-households were more diverse. The two farmer groups' farms had the same level of soil erosion. Farmers concur that planting trees reduces soil erosion, increases the output of fuel wood, and manages risks through the sale of fruit and timber. Households are more likely than non-households to be able to adapt to climate-related dangers like drought and floods because of their physical characteristics. It was determined that afforestation contributes to farmers being less vulnerable to climate unpredictability. Additionally, studies suggested that in order to increase agricultural production, the government should work harder to plant new trees and preserve those that already exist.

Mátyás (2022) conducted research about the impact of afforestation on the effectiveness of agroforestry projects in three East African nations—Rwanda, Kenya, and Tanzania—which were taken as case studies. Purposive sampling was utilized to pick a sample size of 7859 from the population of 17893 in order to obtain the necessary data for the study, which employed a cross-sectional research design. The findings showed that creating tree nursery, awareness on planting methods and increase the area of forest contribute to the performance of project more than 60%. In order to minimize the environment circumstances, afforestation practices should be implemented at satisfactory extent.

3. Research methodology

This section describes in full the procedures used in order to collect data for the research. It lays forth the procedures that were followed in order to achieve the goals of the research and answer its questions. This section describes the research population, sample size, sampling process, data collection and analysis methods, and research population. It goes on to explain how the study took ethical considerations into account.

Research Design
The researcher used a mix of descriptive and correlational methods. Various topics were evaluated by participants in the descriptive survey. In the quantitative research, people assessed their own responses. The participants in the correlational studies assessed the degree of relationship between the variables.

Study Population and Sample Size
The population is the set of all the things you can create a sum out of. The 126 people who worked on the Unicoopagi Project were the intended subjects of this research.

Because the population is so little, the researcher used a census inquiry approach rather than a sampling strategy. A total of 126 participants were found to be the sample size.

Data Collection Instruments
Research data and information may be collected using a range of techniques. For this study, researchers used questionnaires and analyzed documents. In order to collect data, a self-administered questionnaire was used, which included some scripted questions. The answers to each question on a questionnaire are already known in advance.

As part of this research, 126 respondents were asked to complete out questionnaires that asked about their background, thoughts, and experiences. The researcher triple-checked all of the data, reports, and project blueprints. The project's background, goals, methodology, and outcomes may be better understood by perusing these records. Document analysis provided valuable findings that supplemented the data gathered from other sources.

Data Analysis Method
Data analysis include using statistical methods, compiling data into manageable chunks, identifying patterns, and summarizing the data. However, data preparation involves quality checks and the transformation of raw data into a more analyzable format via data entry, editing, and coding. Data coding classifies responses into a limited number of predetermined categories using numerical values or symbols. Whether it comes from primary or secondary sources, the data must first be entered before it can be prepared for interpretation.

Version 22.0 of the statistical package SPSS was used by the researchers when it came time to conduct quantitative data analysis for this investigation. The statistical package SPSS allowed for a plethora of analysis. This method proved helpful in reducing the amount of information that was presented and highlighting the most significant findings.

Ethical Consideration
In order to get the agreement of the individuals who had a stake in the study, the researcher first made a formal request for it from the administrators behind the program. The most important ethical concerns in research are obtaining informed consent, ensuring that participation is voluntary, and safeguarding confidentiality or anonymity. Recognizing the importance of seeing respondents where they felt most comfortable enabled the researcher to respect their right to privacy. The responders were assured that their information will be treated appropriately and confidentially. Instead of their actual identities, study participants were given code numbers to ensure their confidentiality.

4. Results & Discussions

This chapter focuses on the analysis of the data gathered from 126 participants. The data are presented in tables and then analyzed.

