Restoration of Degraded Agricultural Landscapes Using Participatory Integrated Planning (PIP) Approaches: Experiences from the Manafwa Watershed Restoration Project, Mt Elgon, Eastern Uganda

Frank Mugagga[1]

[1]fmugagga@gmail.com/frank.mugagga@mak.ac.ug (+256772968421)

[1]https://orcid.org/0000-0002-8426-0736

[1]Department of Geography, Geo-informatics and Climatic Sciences, Makerere University, Uganda

ABSTRACT

This study assessed the determinants and constraints impeding the adoption of participatory integrated farm planning (PIP) approaches by smallholder farmers to restore landscapes on the slopes of Mt. Elgon, Eastern Uganda. Two hundred seventy-seven (277) household interviews complimented with focus group discussions were conducted with smallholder farmers in two purposively selected sites (one of which was a Manafwa Watershed Restoration project site and the other was a control). Key informant interviews were employed to gather information from technical personnel and local leaders. Field observations were used to triangulate and validate some of the data from the interviews and discussions. Qualitative data were thematically analyzed. SPSS v23 was employed to generate descriptive statistics, while chi-square tests, ANOVA, t-tests, correlation, and regression analyses were used to test for associations. Major determinants for PIP adoption were marital status, extension services, education, age, and sex of the farmers. Integration, empowerment, and collaboration principles influenced uptake of PIP, while limited knowledge, inadequate finance, limited labour, small land sizes, and low incentives constrained PIP implementation. It can thus be concluded that the PIP has the potential to promote widespread landscape restoration. However, for sustainable impact, the PIP approach ought to be extended to other areas; this will require that local governments adopt it and allocate logistical support to its extension workers.

Key words: Collaboration, Integration, Landscape Restoration, Mt. Elgon, Participatory Integrated Farm Planning

I. INTRODUCTION

The role of community participation in sustainable environmental restoration interventions has been emphasised by several scholars (Blake et al., 2018) who underscore their relevance in ensuring sustainability and ownership by the communities through intrinsic motivation (Kessler et al., 2016). However, in most landscape restoration interventions, the role of local communities has been insufficiently considered (Mutekanga et al., 2013), yet stakeholders' involvement enables improvement in the effectiveness of landscape management projects (The Nature Conservancy [TNC], 2016). Moreover, promotion of participatory approaches at a multiscale level, considering needs of all different actors, can be effective for restoration and protection of landscape ecosystems (Boafa & Ichikwa, 2016; Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services [IPBES], 2018).

Participatory community mapping and involvement in integrated landscape management have been noted to spur empowerment, adoption of interventions, and eventually reduce landscape denudation across regions (Worku & Tripathi, 2015; Bhan, 2013; Hossen, 2016; Ofgeha, 2017). In Uganda, for instance, Mutekanga et al. (2013) applied community participatory tools to understand stakeholder analysis and policy development for integrated landscape management in Uganda's highlands. Adoption of integrated participatory land use planning bottom-up approaches will address socio-economic and geographical conditions (Wunder et al., 2018).

Between 2019 and 2023, a consortium comprising Makerere University, Kyambogo University, and Africa 2000 Network, all from Uganda, together with Wageningen University and Research from the Netherlands, implemented a project titled the Manafwa Watershed Restoration Project (MWARES), which applied the integrated farm planning (PIP) approaches to spur community initiatives towards the restoration and conservation of the Upper Manafwa catchment, located on the slopes of Mt. Elgon National Park, Eastern Uganda. The PIP approach, from French '*Plan Intégré du Paysan*' or Integrated Farm Plan, is a bottom-up approach that aims at wide-scale sustainable change by motivating local farmers to transform their reality through conscious collective action to conserve and restore the natural resources (Kessler et al., 2016). The approach considers and relies on local stakeholders, with the right mindset and attitude, as the core towards laying a solid foundation for transforming local realities and investing

in the future for sustainable development. In the PIP approach, local stakeholders with the right vision and intrinsic motivation to transform their reality and invest in the future are considered the required solid foundation for sustainable development. The PIP approach thus heavily relies on changing people, on moving them to take responsibility and collaborate for the shared interest of natural resources conservation and restoration. First tested and implemented in Burundi (Kessler et al., 2016), a country facing similar constraints to those of the Manafwa landscape, entailing agricultural intensification on hilly landscapes as well as high population densities, coupled with inappropriate farming practices, leading to soil erosion and land degradation, the PIP approach is rooted in sustainable rural development initiatives that promote farmer participation, engagement, and investment for individual and collective farmer action, and particularly also in transdisciplinary approaches that focus on integrated soil fertility management.

1.1 Statement of the Problem

A number of natural resource management policies and programmes have been put in place by the Government of Uganda to curb the ever increasing landscape degradation (Barungi et al., 2013) including afforestation in the degraded land areas, terrace improvement, and improvement in the farming systems (Buyinza & Mugagga, 2010). Specific to the Mt. Elgon landscape, initiatives such as the Plan for Modernization of Agriculture (PMA) and the Northern Uganda Social l Action Fund (NUSAF) were put in place to promote water and land conservation practices. In addition, the Ministry of Agriculture, Animal, Industry, and Fisheries and some Non-Governmental Organizations (NGOs) such as the African Highlands Initiative (AHI), and the Sloping Agricultural Land Technology (SALT) projects trained smallholder farmers on sustainable soil conservation practices along slopes of Mount Elgon. However, despite these interventions, the Mt. Elgon landscape continues to face serious degradation by way of deforestation, soil erosion and denudation; partly attributed to the top-bottom approaches which do not directly and actively involve the local stakeholders in the design and implementation of these initiatives, resulting in limited motivation and local ownership of the solutions. To address this problem, between 2019 and 2023, the Manafwa Watershed Restoration Project (MWARES) implemented the Participatory Integrated Farm Planning (PIP) approach in selected sites along the slopes of Mt. Elgon. The PIP approach is a bottom – up approach that seeks to change the mind-set of smallholder farmers and other stakeholders to take charge and become more resilient through initiating actions geared towards landscape restoration and environmental stewardship. However, the adaptability rate and effectiveness of PIP as an alternative approach has not been cleared documented, despite its potential to inform environmental conservation policy and practice in Uganda and beyond. This paper thus assesses the determinants and constraints for the adoption of the Integrated Farm Planning (PIP) as an approach used by smallholder farmers to restore degraded landscapes in two purposively selected sites, one being a MWARES project site, the other being a control. Specifically, the paper unravels the determinants for the adoption of the PIP approach, uptake of PIP principles, influence of PIP approach on the use of landscape restoration practises as well as, the constraints faced by smallholder farmers when implementing landscape restoration measures.

1.2 Research Objective

The overarching objective of this study was to explore the contribution of the Integrated Farm Planning Approach (PIP approach) towards landscape restoration on the slopes of Mount Elgon. Specifically, the study assessed the determinants and constraints for the adoption of the Integrated Farm Planning (PIP) approaches by smallholder farmers, drawing on experiences from the MWARES project.

