



Enhancing Climate Change Adaptation through Participatory Monitoring and Evaluation Practices: Evidence from Coffee Farming Households in Southwestern Uganda

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Participatory Monitoring and Evaluation (PM&E) practices play a major role in enhancing the adoption of climate adaptation measures. A convergent parallel mixed-method design was therefore used to determine the contribution of PM&E practices in enhancing climate change adaptation among coffee farming households in Ntungamo district, southwestern Uganda. A structured questionnaire was administered to a sample of 385 respondents who were selected from a population of 724 farmers using Krejcie and Morgan (1970) table. The respondents were selected from district council members, steering committee members as well as coffee farmers from the sub-counties of Ihunga and Kibatsi. These categories of respondents were chosen because of their regular interaction with climate change measures while utilizing M&E practices at the district level. The data were analyzed using correlation, regression and analysis of variance (ANOVA) methods to assess the strength, association, and linkage of PM&E practices and climate change adaptations. This type of analysis was appropriate because the study data were non-parametric. Results showed that participatory planning, needs assessments, monitoring with farmers, farmer-to-farmers exchange visits, and, participatory evaluation were positively and significantly ($p=0.00$) correlated with planting of the recommended shade trees in their coffee fields as well as soil and water conservation practice as interventions for adapting to climate change. However, regular data collection had a weak negative but significant correlation with farmers' access to timely climatic information ($r=-.155$; $p=0.00$), use of soil and water conservation practices as a means of climate change adaptation ($r=-.158$; $p=0.00$) as well as farmers knowing the management of pests and diseases ($r=-.178$; $p=0.00$). This implies that most of the assessed PM&E practices enhance the planting of shade trees as well as the use of soil and water conservation practices as interventions for adapting to climate change in the coffee agro systems. The findings of this study therefore provide an informed basis for designing climate change adaptation strategies and formulation of policy recommendations at local Government level. This is vital for the various practitioners, implementers and actors in embracing the bottom-up approaches M&E in the execution of climate change interventions. We therefore recommend increased participation of coffee farmers in local Government planning, monitoring, and evaluation discussions deliberations. This bottom-up approach will increase farmers' ownership and commitment to better adoption, implementation, and sustainability of climate change interventions, ultimately enhancing smallholder livelihoods.

Keywords: Bottom-up-approach; exchange visits; local-Government; needs-assessments; planning; planting-shade-tree; soil-and-water-conservation.

1. INTRODUCTION

Coffee is the second most traded agricultural commodity in the world, after gold (Slavova & Georgieva, 2019), with a pivotal role in sustaining agrarian economies such as Uganda (Poncet et al., 2024). The crop remains Uganda's most important cash crop, contributing about 18% of the country's export earnings which translates to US\$ 1.50 billion from coffee exports for twelve months (December 2023-November 2024) (UCDA, 2024). It is grown by more than 1.7 million households on an estimated 353,907 hectares of land, with 90% of them owning gardens ranging between 0.5 and 2.5 hectares in size (NCP, 2013; Bunn et al., 2015; Mugoya, 2018). Coffee also supports more than 9 million people in Uganda who derive their livelihood from coffee-related activities along the value chain (NCP, 2013). Despite the importance of coffee to the smallholder farmers and the

national economy of Uganda, its production and productivity remain low in most parts of the country including the south-western region. For example, a research study by Wang et al. (2015), reported that the actual yield of Arabica coffee in the southwestern region of Uganda ranged between 164 and 2243 kg ha⁻¹ year⁻¹. This is far below the 5,000 kg ha⁻¹ year⁻¹ obtained in some closely spaced and unshaded large-scale coffee blocks planted with compact-type Arabica cultivars, e.g., in Brazil, Colombia, and Kenya (Vander, 2005). This is due to a number of constraints, with climate variability being paramount and is exacerbated by the low adoption of change adaptation (Jassogne et al., 2013; Mulinde et al., 2019; Cuni et al., 2022).