Table 1: Perceptions of respondents on land rehabilitation

Results	SD	D	N	A	SA	Mean	St. Dev
Manure application is applied to improve performance of agroforestry project	.8	4.0	11.9	46.0	37.5	4.15	.83
Mulching contributes to performance of agroforestry project	2.4	4.8	9.5	47.6	35.7	4.09	.92
Crop rotation leads to performance of agroforestry project	3.2	9.5	26.2	36.5	24.6	3.69	1.04
Drainage system is adopted to enhance performance of agroforestry project	10.3	30.2	18.3	27.8	13.5	3.04	1.24

Source: Primary data, 2023

The impact of land restoration on the UNICOOPAGI agroforestry project's performance is displayed in Table 1. The study was interested in knowing whether manure application is applied to enhance the agroforestry project's performance. The results indicated that the statement had a strong mean of 4.15 and an insignificant standard deviation of.83, with 37.3% strongly agreeing and 46.0% agreeing. Based on the findings, respondents confirmed the statement at a satisfactory level, with 4% disagreeing and 0.8% strongly disagreeing, and 11.9 being neutral.

The majority of respondents—47.6% and 35.7% strongly agreed—agreed with the researcher's question on whether mulching improves the performance of agroforestry projects. The replies were accompanied by a significant mean of 4.09 and a low standard deviation of.92. Conversely, 9.5% were indifferent. While the majority of respondents agreed, 2.4% strongly disagreed with the statement, and 4.8% disagreed with it.

The investigator questioned the participants on the relationship between crop rotation and agroforestry project performance. The results showed that, with a mean of 3.69 and a standard deviation of 1.04, 24.6% strongly agreed and 36.5% agreed. On the other hand, 26.2% of respondents were neutral on the impact of crop rotation on project performance, while 9.5% disagreed and 3.2% strongly disagreed with the statement. Regarding the drainage system chosen to improve the agroforestry project's performance, the following feedback was received. The results indicated that respondents agreed at a mean of 3.04 and standard deviation of 1.24, with 13.5% strongly agreeing and 27.8% agreeing. While 10.3% strongly disagreed and 30.2% disagreed with the assertion, 18.3% expressed no opinion regarding the drainage system's impact on the success of the agroforestry project.

Masila *et al.* (2016) stated that organic manures, tree planting, mixed cropping, stone edging, and gabions play great role to the land rehabilitation in in Kalama Division, Machakos County, farmers are encouraging to use manure to maintain quality of land as well as increase the farming production. Furthermore, land rehabilitation can be achieved through motivating farmers to use crop rotations and covering land to reduce the lost nutrients for land. The results showed that effective drainage systemin play significant contribution to the performance of agroforestry project where the system helps farmers to retain fertility land as well as maintain environment. Agroforestry project educated farmers the ways applied to maintain biodiversity which paly significant role to the performance of project.

Table 2: Perceptions of respondents on soil erosion control

Responses	SD	D	N	A	SA	Mean	St. Dev
Construction of terraces improves performance of agroforestry project	2.4	4.8	1.6	56.3	34.9	4.12	.86
Installation of water tanks enhance performance of agroforestry project	4.0	32.5	14.3	29.4	19.8	3.28	1.22
Anti-erosive ditches are applied to boost performance of agroforestry project	2.4	7.1	11.1	50.8	28.6	3.96	.95
Establishing effective water trapping pits is done to enhance performance of agroforestry project	0	.8	4.0	54.0	41.3	4.35	.60

Source: Primary data, 2023

Table 2 displays the effect of soil erosion control on performance of agroforestry project in UNICOOPAGI. Concerning on the construction of terraces improves performance of agroforestry project, The replies showed a low standard deviation and a strong mean of 4.12, with 34.9% strongly agreeing and 56.3% agreeing.86. In contrast, 1.6% of respondents were neutral, while 4.8% disagreed and 2.4% strongly disagreed with the

statement. Additionally, the respondents agreed that the placement of water tanks improves the operation of the agroforestry project, with 19.8% strongly agreeing and 29.4% agreeing, with a moderate mean of 3.28 and a standard deviation of 1.22. The majority of respondents, however, disagreed with the statement—32.5% disagreed, 4.0% strongly disagreed, and 14.3% were neutral—about the idea that installing water tanks would improve the effectiveness of an agroforestry project.

The findings revealed that anti-erosive ditches are applied to boost performance of agroforestry project at 28.6% strongly agreed and The statement with a modest mean of 3.96 and a standard deviation of.95 was agreed upon by 50.8% of the respondents. Conversely, 11.1% of respondents expressed neutrality. But 2.4% and 7.1%, respectively, strongly disagreed and disagreed. When the researcher asked the respondents if they thought that creating efficient water trapping pits will improve the performance of the agroforestry project, 41.3% strongly agreed and 54.0% agreed. The respondents agreed on a mean of 4.35 and a standard deviation of 0.60, according to the data. However, a few people declined the statement at that point.8% disapproved of the statement, while 4.0% were neutral.