II. LITERATURE REVIEW

2.1 The Integrated Farm Planning Approach (PIP)

The Integrated Farm Planning approach (from French ‘Plan Intégré du Paysan’) finds its origin in Bolivia where it was developed and first tested in the year 2000-2003. It was further implemented in Burundi from 2013-2016 by the project “Fanning the Spark” locally known as the SCAD project. Later in the next phase, the PIP approach was developed and validated within the PAPAB project where it was implemented at a much larger scale (Kessler et al., 2020). It is now expanding to other African countries like Uganda, Rwanda, and Ethiopia. In Uganda, it started in 2019 in the Manafwa watershed under the MWARES project. The slogan of the PIP approach is “proud farmers, better soils, and more food.” The approach focuses on people and land. According to Kessler et al., (2020), motivated people and healthy land are considered the foundation for sustainable development.

The objective of the approach is to foster resilient farming systems i.e., farms that can resist and recover from shocks (drought, excessive rainfall, pest infestations, etc.), to continue producing food sustainably -Resilience-based

stewardship. According to Kessler et al., (2020), resilience-based stewardship makes farmers more committed to keeping their land healthy making their farms resilient.

PIP responds to a need, it focuses on empowerment where farmers become aware that they can change their reality, it generates a family vision, and it stimulates integration which gives room for the inclusion of various activities. It does not use incentives leading to intrinsic motivation but triggers collaboration, it stimulates fast upscaling due to open days and exchange visits, it engages institutional stakeholders like policymakers and it works with engaged staff who fully believe in the approach. The PIP approach in practice is done in four phases. The 1st phase is awareness raising at the community level which takes 2 months, it is followed by PIP creation with PIs for 4 months, phase 3 is PIP scaling up in each community and which takes a year, and this is followed by scaling up to adjacent communities and it also takes a year (Hossen, 2016).

According to Linssen and Meeske (2020) and Kessler et al. (2021), the PIP approach generates an ever-increasing number of proud farmers who realize that their land is their main asset and who feel intrinsically motivated to invest in their land. The approach is seen as a pathway toward sustainable land management in farmers' households, the wider community, and the ultimate landscape (Kessler et al., 2016; Linssen & Meeske, 2020). The approach emphasizes a bottom-up approach where intrinsically motivated farmers act and conserve their environment. According to Linssen and Meeske (2020), erosion is best controlled through decisions made by individual farmers.

2.2 Conceptual Framework

Rampant degradation, by way of soil erosion on the slopes of Mt. Elgon region is mainly due a combination of anthropogenic and topographic factors including to poor farming practices, the steep nature of the landscape and increased population. The PIP approach is founded on the principles of stewardship, resilience and motivation, together with the guiding principles of integration, collaboration and empowerment. For this study both foundation and guiding principles were conceptualized as the independent variables, upon which adoption and utilization of landscape restoration initiatives such as crop rotation, strip cropping, contour ploughing, terracing, agroforestry, mulching, non-tillage and trenching practices depended, resulting into intrinsic motivation, good stewardship and resilient farms. Thus, interrogating the link between these variables would then help in unravelling the determinants for the adoption of the PIP approach, uptake of PIP principles, influence of PIP approach on the use of landscape restoration practises as well as, the constraints faced by smallholder farmers when implementing landscape restoration measures.

III. METHODOLOGY

3.1 Research Design

The study adopted a descriptive design and employed a mixed methods approach to collect both qualitative and quantitative data using a quasi-experimental design to assess the determinants and constraints for the adoption of the PIP as an approach used by smallholder farmers to restore degraded landscapes within one MWARES project intervention sub county and one non-intervention Sub County. The major assumption was that there was little or no spill over effects of the PIP approaches across comparison sub county, similarly, little, or no external contaminations on the non-PIP farmers.

3.2 Study Area

The study was conducted in Bushika and Bumasheti Sub counties both found in Bududa District, one of the districts that has faced rampant landscape degradation owing to the high population pressure and density standing at an average of 952 persons per square kilometre, coupled with poor farming activities (Nakileza et al., 2017); moreover, over 90% of the people rely on subsistence farming for their livelihoods (Opedes et al., 2023). Bushika is one of the sub counties that implemented the PIP approach to restore and conserve the landscape through the MWARES project and thus served as the intervention site; while, Bumasheti, having similar socio-economic and terrain characteristics with Bushika was used as a control site, owing to its being out of MWARES project areas.

Bududa is located on the slopes of Mt Elgon and borders the Republic of Kenya in the East, the districts of Sironko, Bulambuli, and Kween in the North, Mbale in the west, and Manafwa in the south. It lies between the longitudes of 34° 16' 18" and 34° 32' 6.69" East and latitudes 00° 58' 45.63" to 1° 7' 22.07". Just like the wider Mt Elgon landscape, Bududa district is characterized by a wet tropical climate, with mean monthly maximum temperatures between 25ºC and 29ºC; humidity ranging between 80% - 90% and an average rainfall of 1800mm per annum with two farming seasons, the first from March to June and the second from September to November (Opedes et al., 2023). The area is characterised by clay loams from the Elgon volcanic rocks and non-laterite brown sandy clay

loams from the basement complex. The major soil types are cambisols, lixisols, ferrallisols, leptosols, gleysols, and acrisols (Nakileza et al., 2017).