Climate change adaptation refers to modifications in natural, communal, or monetary aspects in response to actual or expected climatic stimuli and their consequences to

weather variations (Smit & Wandel, 2006; IPCC, 2007). Climate change adaptation options commonly employed by farming households in Africa include: use of drought resistant varieties of crops, diversification, changes in cropping pattern and calendar of planting, conserving soil moisture through appropriate tillage methods, improving irrigation efficiency, as well as afforestation and agro-forestry, among others (Akinagbe & Irohabe, 2015; Atube et al., 2022; Takal et al., 2025). Nevertheless, recent research indicates that climate change adaptations have more proficient results with Participatory Monitoring and Evaluation (PM&E) practices (Villanueva, 2010; Bours and Pringle, 2014; Dinshaw et al., 2014; Cradock et al., 2020) and this can lead to achievement of food security and improvement of livelihoods (Chesterman & Ericksen, 2013; Thapa and Kaufmann, 2017; Khanal et al., 2018). Various scholars have underscored the relevance of PM&E in enhancing climate change adaptation. For example, Ssekamatte (2018) argues that strategic planning with the relevant parties ensures ownership and a sense of responsibility to make informed decisions for climate change adaptations while, Vernooy et al. (2006) argues that participatory planning contributes a lot to empowering farmers, researchers, government officials through ownership in attaining climate change interventions. Furthermore, Vernooy et al. (2006) and Ssekamatte (2018) argue, that planning sessions ensure accountability which has been the norm in the M&E practices in climate adaptation as a requirement for donor-funded programs. Also, Thapa and Kaufmann (2017), adds that accountability is increasing transparency among the farmer members. However, Ngwenya (2014), compared the farmer groups' dynamics of PM&E but did not elaborate more on climate change adaptations.

On the other hand, Dinshaw (2018) and Mulinde et al. (2019), point out that farming communities have well-adjusted to the climate intervention instances where PM&E's have been in place. Furthermore, Ford et al. (2013), share the view that PM&E generates learning lessons which are vital concepts in adaptation measures, and provides the farmer with judgment on which intervention worked well, considering the advantages and the financial implications. Participatory monitoring emphasizing learning through participatory approaches has a far-reaching impact on transformation in aspects of climate variations. Also, Ssekamatte (2018), agrees that M&E plays a critical role in

knowledge capital and the effectiveness of the intervention adaptations. Though, Thapa and Kaufmann (2017), compared the effectiveness of three farmer groups with PM&E practices, some concepts of climate adaptation were not clearly stated in their research. Research findings by Nkoana et al. (2018) draw the attention that information is often up-bottom approach rather than a bottom-up approach. However, studies by Nkoana et al. (2018), lacked in elaborating how P&E can enhance climate adaptations. M&E contributes a lot to this decision-making and learning from outcomes of the program requirements to make evidence-based decisions. Villanueva (2010) and Siders and Pierce (2021), believe that making evidence-based decisions on climate adaptations performs well with approaches that work best. Relatedly, Egeru (2012), conducted a study on the role of native knowledge in weather alterations, whose findings showed that farmers tend to make decisions in response to climate adversities. However, Vernooy et al. (2006), focused a lot on PM&E's whose context was in natural resource management.

Based on the above backdrop, therefore, a study was conducted in the Ntungamo district, southwestern Uganda to understand the relevance of PM&E practices in the context of climate adaptations among coffee farmers.

2. MATERIALS AND METHODS

2.1 Study Area

This study was conducted in Ntungamo district (Fig. 1) located in south-western Uganda; between latitudes 0°35' and 1°15' south and longitudes 30°05' East (HRV, 2016) at an elevation of 1300-1560 m.a.s.l (Okech et al., 2005). The district has a bimodal distribution of rainfall (800-1500 mm) falling between March to mid-May, and September to December. It also experiences a mean annual temperature of 26°C and a mean annual minimum of 14.5°C. High temperatures are recorded in January – February and June- August which correspond to dry spells (Okech et al., 2005; HRV, 2016) Ntungamo borders with Kabale district in the south, the Rukungiri district in the west, the Shema and Mitooma districts in the north, the Mbarara district in the northeast, the Isingiro district in the east, the Republic of Tanzania and Rwanda in the southeast. It has 15 sub-counties, three (3) town councils, and one (1) municipality with three (3) divisions (HRV, 2016).