Research by Julian *et al.* (2019), which evaluated the impact of soil erosion on the effectiveness of agroforestry projects in Brazil, supported the findings. They concluded that effective preventing measures for erosion contribute significantly to the farmers production as well as agriculture project performance. The findings indicate that they are numerous practices supports the use of sustainable land management techniques on the effectiveness of agroforestry projects, the construction of terraces, installation of water tanks, anti-erosive ditches as well as establishing effective water trapping pits influence highly performance of agroforestry project, various agriculture projects are implemented to maintain the sustainability of land, due to various circumstances caused by environment degradation and heavy rain, construction of terraces play great role to the performance of agroforestry project as well as increasing the agriculture productivity.

Table 3: Perceptions of respondents on afforestation

Responses	SD	D	N	A	SA	Mean	St. Dev
Training famers on agroforestry techniques lead to performance of agroforestry project	0	2.4	7.1	46.0	44.4	4.32	.71
Provision of trees seeds leads to the performance of agroforestry project	1.6	5.6	9.5	50	33.3	4.08	.89
Establishing tree nursery improves performance of agroforestry project	3.2	7.9	8.7	53.2	27.0	3.93	.98
Trees planting contributes to performance of agroforestry project	2.4	7.1	11.1	50.8	28.6	3.96	.95
Management of planted trees leads to the performance of agroforestry project	4.0	9.5	19.8	38.9	27.8	3.76	1.08

Source: Primary data, 2023

The impact of afforestation on the UNICOOPAGI agroforestry project's performance is further explained in Table 3. The researcher wants to discover if agroforestry project success is impacted by training farmers in agroforestry techniques. The subsequent reactions were noted Training farmers in agroforestry techniques results in the performance of an agroforestry project, as agreed upon by 46.0% and 44.9% of respondents, respectively. The replies had a strong mean of 4.32 and an uncertain standard deviation of.71. 2.4% disagreed with the statement, while 7.1% were neutral.

In addition, the researcher inquired about the relationship between the provision of tree seeds and the success of an agroforestry project. Of the answers, 33.3% strongly agreed and 50% agreed. While 9.5% of respondents were neutral, 1.6% strongly disagreed, and 5.6% disagreed, the mean of 4.08 and the standard deviation of 0.89 indicated that respondents agreed with the statement to a satisfactory degree.

. Researchers wanted to know if starting a tree nursery would increase the success of an agroforestry project. Of those who responded, 27% strongly agreed, 53.2% agreed, and 8.7% were neutral. On the other hand, 3.2% strongly disagreed with the statement, and 7.9% disagreed. Respondents concurred at a standard deviation of 0.98 and a strong mean of 3.96. In order to ensure that farmers receive enough trees, project implementors must set up tree nurseries. According to the study, planting trees improves the performance of agroforestry projects; 28.6% of respondents strongly agreed and 50.8% agreed. Although the majority of respondents agreed with the statement, 2.4% and 7.1% of respondents disagreed and strongly disagreed with it, respectively. However, 11.1% of respondents were indifferent, and the mean and standard deviation of the responses were 3.96 and 0.95, respectively, confirming

Lastly, the results showed that 38.9% of respondents agreed and 27.8% strongly agreed that the management of planted trees contributes to the success of agroforestry projects. Despite the fact that the majority of respondents agreed, 19.8% were neutral, 9.5% disagreed, and 4.0% strongly disagreed with the statement. However, respondents agreed that proper management of planted trees improves the effectiveness of agroforestry, with a mean score of 3.76 and a standard deviation of 1.08.

The study agreed with Mabel (2017) who examined the contribution of tree planting on farmers' welfare. According to the study's findings, afforestation helps farmers become less vulnerable to climatic unpredictability. Ability of establishing afforestation practices influence effective performance of agroforestry project through various practices such as provision quality and sufficient trees seeds facilitate farmers to plant many trees needed to maintain the sustainability of land. Even trees are planted every year however, the cutting, damaged and poor management of trees affect negatively the performance of agroforestry project. Agroforestry project helps farmers to get trees through trees nursery where farmers get trees at free of low cost leading to the increase of number of trees as well as agroforestry products.