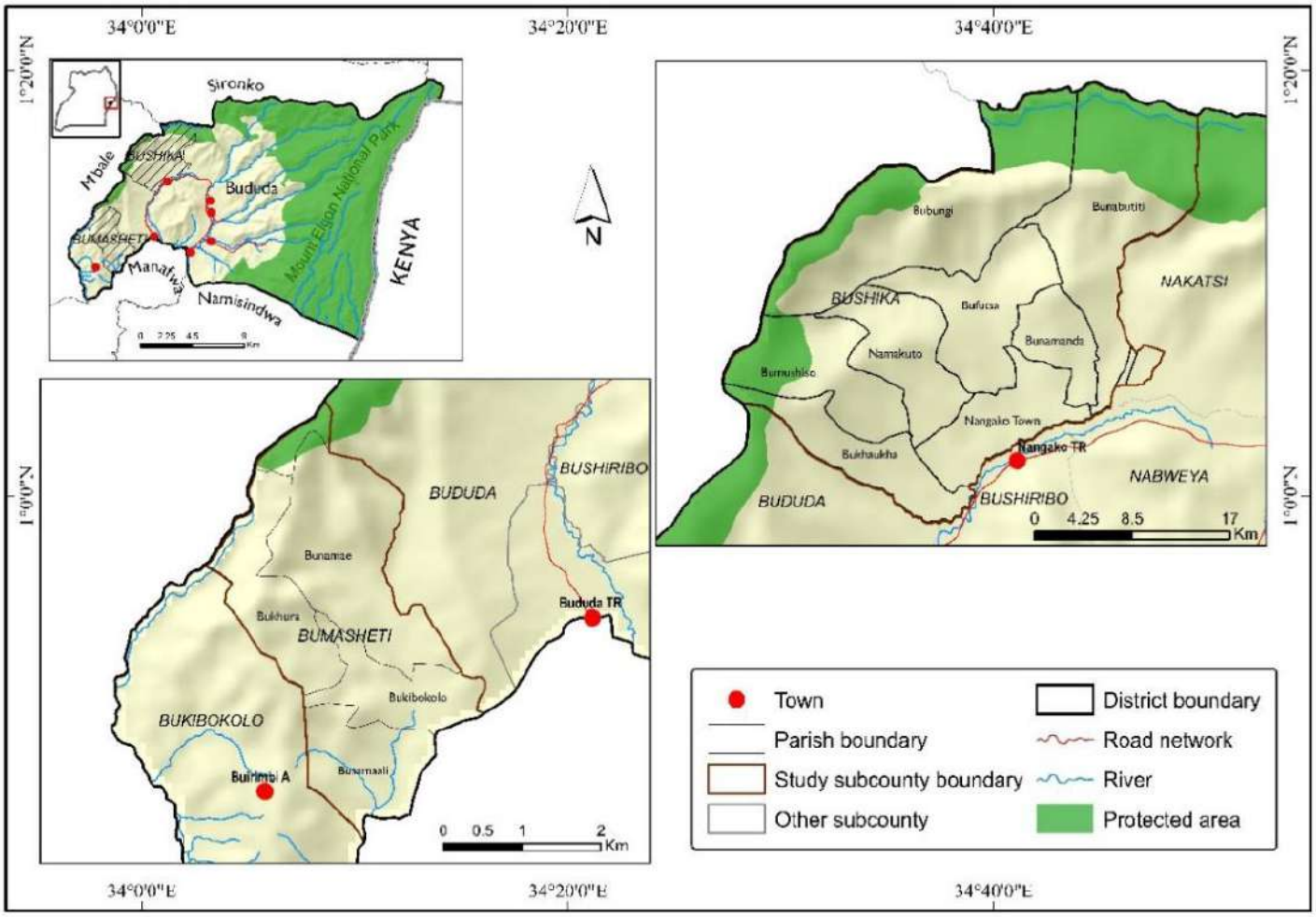

Plate 1

Location of Study Areas in Bududa District, Eastern Uganda (MWARES Project archives)

3.3 Sampling Framework, Techniques and Sample Size

The study participants, comprising farmer households were drawn from two purposively selected sub counties, as already elaborated. A multi stage sampling stage in which two sub counties were purposively selected, followed by random selection of two parishes from each of the sub counties and finally random selection of study participants, drawn from farmer households, was employed. In the end, 173 and 104 study participants, comprising farmer households, were drawn from Bushika and Bumasheti Sub Counties, respectively.

3.4 Data Collection and Instruments

3.4.1 Household Surveys

A survey of the selected households, targeting household heads, was conducted using questionnaires that were loaded onto Tablets using Kobo Toolbox Software (https://kf.kobotoolbox.org/#/formsto) and open Data Kit (ODK) applications. The questionnaire, largely containing close- ended questions, delved into the socio-demographic conditions of the households, the factors for the adoption of the PIP approach and the constraints faced by smallholder famers in implementing the landscape restoration activities in the intervention and control sub counties.

3.4.2 Focus Group Discussion

A total of three Focus Group Discussions, each having ten participants, comprising five males and five females and lasting approximately 90 minutes, were conducted with purposively selected participants from MWARES project beneficiaries in Bushika Sub County. The participants were selected based on their involvement, interest, and knowledge of action planning towards the restoration of the upper Manafwa watershed. The FGDs aimed at gathering

opinions, experiences, and the constraints faced by smallholder famers in implementing the landscape restoration activities using the PIP approach. The FGDs were held in a private and comfortable setting that allowed for free-flowing uninterrupted discussions.

3.4.3 Key Informant Interviews

Key informant interviews were held with six key informants including the Personal Assistant to the Secretary to the Chief Administrative Officer of Bududa District, Bududa District Production Officer, Community Development Officer for Bushika Sub County, the Bududa District Environmental Officer, the MWARES project Junior Agronomist and the Project Coordinator to enlist their perspectives and experiences regarding the PIP approach and its impact on the restoration of the degraded landscapes on Mt. Elgon. The interviews were conducted face-to-face, and consent was sought to have them recorded on Samsung Galaxy – SMT2220 Tablets.

3.4.4 Field Observations

Field observations and documentation through photography were used to document the various landscape restoration interventions as well as the constraints that the smallholder farmers were facing.

3.5 Data Analysis

Quantitative data was first cleaned, coded, transformed and analysed for both inferential and descriptive statistics using the Statistical Package for Social Scientists (SPSS) v23 Environment. Descriptive statistics by way of percentages and frequencies were used to describe the socio-economic and demographic information. Univariate, bivariate, and multivariate analyses were employed to assess the relationship between study population characteristics and categorical data. Cross tabulation, Pearson chi-square, analysis of variance (ANOVA), T-test statistics, and binary logistics regression was used to measure both association and relationship of various dependent and independent variables. Further logistic regression and multiple linear regressions were used to measure the joint significance of the variables under study.

Bivariate analysis: Association of independent and dependent variables was carried out using a chi-square test to measure the association of soil control measure use and other variables.

The test statistic for chi-square; $x^2 = \sum_{i=1}^{r}\sum_{j=1}^{e}\left(\frac{\left(O_{ij-E_{ij}}\right)^2}{{E_{ijs}}^2}\right)$

Where; O_{ij}= observed value, E_{ij}= expected value, x^2 = Chi-square, i = 1...r; j = 1...e; assuming independent variables, r = the number of categories of independent variables, e= the number of categories of the dependent variable.

Model formulation: Logistic regression model was used to analyse the determinants of soil control measures and other determinant variables.

$$Ln = \left(\frac{p}{1-p}\right) = \beta_0 \ + \ \beta_1 \ X_2 + \ \beta_2 \ X_2 + \cdots + \beta_m X_m + e_t$$

Where p – the probability that the farmer uses soil erosion control measures (probability of having a yes in the dependent variable)

p/ (1-p) - odd ratio

β_0 – the intercept

β_i – Slope coefficients of X_i for i =1,2,3...m of independent variables

X_i – Independent variables for i =1,2,3...m

Multivariate analysis: Multiple linear regression and logistic regression were used to measure the relationship between the adoption of the PIP approach and other study variables. Results of the logistic regression were used to explain the significance of different factors towards adoption since logistic regression provided the best model.

Qualitative data captured from focused group discussions and key informant interviews were transcribed verbatim and the data was analysed thematically. The results were thereafter used to triangulate findings from the quantitative survey; emerging issues and themes in line with study objectives and questions were captured and used to further explain findings from the quantitative survey.