2.2 Data Collection

2.2.1 Data sources

The study population comprised 724 respondents, including, members of the district council and steering committee whereas, the coffee farming households were the main respondents that answered the structured questionnaires. The categories were selected because of their involvement in

monitoring activities in their respective cooperatives. The coffee farmers were selected from the Ankole Coffee Producers Cooperative Union (ACPCU) (Okech et al., 2005) residing in the Ihunga and Kibatsi sub-counties.

2.2.1.1 Sampling criteria

The sample size (Table 1) was selected using (Krejcie & Morgan, 1970).

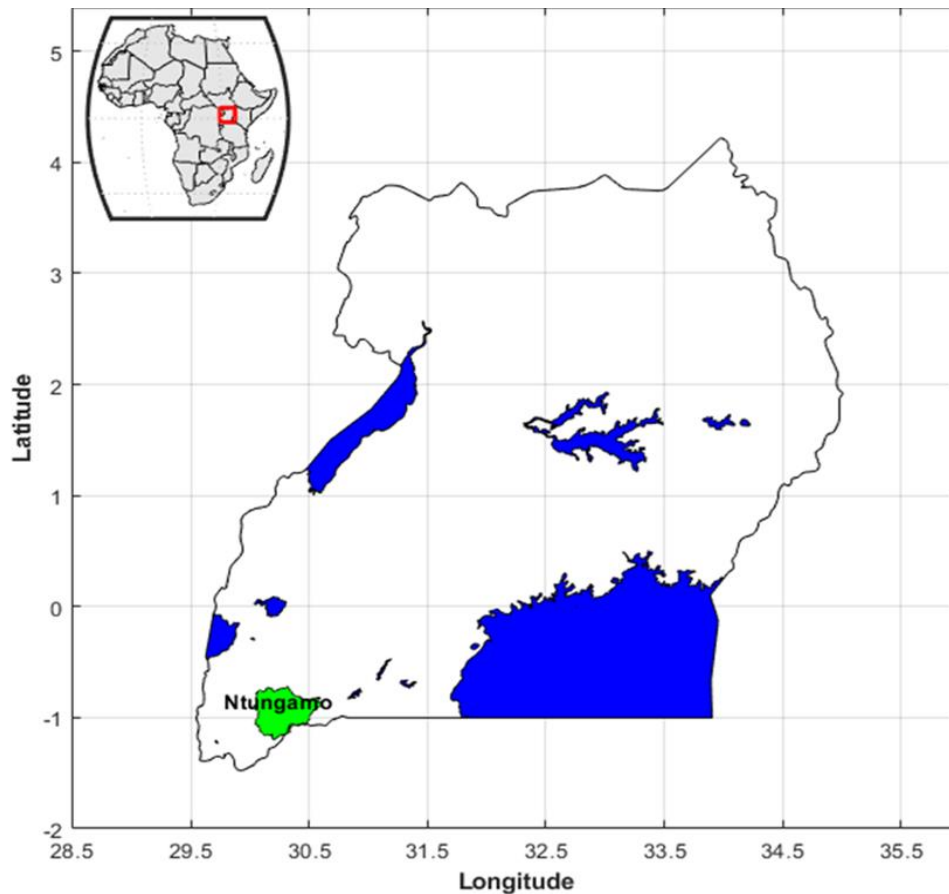


Fig. 1. Location of Ntungamo district in south-western Uganda

Table 1. Sampling criteria adopted for the study

Category of study population	Study Population	Sample Size	Selection Criteria
Members of the district council	15	14	Simple random sampling
Members of the district coffee steering committee.	15	14	Simple random sampling
Coffee farmers in Kibatsi sub-county Kibariko parish, Kihumuro village	444	205	Simple random sampling
Coffee farmers in Ihunga sub-county, Rukarango Parish, Rukarango 1 village	250	152	Simple random sampling
Total	724	385	

2.2.1.2 Survey questionnaire

The questionnaire survey method was used to understand the contribution of PM&E among coffee farming households. It is a method used for gathering information about the characteristics, attitudes, of a population by using a structured set of questions (Navarro & Kosmin, 2011). This questionnaire was administered to the coffee farmers, members of the district council, and, members of the coffee steering committee with the help of trained research assistants who explained the questions to the respondents. The method was also used because it was easy to construct and can handle large data sets (Young, 2015).