Table 4: Perceptions of respondents on agroforestry project Performance

Responses	SD	D	N	A	SA	Mean	St. Dev
Agroforestry project completed within planned budget	0	1.6	3.2	50	45.2	4.38	.63
Agroforestry project delivered on time	.8	1.6	0	51.6	46	4.4	.65
Agroforestry project meets its objectives	0	1.6	3.2	50.8	44.4	4.38	.63
Agroforestry project meet beneficiaries needs without compromising quality and quantity	.8	4.0	.8	50.8	43.7	4.32	.75

Source: Primary data, 2023

Table 4 provides information related to indicators of agroforestry project performance; researcher used various indicators demonstrating the project's performance. The results indicated that most respondents (45.2% strongly agreed, 50% agreed, with a strong mean of 4.38 and a low standard deviation of.63) agreed that the agroforestry project was finished within the allocated budget. Nevertheless, 1.6% disagreed with the statement and 3.2% were neutral. The majority of respondents—51.6%—agreed with the researcher's question on whether the agroforestry project was delivered on time, and 46% strongly agreed—with a mean score of 4.4 and a standard deviation of 0.65. However, 1.6%,.8%, and strongly disagreed with the assertion, respectively. The study also showed that, with a strong mean of 3.32 and a standard deviation of 0.81, 38.3% of respondents strongly agreed and 49.4% agreed that the project adheres to budgets.
  4.9% strongly disagreed with the statement, while 7.4% disagreed.
With a highest mean of 4.38 and a low standard deviation of 0.63, the respondents highly agreed that the agroforestry project achieves its aims, with 44.4% strongly agreeing and 50.8% agreeing. 3.2 and 1.6, however, disagreed with the statement and were indifferent. When the researcher finally asked if an agroforestry project could meet the demands of beneficiaries without sacrificing quantity and quality, 50.8% of respondents said they agreed, and 43.7% strongly agreed, with a mean response of 4.32% and a standard deviation of 0.75. Conversely, 4.0% disagreed, 8% strongly disagreed, and.8% were neutral with the statement.
The results were consistent with study by Bonner and Gundlach (2015), who found that attaining project objectives within triple constraints—budget, scope, and schedule—defines project performances. In light of the results, sustainable land management techniques on the performance of agroforestry project meet with numerous indicators clarifies the performance of project where project completed with planned cost, time as well as fulfill the beneficiaries needs without compromising quality and quantity.

Table 5: Pearson Correlation Matrix

		Afforestation	Soil erosion control	Land rehabilitation	Performance
Performance	Pearson Correlation	.814**	.824**	.828**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	126	126		
Land rehabilitation	Pearson Correlation	.904**	.956**	1	
	Sig. (2-tailed)	.000			
	N	126			
Soil erosion control	Pearson Correlation	.916**	1		
	Sig. (2-tailed)	.000			
	N				
Afforestation	Pearson Correlation	1			
	Sig. (2-tailed)	.000			
	N	126			

**. Correlation is significant at the 0.01 level (2-tailed).
Source: Primary data, 2023

The researcher was interested in knowing how sustainable land management practices influence performance of agroforestry project. Basing on the results generated by software, researcher found that all components of independent variables are correlated with dependent variable at significant statistical level. The findings showed that land rehabilitation practice has strong positive correlation with agroforestry project performance at Pearson Coefficient Correlation of .814 (81.4%), establishing effective land rehabilitation measures improve significantly the performance of agroforestry project performance due to land cannot lost its quality and level of fertility.