IV. FINDINGS & DISCUSSIONS

4.1 Socio-Demographic Conditions of the Respondents

It was critical to understand the socio-economic and demographic characteristics of the two study groups owing to the pivotal role these characteristics play in shaping individual and household decisions, such as engagement

in landscape restoration activities. As presented in Table 1, a total of 277 smallholder farmers were involved in the study, of which 173 (62%) were drawn from Bushika Sub County, the intervention area, of whom 54% were female, while 104 (38%) were from Bumasheti Sub County, the control site, with 58% males interviewed, depicting a near gender parity in the study participants. Whilst the mean age for the intervention group was 43 years and that of the control group was 39 years, the chi square test results showed no significant statistical difference; moreover, the main target for the survey was the head of a farming household. Indeed, the majority (85%) of the farmers in the intervention area were married, of which 51% and 43% were household heads and spouses, respectively. Seventy-two percent of those interviewed in the control area were married, of which 68% and 28% were household heads and spouses, respectively. Regarding education, 68% and 26% of the respondents in the intervention area had at least attained primary level education and secondary level education, while 56% and 18% of those in the control group had attained the same level, respectively. The average household size in the control group and intervention group was 5.6 and 6.7, respectively. For both groups, 86% of the respondents relied on crop cultivation for their main source of income. Very few were involved in livestock rearing (9% and 3% for the intervention group and control group, respectively). In terms of monthly income, 43% and 50% of the respondents in the control group and intervention group earned between UGX100,000 and 300,000 (equivalent to approximately USD 27-881). There was a significant proportion of farmers in the control (13%) and intervention (6%) who earn UGX 1,501,000 (approx. USD 404) monthly. Overall, there was a significantly higher monthly income in the intervention group compared to the control group. In both groups, the majority of the respondents either owned land through customary tenure or had privately bought the land.

Table 1

Socio-Economic and Demographic Characteristics of the Respondents.

Variable	Frequencies/ means	Control (n=104)	Intervention	P-value
Gender				0.065
Female	137 (50%)	44 (42%)	93 (54%)	
Male	140 (51%)	60 (58%)	80 (46%)	
Age				0.333
15-24	42 (15%)	12 (12%)	30 (17%)	
25-49	152 (55%)	57 (55%)	95 (55%)	
50 above	83 (30%)	35 (34%)	48 (28%)	
Mean age	40.8	43	39	0.090
Marital status				0.062
Divorced	7 (3%)	3 (3%)	4 (2%)	
Married	222 (80%)	75 (72%)	147 (85%)	
Single/Never married	31 (11%)	16 (15%)	15 (9%)	
Widowed	17 (6%)	10 (10%)	7 (4%)	
Level of education				0.000*
Never attended school	30 (11%)	19 (18%)	11 (6%)	
Primary	175 (63%)	58 (56%)	117 (68%)	
Secondary	64 (23%)	19 (18%)	45 (26%)	
Above secondary	8 (3%)	8 (8%)	0 (0%)	
Household head				0.006*
No, child	13(11%)	4 (4%)	9 (5%)	
No, spouse	104 (89%)	29 (28%)	75 (43%)	
Yes, household head	160 (58%)	71 (68%)	89 (51%)	
Average household size	6.3	6	7	0.004*
Main source of income				0.039*
Crop cultivation	237 (87%)	89 (86%)	148 (86%)	
Livestock rearing	18 (7%)	3 (3%)	15 (9%)	
Business (produce, retail and roadside seller)	12 (4%)	5 (5%)	7 (4%)	
Formal employment	5 (2%)	5 (5%)	0 (0%)	
Other sources	2 (0.7%)	2 (1%)	2 (2%)	
Average monthly income				0.009*
Less than 100,000	77(29%)	35 (34%)	42 (24%)	
100,000-300,000	131 (47%)	45 (43%)	86 (50%)	
301,000-500,000	20 (7%)	4 (4%)	16 (9%)	
501,000-800,000	6 (2%)	2 (2%)	4 (2%)	

801,000-1,000,000	4 (1%)	0 (0%)	4 (2%)	
1,001,000-1,200,000	8 (3%)	0 (0%)	8 (5%)	
1,201,000-1,500,000	7 (3%)	5 (5%)	2 (1%)	
1,501,000 and above	24 (9%)	13 (13%)	11 (6%)	
Land ownership				
customary	252 (57%)	96 (38%)	156 (61.9%)	
Bought	184 (42%)	64 (35%)	120 (65.2%)	
Lease offer	4 (1%)	1 (25%)	3 (75%)	

Data Source: Smallholder farmer household survey in Bushika and Bumasheti (*P-vale < 0.05)

Although more female farmers were interviewed from the intervention sub county and conversely more males were interviewed from the control sub county, there was no significant difference in the gender proportion between the two sub counties. There was no significant difference in the mean age and marital status of the control and intervention groups. These results were expected as the target interview group was farmer households and the heads of farming households in particular. Level of education was one of the key parameters for selecting farmer innovators by the MWARES project. It is thus not surprising that respondents in the intervention group had attained slightly higher education compared with their counterparts in the control group. Otherwise, the two study groups were drawn from generally comparable communities in terms of education attendance, according to the Uganda Bureau of Statistics [UBOS] (2021). Most of the farmers from both control and intervention sub counties earn their main source of income from agriculture, which is rain-fed. They mainly grow bananas and coffee, together with seasonal crops such as maize, beans, onions, and cabbages, which are planted during the rainy seasons; and more recently, beekeeping in the park has also been encouraged by the MWARES project as a sustainable activity, especially by the communities near the park (Opedes et al., 2023). The majority of the respondents in both groups earned between UGX 100,000 and 300,000 (approx. USD 27 and 81) per month, which agrees with statistics provided by the Uganda Bureau of Statistics [UBOS] (2021).

4.2 Determinants for the Adoption of the PIP Approach by Smallholder Farmers

Results (Table 2) revealed that there was a statistically significant association between marital status, receiving training, extension services, education level, and age of the farmers with the adoption of the PIP approach given the $p < 0.05$ respectively. Other factors like knowledge about soil erosion, average household income, and size of the household had no significant association with the adoption of the approach ($p > 0.05$). The approach was highly adopted by the married people (92%), whilst, education levels also determined the adoption of the approach with majority adopters having stopped at primary level with (89%). Most of the farmers who adopted were low-income earners earning less than 300,000 (approx. USD 80) a month (89%) and most of them had knowledge about soil erosion (90%) and experienced it on their farms (90%). Training in PIP approach greatly determined the adoption of the approach with 99%.

Table 2

Determinants for the Adoption of the PIP Approach.