2.2.2 Quality control (Validity and reliability of instruments)

2.2.2.1 Validity

Validity of a research instrument assesses the extent to which the instrument measures what it is designed to measure (Cohen & Morrison, 2017). It is the degree to which the results are truthful. On the other hand, content validity refers to the degree to which an assessment instrument is relevant to, and representative of, the targeted construct it is designed to measure. The content validity was established through a qualitative expert review of tools (Brod & Christensen, 2009). It refers to the degree to which the tool adequately samples the research domain of interest when attempting to measure (Cohen & Morrison, 2017)

$$\text{Content Validity Index} = \frac{\text{relevant items by all judges as suitable}}{\text{Number of Questions}} \text{Eq.(1)}$$

Our results showed Content Validity Index (CVI) of 0.73 for the Dependent Variable (Table 2) and

0.81 for the Independent Variable for the instrument. This is in line with Polit & Owen (2007) proposition that shows that CVI greater than 0.7 is considered to be good while that at 0.9 is considered to be excellent. The instrument was therefore considered to be valid. The obtained CVI of 0.73 for the dependent variable and 0.81 for the independent variable therefore, indicates that the data collection tool was valid.

2.2.2.2 Reliability

According to Golafshani (2003), reliability is trustworthiness in the context of measuring an instrument. The instrument was tested for reliability to ascertain if it would consistently measure whatever it was supposed to measure after several trials. Test-retest reliability was done by administering the same questionnaire to the same group of respondents at two different points in time. The correlation between the two sets of results was computed using Cronbach's alpha coefficient which employs this formula (Equation 2): -

$$r\alpha = \frac{N(1-\sum V_1)}{(N-1)(V_t)} \text{Eq. (2)}$$

Where; $r\alpha$ - coefficient alpha, N - Number of items, V_1 -Variance of one item, V_t -Variance of the total test scores, $\alpha \geq 0.7$ is acceptable.

Cronbach's Alpha for the dependent variable of 0.71 (Table 4) and that of independent variable of 0.891 (Table 5) implies that the instrument is considered reliable because >0.7 is considered reliable. Internal consistent above or greater than 0.7 would be acceptable and data collection instrument was considered reliable while when Cronbach's alpha is less than 0.7 would be considered unreliable (Golafshani, 2003).

Table 2. Validity index for the dependent variable

Variable	Number of questions	Relevant items	Validity Index
Expert 1	6	5	0.8
Expert 2	6	4	0.7
Content Validity Index (CVI) Average			0.73

Source: Primary data (2021)

Table 3. Validity index for the independent variable

Variable	Number of questions	Relevant items	Validity Index
Expert 1	8	7	0.875
Expert 2	8	6	0.75
Content Validity Index (CVI) Average			0.81

Source: Primary data (2021)

Table 4. Reliability Statistics for the Climate Change adaptations Dependent Variable (DV)

Cronbach's Alpha	Number of items
0.714	5

Source: Primary data (2021)

Table 5. Reliability Statistics for Participatory Monitoring and Evaluation (PM&E) Practices Independent Variable (IV)

Cronbach's Alpha	Number of items
0.891	7

Source: Primary data (2021)

2.3 Data Analysis

The data were cleaned, sorted, coded, and entered into the computer system using the Statistical Package for Social Scientists (SPSS) version 26 for analysis. Descriptive statistics and inferential statistics were generated. This was appropriate since a sample was obtained from the population to make interpretations and draw conclusions (Bettany & Whittaker, 2014). Spearman correlation was used to assess the strength, association, and linkage of PM&E practices and climate change adaptations. This type of analysis was appropriate for this study because the data were non-parametric (Ruscio, 2008; Schober et al., 2018). Furthermore, inferential statistics such as Analysis of Variance (ANOVA) along with Regression analysis were also performed.