Furthermore, the findings revealed that soil erosion control influence performance agroforestry project at significance statistically where the Pearson Coefficient Correlation computed .824 (82.4%), ignoring to establish the measures to prevent and mitigate the effect caused by erosion decline the contribution of agroforestry project on the development of agriculture sector. On the other hand, appropriate soil erosion control measures are very important to enhance performance of agroforestry project. Last but not least, the results affirmed that afforestation improves performance of agroforestry project, this confirmed by findings of Pearson Coefficient Correlation which is strong positive correlation of 828 (82.8%), to ensure sustainable land management is achieved, afforestation practices need to be implemented at satisfactory level. In reference to the results obtained, land rehabilitation, soil erosion control and afforestation have significance statistically to the performance of agroforestry at strong positive correlations.

Table 6: Model Summary on Sustainable Land Management Practices and Performance of Agroforestry Project in Rwanda.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.846[a]	.715	.708	1.39010

Source: Primary Data (2023)

a. Predictors: (Constant), Rehabilitation, Erosion Control, Afforestation

Regression analysis yielded a positive result (R =.846), as Table 6 demonstrates. The model's predictors—land rehabilitation, soil erosion control, and reforestation—coordinated 71.5% with the agroforestry project as the dependent variable, according to the R square of 0.715. The study also found that the performance of an agroforestry project is greatly influenced by the combination of all independent variable components.

Table 7: ANOVA[a] on Sustainable Land Management Practices and Performance of Agroforestry Project in Rwanda.

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	591.748	4	147.937	76.572	.000[b]
Residual	235.752	122	1.932		
Total	827.500	126			

Source: Primary Data (2023)

a. Predictors: (Constant), Land rehabilitation, soil erosion control and afforestation
b. Dependent Variable: Agroforestry project performance

The findings indicated that there is difference of 71.5% in agroforestry project performance where the elements captured computed 71.5% (591.748 out of 827.500) whereas other variables which are not captured by model computed 28.5% (235.752 out of 827.500)

The model's F value is 76.572, which is considerably different from zero. A P-value of 0.000 indicates that the independent factors have a statistically significant impact on the dependent variable, and it is below the predefined level. As a recommendation, the model does a good job of showing how sustainable land management techniques affect an agroforestry project's success.

Table 8: Coefficients on Sustainable Land Management Practices and Performance of Agroforestry Project in Rwanda.

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
1 (Constant)	7.169	.679		10.561	.000
Land rehabilitation	.112	.120	.159	.704	.000
Soil erosion control	.226	.144	.282	.790	.000
Afforestation	.254	.074	.426	.596	.001

Source: Primary Data (2023)

$Y = 7.169 + 0.159 X_1 + 0.282 X_2 + 0.426 X_3 + 1.39010$

The regression coefficients' responses are displayed in Table 8. The performance of the agroforestry project was evaluated by calculating the Standardized Coefficients (β). Effective land rehabilitation, soil erosion

control, and afforestation have a stronger impact on the performance of agroforestry projects, according to the T-statistics. According to the results, a unit change for land rehabilitation increases an agroforestry project's performance by 0.159 times, a unit change for soil erosion control increases an agroforestry project's performance by 0.282 times, and a section change for afforestation increases an agroforestry project's performance by a multiple of 0.426.

The study's p-values were all less than 0.05, which indicates that the independent variables statistically support the significant influence of the dependent variables on the success of the agroforestry project.

5. Conclusion

The results of this study make it very clear why sustainable land management techniques improve agroforestry project success. The respondents' varied answers confirmed that their many approaches improve the performance of agroforestry projects. The study came to the conclusion that land rehabilitation improves an agroforestry project's performance.

, ability to use manure, applying mulching process, application of crop rotation and application of drainage system improve the performance of agriculture project. Encouraging farmers to use manure is very important to maintain the sustainability of land resulting in the agroforestry project's efficacious performance.

Additionally, the study found that agroforestry project performance is influenced by soil erosion control through a variety of techniques, including the building of terraces, the installation of water tanks, the creation of anti-erosive ditches, and the creation of efficient water trapping pits.

Additionally, the study found that afforestation strategies enhance the effectiveness of agroforestry project, training the farmers improve the level of skills and knowledge require to implement project successfully, provision of trees seeds is key aspect to ensure agroforestry project meets its objective within planned triple constraints.

By overall conclusion, land rehabilitation, soil erosion control and afforestation through a variety of methods used by project implementors, greatly enhance the performance of the agroforestry project.