Socio-demographic factors		**Yes**	**No**	**Chi value**	**P value**
Sex	Female	120 (88 %)	17 (12%)	2.9115	0.088
	Male	131 (94%)	9 (6%)		
Marital status	Divorced	7 (100%)	0.0	32.7295	0.000
	Married	204 (92%)	8%)		
	Single	31 (100%)	0.0		
	Widowed	9 (53%)	8 (47%)		
Age				8.38	0.0038
Education level	No education	24 (80%)	6 (20%)	9.8533	0.02
	Primary	156 (89%)	19 (11%)		
	Secondary	63 (98%)	1 (2%)		
	Tertiary/ Uni	8 (100%)	0.0		
Household size				1.76	0.1848
Economic factors					
Average income	<300,000	185 (89%)	23 (11%)	2.755	0.252

	300,001-800,000	25 (96%)	1 (4%)		
	800,001+	41 (95%)	2 (5%)		
Extension services	No, we don't	127 (84%)	24 (16%)	16.5296	0.000
	Yes, we receive	124 (98%)	2 (2%)		
Knowledge factors					
Experience soil erosion	We don't	19 (100%)	0.00	2.1131	0.146
	Experience	232 (90%)	26 (9%)		
Know about soil erosion	No, I don't	4 (80%)	1 (20%)	0.6744	0.412
	Yes, I do	247 (91%)	25 (9%)		
Received training	Never received	8 (57%)	6 (43%)	54.6766	0.000
	Received training	146 (99%)	1 (1%)		

Data Source: Smallholder farmer household survey in Bushika and Bumasheti (*P< 0.05)

The results indicated that the determinants for the adoption of the PIP approach were marital status, age, level of education, average level of income, knowledge about soil erosion and training received. This study confirms the work of Ntshangase et al., (2018) who stated that factors associated with adoption were perception of the farmer, age, education level and knowledge from extension workers. The married adopted the approach more (92%) compared to the singles, widowed and divorced. According to the focus group discussions, couples were invited to the training (husband and wife), and this explains why the approach was highly adopted by the marrieds. The entry point of the approach was households and it always emphasized collaboration among the household members and the community at large. Majority of the farmers who adopted the approach were of the Primary level of education (89%) (Linssen & Meeske, 2020). This was backed up by observation as most of the respondents could not express themselves in English. At this level of education, majority of the farmers were younger. This is attributed to the fact that older famers are accustomed to the old methods of farming and were unlikely to change. In addition, they are also not energetic enough to take practices like trenching as they require considerable effort and labour. Yet the young farmers were hungry for knowledge and were willing to walk long distances for the training and to also train fellow farmers. This is contrary to the findings of Ntshangase et al. (2018) who stated that the elderly attended the training for conservation agriculture compared to youth who entirely stay in urban areas. The data suggests that most of the farmers that adopted the approach earned an income of <300,000 monthly. This is because the approach looks at sustainable land management which in turn increases crop yields of farmers hence a bigger income. Therefore, most of the low-income earners highly adopted the approach to raise their income levels. According to the results, 91% of the adopters of the approach had knowledge on soil erosion. They knew the signs of erosion, the different types and the effects that come with excess erosion. Due to the negative effects, they had experienced, the farmers had the need to adopt good farming practices and erosion control practices hence the adoption of the PIP approach. Training was a very important aspect in explaining the adoption of the approach (Kessler et al., 2020). The farmers that attended the training with the PIP extension workers adopted the approach. According to the results, 99% of those that attended the training, adopted it and used it in their homes. This finding is in line with the findings of Danso-Abbeam et al. (2018) who stated that extension services assist farmers in problem solving and getting actively involved in agricultural knowledge.

4.3 Uptake of PIP Principles by Smallholder Farmers

According to the survey in the intervention communities, majority of the farmers use the principles of integration (90%), empowerment (87%) and collaboration (86%). When asked on how they apply PIP approach principles in landscape restoration practises, majority (83%) alluded to working together as family, 64% highlighted working together as a community, 38% pointed out training fellow farmers on soil conservation and 37% cited diversifying source of income beyond agriculture productivity. This was validated in the focus group discussions as a farmer was able to testify that

> *"because almost all gardens are having trenches*" and another farmer from Munyende village also testified that "*like the principle she talked about of empowerment, it means having power/authority to perform our duties in our homes (yes) without asking for help from another person, so it means that, the authority we have like in our homes, we can sit down and agree that me, my wife and the children, we have the courage to go and dig trenches, so that we can control soil erosion in our gardens."*

Through the PIP principles the farmers have been able to train fellow farmers through the principle of empowerment and collaboration as testified by a farmer in a focus group discussion.

"*After the trainer/facilitator trained me, we also started teaching, different villages/people neighbouring us, and after training them and they graduated, they also continued teaching others and we shall keep on like that,.*" A farmer from Bushaki village testified that, *"Through the principle of collaboration, we formed a group as PIs in our area. This group makes us able to help each other in implementing soil conservation activities like making trenches, planting trees, planting onions, training other farmers in our locality. And through collaboration, we have been able to make a road in our community which has enabled us to access quick markets for our crops."*

During a KII, the District Environmental Officer of Bududa district confirmed that the PIP principles have empowered farmers and also encouraged information sharing as she testified that,

"*The farmers have established the tree nursery beds, they have gotten empowered to establish their own tree seedlings, how to manage them, how to propagate them up to the time of transplanting which previously was not the case before they got the knowledge and skill of PIP principles."*