3. RESULTS AND DISCUSSION

3.1 Relationship between Participatory Monitoring and Evaluation (PM&E) Practices and Climate Change Adaptation Measures

Participatory climate adaptation planning with the local community integrates local knowledge and needs with scientific information, allowing for responsive adaptation interventions that best reflect the community's risk level and values (Kissinger et al., 2013; Kim & Kang, 2016). Increased community-based planning is therefore vital for addressing trade-offs and synergies between the three pillars of productivity, adaptation, and mitigation (Vermeulen et al., 2012). Results of the Spearman correlation between participatory monitoring and evaluation (PM&E) practices (independent variable) and climate change adaptation measures (dependent variable) are summarized in Table 6. Participatory planning

with farmers' representatives at the district/sub-county/cooperative level as well as needs assessment during the planning process with farming communities were positively and significantly correlated with the adoption of planting shade trees ($r=.272^{**}$; $p=0.00$ and $r=.203^{**}$; $p=0.00$, respectively). However, both correlations were weak, implying that an increment in participatory planning with farmers' representatives as well as needs assessment during the planning process with farming communities, may not necessarily enhance the adoption of planting shade trees. This could in part be due to land shortage and fragmentation in the district (Tukahirwa, 2002; Ntakyo et al., 2011; Kanyesigye, 2023) and/or tree growing is not being prioritized in the area (Agea et al., 2009; Riedman et al., 2022). Nevertheless, studies conducted in Ethiopia by Fikreyesus et al. (2022), showed that limited participation of the local community in planning resulted in the limited planting of trees many of them being planted on rocky areas and land inappropriate to sustain them. Participatory planning in planting trees has been reported to replace the top-down 'reforestation' approaches that are insensitive to local needs and preferences (Noordwijk et al., 2011).

On the other hand, results further showed that participatory planning with farmers' representatives at the district/sub-county/cooperative level as well as needs assessment during the planning process with farming communities were positively correlated with soil and water conservation practices ($r=.920$, $p=0.00$; $r=.684$, $p=0.00$, respectively) as climate change adaptation measures. The correlation shows a strong association, implying that participatory planning with farmers' representatives as well as needs assessment during the planning process with farming communities, resulted in increased use of soil and water conservation practices as a means of

climate change adaptation. This finding is in agreement with several earlier studies which have demonstrated that participation of farmers in soil and water conservation planning, increases the acceptance and adoption of these climate adaptation measures (Okoba et al., 2007; Tenge et al., 2007; Mazengia & Mowo, 2012; Tumwesigye et al., 2018; Indrawati, et al., 2022). This is because these climate adaption measures solve problems that are perceived by farmers themselves (Okoba et al., 2007; Tenge et al., 2007).

All in all, these findings spell out the contribution of decision making during strategic planning for governments in monitoring and evaluation that translate to the communities at grassroots levels (Bours & Pringle, 2014; Ssekamatte, 2018). Our results confirm several research studies that revealed that farmers' adoption of soil and water conservation practices and shade trees is influenced by their perception and prior knowledge and benefits to make such decisions (Buyinza et al., 2021; Chuma et al., 2022; Yifru, & Miheretu, 2022; Ntawuruhunga et al., 2025). In addition, also Vernooy (2006). established that farmers attain empowerment from consultations. Needs assessment are crucial in participatory monitoring and evaluation processes.

Furthermore, our results showed that participatory monitoring with farmers was weakly and positively correlated with adoption of planting shade trees ($r=.271^{**}$; $p=0.00$). This implies that an increase in participatory monitoring with farmers does not necessarily enhance adoption of planting shade trees. This could in part be due to the fact that participatory monitoring is not usually applied in agroforestry project as reported by (Mukuralinda et al., 2016; Evans et al., 2018). However, participatory monitoring with the farmer was moderately and positively correlated with soil and water conservation practices ($r=.658^{**}$; $p=0.00$). This implies that an increase in participatory monitoring with farmers enhances the use of soil and water conservation practices as a method of adapting to climate change. This finding is in agreement with scholars like Shah et al. (1988) and Atnafe et al. (2015) who spell the relevance of participatory monitoring approaches for the adoption of soil and water conservation interventions. Participatory monitoring recognizes the central role that local people can play in planning and managing their use of the environment (Abbot & Guijt, 1998).