6. Recommendations

The following recommendations were developed in light of the research's findings and conclusions:
Due to workload for the people who are in charge of managing planted trees are not effectively managed. Hence, the study recommended that there are needed of increasing the number of people who are capable to manage the planted trees. The majority of respondents disagreed that drainage system is adopted to enhance performance of agroforestry. Hence researcher recommended that farmers should put more effort in application of drainage practices to maintain sustainability of land. Due to inadequate budget to purchase water tanks, installation of water tanks for farmers has low percentage. Therefore, study recommended that project sponsors to provide water tanks for farmers as the measures of preventing and mitigating erosion.

References

1. Crawford, Y., Singh, H., & Breman, W. (2018). Guidelines for computing crop water requirements. FAO Irrigation and Drainage Paper 56: Crop Evapotranspiration, 1–15. FAO Publishing.
2. Danga, R., & Wakindiki, M. (2020). The potential of reducing tillage frequency and incorporating plant residues as a strategy for climate change mitigation in semiarid Mediterranean agroecosystems. *Agriculture, Ecosystems & Environment,* 246, 210–220.
3. Dinesh, B., Rajeev, J., Raju, R. R., & Nripesh, A. (2021). Assessment of soil erosion and its impact on agricultural productivity by using the RMMF model and local perception: A case study of Rangun watershed of mid-hills, Nepal. *Applied and Environmental Soil Science, 2021*, 1–14.
4. Félicien, M., & Umaru, G. W. (2022). Analyzing various factors affecting farmers' willingness to adopt soil erosion control measures in the Sebeya catchment, Rwanda. *Sustainability,* 14(21), 12895.
5. Ikponmwosa, D. I., Francois, S. L., & Shehu, F. G. Y. (2013). The impact of soil erosion on agricultural potential and performance of Sheshegu community farmers in the Eastern Cape of South Africa. *Journal of Agricultural Science,* 5(5), 130-144.
6. Julian, R., Silva, M., Costa, P., & Almeida, L. (2019). Assessing the impact of soil erosion on the success of agroforestry projects in Brazil. *International Journal of Agroforestry and Soil Management,* 5(3), 234-245.
7. Layton, K., & Ellison, D. (2016). Induced precipitation recycling (IPR): A proposed concept for increasing precipitation through natural vegetation feedback mechanisms. *Ecological Engineering,* 91, 553–565.
8. Louise, T. M. (2021). Factors impacting Rwanda's agroforestry project's performance. Journal of Environmental Management and *Sustainability,* 35(2), 112-124.
9. Mabel, N. (2017). Contribution of agroforestry practices to reducing farmers' vulnerability to climate variability in Rakai district, Uganda. Technische Universität Dresden Mátyás Báder. Dresden, Germany.

10. Masila, S. M., Kauti, M. K., & Kimiti, J. M. (2016). Effects of land degradation on agricultural land use: A case study of smallholder farmers' indigenous knowledge on land use planning and management in Kalama Division, Machakos County. *Current Journal of Applied Science and Technology,* 15(4), 1–12.
11. Mátyás, B. (2022). The impact of afforestation on the effectiveness of agroforestry projects in East Africa: Case studies from Rwanda, Kenya, and Tanzania. *Journal of Environmental Management and Sustainable Development,* 10(2), 123-145.
12. Niang, D., Yacouba, H., Doto, C. V., Karambiri, H., & Lahmar, R. (2015). Land degradation impact on water transfer of soil-plant-atmosphere continuum in the Burkinabe Sahel. *LARHYSS Journal,* 24, 109-127.
13. Roberto, J., Soraya, R., Lisandro, R., David, F., & Alejandra, E. (2020). Factors affecting the adoption of agroforestry practices: Insights from silvopastoral systems of Colombia. *Agroforestry Systems,* 94(5), 1237-1248.
14. Saowanee, W. (2016). The impact of land use and spatial changes on desertification risk in degraded areas in Thailand. *Sustainable Environment Research*, 26(4), 173–180.
15. Walter, L. F., Ulisses, M. A., & Andréia, F. Freitas, S. (2021). Challenges in sustainable land use management. European School of Sustainability Science and Research, 10, 45-58. Hamburg University of Applied Sciences, Hamburg, Germany.