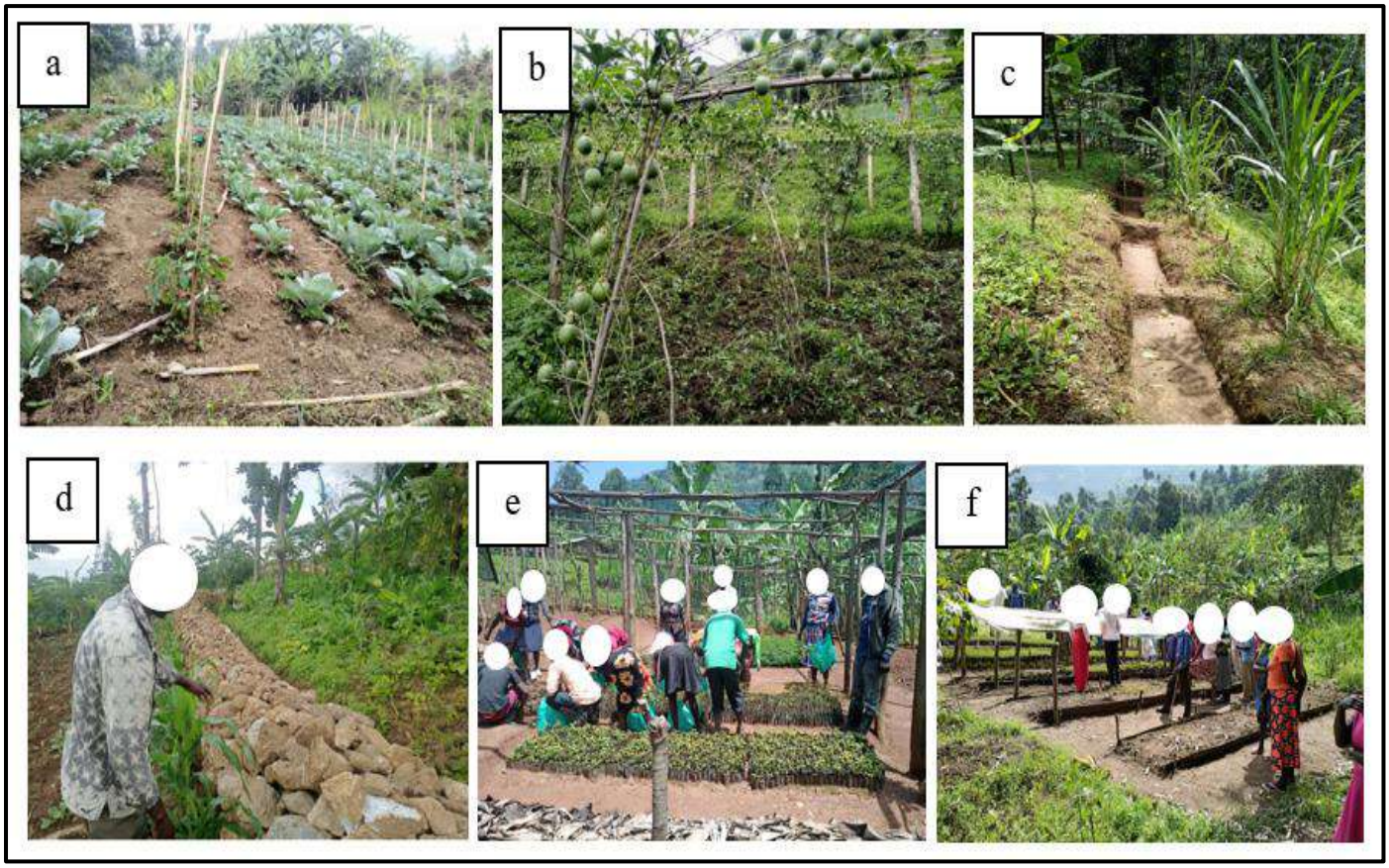

Plate 2

Prevalent Restoration Activities in Bushika Sub County: (a) Line Spacing, (b) Fruit Growing, (c) Digging Trenches and Elephant Grass, (d) Stone Banding, (e-f) Nursery Bed Preparation.

Note: Faces are masked for anonymity purposes (Source: MWARES project archives)

As shown in table 3, it was found that farmers, who trained in the PIP approach, adopted the practices that controlled soil erosion more than those who never trained. For example, those who were digging trenches in Bushika sub county before training were 46 (30%) and increased to 134 (88%) after training in the PIP approach, those who were growing *Napier grass* increased from 35 (23%) to 104 (68%) after training in the approach, those who practiced agroforestry also increased from 54 (35%) to 108 (71%). It is evidenced that practices that never controlled soil erosion were dropped by farmers after receiving training from the PIP trainers. For example, continuous cultivation reduced from 41 (25%) to 11 (7%) and mono-cropping from (16%) to (7%). This was due to training and guidance from the PIP extension workers, and it has helped in soil erosion control. As the Senior Assistant Secretary (SAS) of Bushika sub county testified in the KIIs that

"*On the side of soil conservation, you see that the soil that would have been gone is trapped in trenches and the soil is removed from the trenches back to the garden."*

After training in the PIP approach, there was an increase in the use of landscape restoration practices and a drop in the use of farming practices like continuous cultivation and mono cropping that increase erosion. Therefore, training in PIP approach led to an increase in the use of soil erosion control practices hence leading to soil erosion control in the intervention sub county.

Table 3

Influence of PIP Approach on Farming Practises Implemented by the Farmers

Farming practices implemented	Intervention (n=173)		Control (n=104)	
	Before 2019	**After 2019**	**Before 2019**	**After 2019**
Mono-cropping	25 (16%)	11 (7%)	12 (10%)	11 (9%)
Mixed farming	74 (48%)	75 (49%)	88 (71%)	81 (65%)
Continuous cultivation	41 (27%)	11(7%)	36 (29%)	36 (29%)
Minimum tillage	6 (4%)	27 (18%)	10 (8%)	7 (6%)
Zero grazing	54 (35%)	74 (48%)	42 (34%)	61 (49%)
Agroforestry	54 (35%)	108 (71%)	76 (61%)	85 (69%)
Intercropping	34 (22%)	35 (23%)	55 (44%)	66 (53%)
Crop rotation	27 (18%)	55(36%)	18 (15%)	23 (19%)
Planting cover crops	20 (13%)	77 (50%)	23 (19%)	34 (27%)
Digging of trenches	46 (30%)	134 (88%)	56 (45%)	76 (61%)
Planting of Napier grass	35 (23%)	104 (68%)	43 (35%)	69 (56%)
Mulching	49 (32%)	114 (75%)	42 (34%)	53 (43%)
Fallowing	6 (4%)	4 (3%)	5 (4%)	6 (5%)
Others specify	2 (1%)	8 (5%)	6 (5%)	7 (6%)

Some of the practices that are emphasised by the PIP extension workers are trenching, agroforestry, mulching, planting cover crops, crop rotation and strip farming. These practices have been taken on by farmers in the intervention sub county. With increased use of these practices, there has been control and reduction of soil erosion in the intervention sub county. This was validated during the KIIs when the District Environmental Officer testified that

> "*Previously we would go to these farmers and they would cry 'our soils, erosion, our soils have lost soil fertility', we are not getting good production but right now, I am hoping that their neighbours also take up what these communities are doing. We now have their gardens being properly managed."*

The study demonstrates that the PIP approach had positive effects on landscape restoration on the slopes of Mount Elgon. For instance, there was an increase in the use of erosion control practices (91%) and reduction in the use of poor farming practices which increase erosion in the intervention sub county where PIP was implemented. This clearly explains that the approach was geared towards sustainable land use management. This finding is in line with Kessler et al., (2021) who stated that land stewardship by implementing better and more diverse conservation practices is central in the PIP approach. The principles of empowerment, collaboration, and integration were highly used by the farmers, and these are the driving factors for landscape restoration. The principle of collaboration (86%) has inspired farmers to work together both at household and community level and there has been increased cohesion in families. Families have been able to work together and provide labour to their farms instead of leaving all the burden to one individual. This has increased productivity in homes, and it has also helped reduce erosion as the tedious work of digging trenches, mulching, terracing among others has been shared among the family members. The principle of Empowerment gives the farmers a feeling that they can do anything and achieve positive results. This principle goes hand in hand with the principle of motivation. Intrinsically motivated farmers take on action independently to conserve their soil (Kessler et al., 2020). In addition, the farmers can also train fellow farmers in good farming practices, and this has facilitated flow of information on a wider scale. Integration (87%) helps famers to get involved in more than one activity that complement each other. For example, a farmer that practices zero grazing, uses the cow dung for manure, the elephant grass and Caliandra used to stabilise the trenches is used as feeds for animals in the zero grazing hence achieving a lot on a small piece of land.

According to the results, there was a reduction in the levels of erosion in the sub county where PIP was implemented. This was also attributed to diversification of sources of income beyond agriculture productivity. In addition, the reduction was also attributed to establishment of nursery beds and planting of trees in their gardens. These trees were indigenous tree species like *Markhamia, Cordia,* Musizi among others. These bind the soil particles together and reduce on surface runoff. All this was achieved after the PIP extension workers trained the communities on the benefits of planting indigenous trees and establishment of tree nursery beds. There were economic benefits from the approach that in the long run contributed to landscape restoration. Through the approach, farmers were trained in VSLAs (Village Savings and Loans Association). Through these, they were able to invest in other income generating activities like apiary, trading and retail shops, and transport services among others. These activities offered

alternative sources of income to the farmers which in turn reduced the dependence on agriculture for survival. This implies that the PIP approach principles and the power of a PIP plan can greatly influence farmers to analyse the problems in their communities and households, come up with solutions and plan different activities to solve the problems leading to sustainable landscape restoration.