Conversely, results showed that regular data collection had a weak negative correlation to farmers' access to timely climatic information ($r=-.155^{**}$; $p=0.00$), implying that regular data collection does not necessarily result in a reduction into farmers' access to timely climatic information. This implies that the collection and availability of climate change information do not guarantee its utilization. Our finding is in agreement with other earlier studies which reported a weak relationship between the availability of climate change information and its utilization (Dukper, 2002; Antwi-Agyei et al., 2021; Baffour-Ata et al., 2022). Other factors such as knowledge and relevance of the information could be limiting factors to utilization (Dukper, 2002). Nevertheless, farmers need to access timely information to make the right decisions for climate change adaptation (Jassogne et al., 2013; Mulinde et al., 2019). However, Ssekamatte (2018), highlights that data for climate change interventions are often underutilised in developing countries and this affects stakeholders and practitioners to generate solutions to climate change. The Government should therefore formulate and implement policies that strengthen the provision of timely, simplified, and adequately actionable climate information that suits the climate change adaptation needs of farmers (Matere et al., 2023).

Similarly, regular data collection had a weak negative correlation with soil and water conservation practices ($r=-.158^{**}$; $p=0.00$) as a means of climate change adaptation. This implies that regular collection of data will not necessarily increase farmers' adoption of soil and water conservation practices as a climate change adaptation strategy, suggesting that the current data collection methods might not be effectively encouraging or supporting these practices. Similarly, though related studies show that coffee farmers are aware of the soil and water conservation practices (Mekonnen et al., 2016; Njenga et al., 2021), the adoption and continued use of these measures have been limited in many smallholder households (Njenga et al., 2021; Turyahabwe et al., 2022; Belayneh, 2023). Soil and water conservation practices should therefore be scaled up through a concerted effort of extension workers, local administration, and other relevant non-state actors (Wordofa et al., 2020; Turyahabwe et al., 2022).

Table 6. Spearman Correlation between the dependent and independent variables (n=385; significant p values are highlighted in bold)

Independent variable		Dependent variables				
		DV 1	DV 2	DV 3	DV4	DV 5
IV1	Correlation coefficient	0.043	-0.021	.272**	.920**	0.072
	P value	0.40	0.68	0.00	0.00	0.16
IV2	Correlation coefficient	0.059	-0.074	.203**	.684**	0.081
	P value	0.25	0.15	0.00	0.00	0.11
IV3	Correlation coefficient	0.065	-0.085	.271**	.658**	0.09
	P value	0.20	0.10	0.00	0.00	0.08
IV4	Correlation coefficient	-.155**	-0.018	0.036	-.158**	-.178**
	P value	0.00	0.72	0.48	0.00	0.00
IV5	Correlation coefficient	-0.04	-0.087	.444**	.445**	0.02
	P value	0.44	0.09	0.00	0.00	0.70
IV6	Correlation coefficient	0.004	-0.056	.367**	.428**	0.06
	P value	0.93	0.28	0.00	0.00	0.24
IV7	Correlation coefficient	0.058	-0.029	0.047	0.086	0.026
	P value	0.25	0.57	0.35	0.09	0.61
IV8	Correlation coefficient	-0.05	-0.061	0.031	0.035	-0.037
	P value	0.33	0.24	0.54	0.50	0.47

Key:

IV1=Participatory planning with farmers representatives ensures inclusiveness at the district/sub-county/cooperative level

IV2=Needs assessments during the planning process with farming communities yield higher results during the implementation process of climate adaptations

IV3=Participatory monitoring with farmers encourages them to manage their coffee fields through learning good agronomic practices from other farmers.

IV4=Data collection exercise is done regularly during the field visits by extension staff to assess farmer's performance communities to work together to achieve high coffee yields through climate change adaption practices

IV5=Participatory monitoring through farmer-to-farmer exchange visits is vital to coffee farmers in providing skills knowledge and experience on how to improve or change the climate adaptation strategies

IV6=Participatory evaluation is often with farmers and farmer leaders to reflect on their actions and determine which intervention is working effectively

IV7=All stakeholders including farmers participate in the feedback sessions before the findings are disseminated to different platforms

IV8=Dissemination of findings and results are conducted during the meetings at the district headquarters

DV1=Coffee farmers have access to timely climatic information that can support climate adaptation measures

DV2=Coffee farmers have information on the availability and access of drought-resistant varieties to enhance climate adaptation

DV3=Coffee farmers often plant recommended shade trees in their coffee fields

DV4=Soil and water conservation measures can greatly contribute to climate change adaptations

DV5=Coffee farmers have the knowledge in the management of the pests and diseases through PM&E practices

Our results also showed that regular data collection exercises had a negative weak correlation with coffee farmers knowing the management of pests and diseases ($r=-.178^{**}$; $p=0.00$). This implies that regular data collection exercise does not necessarily translate to the management of pests and diseases. This could in part be due to the fact that farmers' knowledge and capacity on handling climate data are generally limited (Hollburg & Stöber, 2021; Ncoyini, et al., 2022), though, accurate, intensive and timely climate data are required to predict the future climate to act accordingly

(Sanga et al., 2005; Tumbo et al., 2018). Nevertheless, various scholars in Uganda (Luzinda et al., 2015; Liebig et al., 2016; Kagezi et al., 2018; Kobusinge et al., 2018) and elsewhere (Hillocks et al., 1999; Segura et al., 2004; Aranka et al., 2021), have reported that farmers have knowledge of coffee pests and diseases but their management remains a big challenge. This finding shows that there is still a conceptual gap between scientific knowledge developed at research institutions and the fulfilment of the farmers' need to solve their major pest and disease problems. This

therefore calls for participatory approaches for pest and disease management in coffee agro-systems with the supervision of the extension officers (Segura et al., 2004; Kagezi, et al., 2018), to empower farmers to develop sustainable crop production and protection systems, replace the traditional role as passive recipients of information (Williamson, 2002) All in all, there is a need of data in monitoring and evaluation (Bours et al., 2014) to support climate change interventions and make informed and corrective action (Villanueva, 2010).

Participatory monitoring through farmer-to-farmer exchange visits was positively and significantly correlated with farmers planting shade trees ($r=.444^{**}$, $p=0.00$) as well as applying soil and water conservation ($r=.445^{**}$, $p=0.00$) as climate change adaptation measures. This implies that farmer-to-farmer exchange visits resulted in increased planting of shade trees as well as the use of soil and water conservation practices as a means of climate change adaptation, agreeing with several earlier studies e.g. (Franzel and Scherr, 2002; Mlenga, 2019; Regreening Africa, 2020). Farmer-to-farmer exchange visits are opportunities for farmers to learn from each other's experiences and practices (Khaila et al., 2015). Exchange visits are vital as they provide concrete examples of technologies, innovations, and practices that farmers apply to their circumstances (Mlenga, 2019). They also improve the skills of farmers in addressing various challenges facing them and enhance the productivity of coffee (Ochago et al., 2024) as well as fostering change in

behaviour and attitudes amongst farmers (Mlenga, 2019).

Furthermore, participatory evaluation with farmers and their leaders was positively and significantly correlated with planting of shade trees ($r=.367^{**}$, $p=0.00$) as well as the use of soil and water conservation measures by farmers as climate change adaptation measures. This implies that participatory evaluation with farmers and their leaders resulted into increased uptake of planting of shade trees as well soil and water conservation practices as a means of climate change adaptation, supporting earlier research studies (Hamilton et al., 2001; Evans., 2008; Mgoba and Kabote, 2020).

All in all, PM&E is crucial for gathering data on the progress of development programs, allowing program managers to assess if implementation is on track, and take corrective action necessary adjustments or redesign based on emerging situations and new information in response to climate change adaptations. This will essentially ensure that the program remains responsive to changing circumstances and effectively achieves its goals (Zerfu and Kebede, 2013). Information collected through PM&E can be used to learn from past experiences and improve performance, operations, and strategic decisions (Woodhill, 2007). PM&E is also increasingly being used for accountability and transparency for several interventions (Estrella et al., 2000; Woodhill, 2007).

Table 7. Model summary

Model	R	R-Square	Adjusted R Square	Standard Error of the Estimate
1	.858 ^a	.736	.735	.303
a. Predictors: (Constant), Participatory planning with farmer representatives ensures the inclusiveness of stakeholders at the district/sub-country/ cooperative level				

Table 8. Analysis of Variance (ANOVA) results

Model		Sum of Squares	Df	Mean Square	F	Sig.
	Regression	97.675	1	97.675	1066.134	0.00 ^b
	Residual	35.089	383	0.92		
1	Total	132.764	384			
a. Dependent Variable: Soil and water conservation measures can greatly contribute to climate change adaptations among coffee farming households						
b. Predictors: (Constant): Participatory planning with farmer representatives ensures inclusiveness at the District/ Sub-country/ Cooperative level.						