4.4 Constraints Faced by Farmers in Implementing Landscape Restoration Measures

Results in figure 1 indicate that those who were in the control sub county lacked adequate tools to implement the practices (62.2%), problem of limited knowledge (12%), and limited financial resources (60.93%), whereas those who were in the intervention sub county faced a problem of limited labour (21%), land (9%), and financial resources (23%). The major constraint to implementation of the practices was limited knowledge, limited finances, inadequate tools, and limited labour. Results indicated that those who received training were majorly influenced by the MWARES project.

Results further revealed that most farmers faced a financial problem (23%), limited labour (21%) and inadequate tools to implement the soil conservation practices (19%) with a few facing limited materials such as mulches (7%). This was also further explained by farmers in the Focus Group Discussions. The farmers gave the following testimonies.

> *"I may want to do those things, but the challenge is that I don't have resources to buy a panga or hoe in my home for me to be able to do those things/implement like digging trenches."*
>
> *"Challenges I get is labour, I may have many things to do but I don't have labour/someone to help, I may lack money to help me perform my duties."*

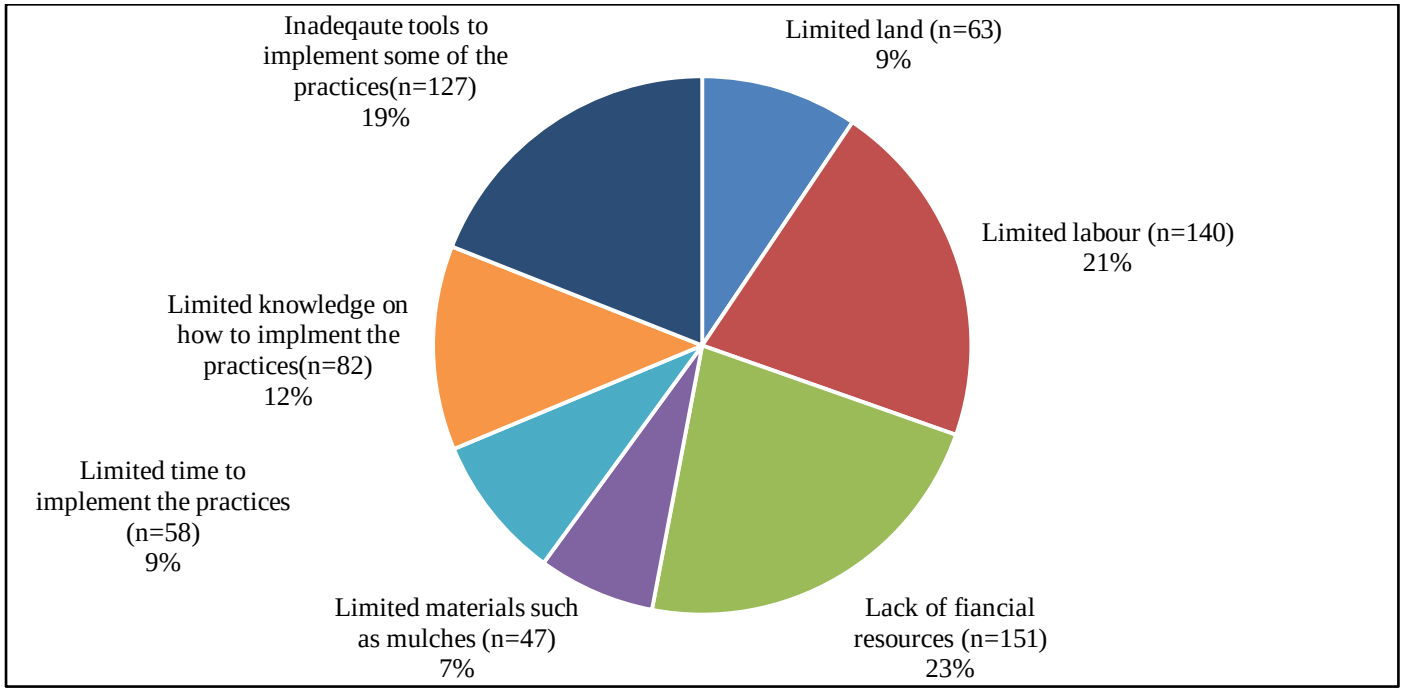

Figure 1

Challenges Faced by Small-Scale Farmers in Implementing Soil Erosion Control Measures

The results illustrated that the farmers mainly faced economic constraints like lack of financial resources, inadequate tools to use and limited labour in the implementation of land restoration measures. This is in line with Ataei et al., (2021) who stated the limited labour and limited finances limit farmers during the implementation of land restoration measures such as soil erosion control practices. As already highlighted 90% of the people in the study area were heavily reliant on rain-fed subsistence agriculture, with inadequate finances to hire farm labour and equipment. Much as the farmers embraced the PIP approach as per the testimonies during the FGDs.

The other constraint was limited extension services from the government. Due to this, majority of the farmers in the control sub county lacked enough knowledge on how to implement the restoration practices. For instance, most of the farmers don't know the recommended size of a trench, the distance between banana and coffee in agroforestry among others. Those who got extension services and trainings on how to implement, were farmers from the intervention sub county who attributed it to the PIP extension workers. Barungi et al., (2013) postulated that adoption of technology can be increased by increase in extension services and endowing farmers with agricultural knowledge

and services. In addition, the farmers in the Elgon region are also constrained by shortage of land. Results indicated that most of the farmers do not dig trenches because they take a lot of the space where one would instead plant another crop. They therefore have the constraint of small pieces of land. This is in line with Chinseu et al., (2019) who pointed to limited land coupled with high population pressure as key deterrents to land restoration.

V. CONCLUSIONS & RECOMMENDATIONS

5.1 Conclusions

The PIP approach is a bottom-up inclusive approach that fosters mind-set change among households and communities towards landscape restoration. The PIP approach has had positive effects on land restoration efforts owing to guiding principles of motivation in which the farmers are intrinsically elated to become environmental stewards without external incentives; collaboration in which farmers trust, jointly decide and work together right from the household level, up to the community; the principle of integration in which farmers diversity their sources of income other than solely depending on agriculture and treat agriculture as a business enterprise, as well as initiate alternative livelihood enhancing schemes such as savings and loans associations.

The PIP approach and practices therein, such as digging trenches and maintaining them is laborious, yet, majority of the households cannot afford hired labour. Those who have gained skills and commit time to train others, are not incentivised and are doing it at the expense of their own gardens given the time it takes to move between distant these places.

5.2 Recommendations

For sustainability of the PIP, the local Government, through the agricultural extension office, ought to take it up and integrate it in their planning. This will however call for allocation of resources to ensure that the Extension Workers are first trained in PIP and are facilitated to move to the communities, conduct trainings and create awareness as well as, make follow ups to ensure that standards are adhered to.