Table 9. Coefficients results

Model	Coefficients ^a			
	Unstandardized Coefficients		Standardized Coefficients	t
	B	Std. Error	Beta	
(Constant)	.465	.119		3.9000
1 Participatory planning with farmer representatives ensures inclusiveness at district/sub-country/cooperative level	.887	.027	.858	32.652
a. Dependent Variable: Soil and water conservation measures can greatly contribute to climate change adaptations among coffee farming households.				

3.2 Regression between Participatory Monitoring and Evaluation Practices and Climate Change Adaptation Measures

Results of a regression analysis between participatory planning with farmers' representatives and the use of soil and water conservation measures which had the most outstanding Spearman Correlation Coefficient (0.92; Table 6) are shown in the model summary below (Table 7). The R-value of 0.858 indicates a strong positive correlation between participatory planning with farmers' representatives and soil and water conservation measures. The observed adjusted R^2 of 0.736 implies that 73.5% of the change in climate change adaptation is explained by participatory M&E practices. The remaining 26.5% could be attributed to other factors not exhibited in the model. This result is in agreement with Gujarati et al. (2012), Ozili (2023) and Gao (2024), who remarked that the econometric model is considered to have high predictable power if the model has a high adjusted R-squared.

Furthermore, the analysis of variance (ANOVA) shown in Table 8 indicated that the p-value was less than 0.05 ($p=0.000$, $p<0.05$) at a 5% level of significance. This was statistically significant, insinuating rejection of the hypothesis that participatory planning with farmers' representatives has no significant influence on the use of soil and water conservation measures as a method of climate change adaptation. The model thus exhibited that participatory planning with farmers' representatives was statistically significant in influencing the use of soil and water conservation measures as a method of climate change adaptation, at a 95% level of confidence. In addition, the ANOVA showed that the Fisher's ratio (F statistic) is significant since the P value is 0.00. Hence, it indicates that PM&E practices significantly contribute to and support climate

change adaptation among coffee farmer households. Therefore, investing in PM&E practices within climate change adaptation initiatives is likely to lead to significant positive change by improving adaptation strategies. This finding is in line with several studies (e.g. Villanueva, 2010; Dinshaw et al., 2014; STAP, 2017; Ssekamatte, 2018, Dupuits, 2024)

Furthermore, the standardised coefficient Beta was 0.858 and highly significant with $p=0.00$ (Table 9), implying that a unit of efforts invested in PM&E practices would result in a 0.858 change in terms of climate change adaptation among coffee farmer households. Results also showed that the coefficient of regression was highly significant ($p= .00$) for PM&E practices and therefore, the null hypothesis is rejected. PM&E practices are therefore, significant predictors of climate change adaptation among coffee farmer households as they provide crucial information to understand the effectiveness of adaptation strategies, identifying areas for improvement and allowing for adjustments to be made (Ssekamatte, 2018; FAO and UNDP, 2019; Dupuits, 2024)

4. CONCLUSION

Our study aimed to define the contribution of the various participatory monitoring and evaluation (PM&E) practices to enhance the adaptation of climate change measures by the coffee farming community of Ntungamo district, southwestern Uganda. Results revealed that participatory planning needs assessments, monitoring with farmers, farmer-to-farmers exchange visits, and, participatory evaluation are good predictors of farmers' use of recommended shade trees as well as soil and water conservation practices as interventions for adapting to the climate in their coffee gardens. This finding thus, underscored the vital role that local participatory planning and the assessment of local needs together with

farmers play in decision-making processes and policymaking in the context of climate change. This study also highlighted that, planting of shade trees and use of soil and water management were the most important measures for climate change adaption in the coffee agro systems of southwestern Uganda. Coffee farmers should therefore be directly involved in planning discussions at the local Government level to identify specific goals and develop climate change adaptation strategies that are tailored to their needs, experiences, and capacity, using a bottom-up approach. This will significantly enhance farmers' sense of ownership and commitment, leading to better implementation of climate change adaptation strategies. Furthermore, the results of this study provide vital information for designing climate change adaptation strategies and formulation of policy recommendations at local Government level.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

The authors have declared that no competing interests exist.

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