The PIP will register more positive effects if the volunteer farmer trainers are incentivised and motivated through facilitation; which they can partly use to hire labour to work on their own gardens when they are out conducting outreach services. Motivational incentives can play a crucial role in addressing the challenges faced by the stakeholders. Motivation is a key factor in driving behavioural change and sustaining participatory initiatives. Incentives, such as financial rewards or recognition, can boost farmers' commitment to landscape restoration efforts.

Disclosure Statement

There are no competing interests to declare.

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REFERENCES

Ataei, P., Sadighi, H., Aenis, T., Chizari, M., & Abbasi, E. (2021). Challenges of applying conservation agriculture in Iran: an overview on experts and farmers' perspectives. *Air, Soil and Water Research*, *14*, 1178622120980022.

Barungi, M., Ng'ong'ola, D. H., Edriss, A., Mugisha, J., Waithaka, M., & Tukahirwa, J. (2013). Factors Influencing the Adoption of Soil Erosion Control Technologies by Farmers along the Slopes of Mt. Elgon in Eastern Uganda. *Journal of Sustainable Development*, *6*(2), 9–25. https://doi.org/10.5539/jsd.v6n2p9

Bhan, S. (2013). Land degradation and integrated watershed management in India. *International Soil and Water Conservation Research*, *1*(1), 49–57. https://doi.org/10.1016/S2095-6339(15)30049-6

Blake, W. H., Rabinovich, A., Wynants, M., Kelly, C., Nasseri, M., Ngondya, I., Patrick, A., Mtei, K., Munishi, L., Boeckx, P., Navas, A., Smith, H. G., Gilvear, D., Wilson, G., Roberts, N., & Ndakidemi, P. (2018). Soil erosion in East Africa: An interdisciplinary approach to realising pastoral land management change. *Environmental Research Letters*, *13*(12). https://doi.org/10.1088/1748-9326/aaea8b

Boafo, Y. A., Ichikawa, K., Dunbar, W., & Manago, C. (2016). Understanding the current status, trends and efforts at revitalization of socio-ecological production landscapes and seascapes in Africa. In *Socio-ecological production landscapes and seascapes (SEPLS) in Africa* (pp. 1-11). United Nations University Institute for the

Advanced Study of Sustainability. https://satoyama-initiative.org/wp-content/uploads/2016/08/SEPLS-in-Africa_FINAL_lowres_web.pdf

Buyinza, M., & Mugagga, F. (2010). Economics of Land Degradation in Mid hills of Mt Elgon Watershed, Eastern Uganda. *Journal of soil and Nature*, *4*(1), 1-6. *http://ggfjournals.com/content/issue/jsn-v4-is1*

Chinseu, E., Dougill, A., & Stringer, L. (2019). Why do smallholder farmers disadopt conservation agriculture? Insights from Malawi. *Land Degradation & Development*, *30*(5), 533-543.

Danso-Abbeam, G., Ehiakpor, D. S., & Aidoo, R. (2018). Agricultural extension and its effects on farm productivity and income: insight from Northern Ghana. *Agriculture & Food Security*, *7*(1), 1-10.Dejene, T., & Guteta, E. (2018). The Effects of Community Based Watershed Management on Livelihood Resources for Climate Change Adaptation the Case in Gemechis District , Oromiya. *International Journal of Environmental Science &Natural Resources*, *15*(2), 9. https://doi.org/10.19080/IJESNR.2018.15.555906

Hossen, M. A. (2016). Participatory mapping for community empowerment. *Asian Geographer*, *33*(2), 97–113. https://doi.org/10.1080/10225706.2016.1237370

IPBES. (2018). *Responses to halt land degradation and to restore degraded land 435*. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. https://files.ipbes.net/ipbes-web-prod-public-files/spm_3bi_ldr_digital.pdf

Kessler, A., van Reemst, L., Beun, M., Slingerland, E., Pol, L., & De Winne, R. (2020). Mobilizing farmers to stop land degradation: A different discourse from Burundi. *Land Degradation & Development* (Special Issue). Wiley. https://doi.org/10.1002/ldr.3763

Kessler, A., van Reemst, L., Beun, M., Slingerland, E., Pol, L., & De Winne, R. (2021). Mobilizing farmers to stop land degradation: A different discourse from Burundi. *Land Degradation and Development*, *32*(12), 3403–3414. https://doi.org/10.1002/ldr.3763

Kessler, C. A., van Duivenbooden, N., Nsabimana, F., & van Beek, C. L. (2016). Bringing ISFM to scale through an integrated farm planning approach: a case study from Burundi. *Nutrient Cycling in Agroecosystems*, *105*(3), 249–261. https://doi.org/10.1007/s10705-015-9708-3

Linssen, R., & Meeske, M. (2020). *From drawing to reality: The impact of the PIP-approach on farmers' motivation, resilience, and stewardship in rural Burundi*. Oxfam Novib.

Mutekanga, F. P., Kessler, A., Leber, K., & Visser, S. (2013). *The Use of Stakeholder Analysis in Integrated Watershed Management*. *33*(2), 122–131.

Nakileza, B. R., Majaliwa, M. J., Wandera, A., & Nantumbwe, C. M. (2017). Enhancing resilience to landslide disaster risks through rehabilitation of slide scars by local communities in Mt Elgon, Uganda. *Jamba: Journal of Disaster Risk Studies*, *9*(1), 1–11. https://doi.org/10.4102/jamba.v9i1.568

Ntshangase, N.L., Mujoyiwa, B., & Sibanda. M. (2018). *Farmers' Perceptions and Factors Influencing the Adoption of No-Till Conservation Agriculture by Small-Scale Farmers in Zashuke, KwaZulu-Natal Province. *Sustainability*, *10*(2), 555. https://doi.org/10.3390/su10020555

Ofgeha, G. Y. (2017). Community's perception on soil erosion and their participation in soil conservation practices: A case study of Alaltu watershed of Najo District, Ethiopia. *Journal of Soil Science and Environmental Management*, *8*(2), 17-24. https://doi.org/10.5897/JSSEM2016.0583

Opedes, H., Nedala, S., Mücher, C. A., Baartman, J. E. M., & Mugagga, F. (2023). How can drones uncover land degradation hotspots and restoration hotspots? An integrated approach in the Mount Elgon region with community perceptions. *Land*, *13*(1), 1. https://doi.org/10.3390/land13010001

TNC. (2016). *Sub-Saharan Africa's Urban Water Blueprint: Securing Water through Water Funds and Other Investments in Ecological Infrastructure*. The Nature Conservancy: Nairobi, Kenya.

UBOS. (2021). *Uganda National Household Survey 2019/2020*. Kampala, Uganda; UBOS

Worku, T., & Tripathi, S. K. (2015). Watershed Management in Highlands of Ethiopia: A Review. *OALib*, *02*(06), 1–11. https://doi.org/10.4236/oalib.1101481

Wunder, S., Kaphengst, T., Frelih-Larsen, A., McFarland, K., & Albrecht, S. (2018). *Implementing SDG target 15.3 on "Land Degradation Neutrality": Development of an indicator based on land use changes and soil values* (Project No. FKZ 3715 71 202 0, Report No. UBA-FB 002587/ENG). Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, German Environment Agency. Ecologic Institute.