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Can Agroecology Provide a Panacea for Sustaining the Adoption of Soil Erosion Control Measures? A Case of Smallholder *Coffea arabica* Production in the Rwenzori Mountain Region, Uganda

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Abstract: Agroecological approaches can provide context-specific and sustainable solutions to issues confronting farming communities, by enabling consorting of the socioeconomic and ecological constraints on the farm. This study is the first attempt to test this argument, based on the challenge of sustaining the adoption of soil erosion control measures among smallholder farmers producing *Coffea arabica* on the Rwenzori Mountain in Uganda. Here, the adoption of soil erosion control measures remains a challenge, despite the efforts of conventional agricultural advisory services in local governments. Using a qualitative research approach, we contrasted the elements of agroecology with the local discourses, to identify if they would provide a panacea for sustaining the adoption of soil erosion control measures. The results indicated that, generally, the agroecology elements harmonized with the local-context discourses on soil erosion control, in contrast to the conventional approach promoted through the agricultural advisory services. For example, the local discourse on a participatory process in developing soil erosion control measures linked with the Co-creation and Knowledge-Sharing element of agroecology; the discourse on concurrent and joint implementation of soil erosion control measures matched with the Synergy and Diversity elements of agroecology; and the argument for sustaining soil erosion control adoption through rewarding adopters and penalizing non-adopters, in line with the Responsible Governance and the Circular and Solidarity Economy elements of agroecology. Drawing conclusions on the implications of these findings, we argue that consideration of the Agroecology Elements at all stages in the process of soil erosion control would foster the sustained adoption of soil erosion control measures.

Keywords: agroecological farming; discourse analysis; mountain conservation; sustainable adoption

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1. Introduction

Soil erosion is a land-degradation challenge, particularly in tropical mountain areas, where top fertile soil is lost on steeply sloping land [1,2]. It is driven by human activity, with the highest rates occurring in the least developed economies [3–5]. Soil erosion is more recognized among farming communities where it results in drastically impaired crop growth [6,7]. This presents an especial challenge for crops/plants that grow at high altitudes. One such crop, which is the focus of this study, is *Coffea Arabica*. It grows well in tropical regions, and its production expansion is linked to land degradation in densely populated mountain areas [8,9].

C. arabica is a high-value crop on the market, and supports the socio-economic development of rural areas. The demand for coffee is expected to increase; however, due to climate change, the production of *C. arabica* is predicted to shift to higher-altitude areas

that are more prone to erosion [10,11]. Therefore, the adoption of soil erosion control is considered important, not only to support the production of *C. arabica* but also to foster the attainment of the United Nations' sustainable development goals (SDGs): Climate Action (SDG 13) and Responsible Consumption and Production (SDG 12); see Keesstra, Bouma [12], and Borrelli et al. [3].

To avert the challenge of soil erosion, among farmers of *C. arabica* in high-altitude areas, several scholars and institutions have recommended numerous measures. Examples of these measures include the following: alley cropping; implementation of no-tillage practices; the establishment of water-catching trenches along contour lines; integration of cover legumes; agroforestry; trash bands; stone bands; and mulching [13]. These measures have been continuously promoted, but their adoption remains low. This is argued to result from a mismatch between the recommended measures and the local context [14–16].

In contexts where *C. arabica* is grown at high altitudes, adoption of measures to tackle soil erosion is found to be influenced by several factors: the nature of the land (particularly the slope); social aspects, including membership of farmer organizations; and economic constraints, such as labor demands [16]. These constraints can broadly be categorized into the socioeconomic and ecological context of the communities at risk of soil erosion. As such, the socioeconomic and ecological constraints are acknowledged to present a complexity, making it difficult for a one-size-fits-all solution for the continued adoption of soil erosion control [16,17]. As a response, several studies on enabling adoption have recommended context-specific approaches, to address the complexities associated with the dynamics brought about by varying social, economic, and environmental elements, which vary both in space and time [17–20]. To attain context fit, agroecology has been presented as a holistic approach [21,22].

Broadly, agroecology is defined as a science, a practice, and a social movement [23,24]. Agroecology simultaneously applies ecological and social concepts and principles, while optimizing interactions between the soils, plants, animals, and humans, as well as considering the social aspects for attaining sustainable and fair food systems [25]; thus, it is known for promoting collective action, locally appropriate technologies, participatory research, and participatory farmer advisory services [21,26–28]. The potential of agroecology to build resilience against climate change, through building resilient livelihood and food systems, has also been documented [29,30]. However, the potential of agroecology to enable sustainable adoption of soil erosion on smallholder farms has not been documented, despite the holistic applicability of the Agroecology Elements (AEs)—on the contrary, the limitations of agroecology in application to smallholder farmers have been documented, albeit with criticism [31,32].

Standpoint theorists would thus argue that if the elements of agroecology reflect in the local discourses on soil erosion control, then they present a panacea for sustaining soil erosion control [33,34]. This study therefore aimed to investigate the presence of the AEs in the local discourses, compared to the conventional agricultural advisory systems, to find out if the local perspectives on sustainable soil erosion control measures harmonize with the AEs. We thus first theorized the elements of agroecology that would support the sustained adoption of soil erosion control measures. Then, we analyzed them against a specific case in the Rwenzori highlands, where the adoption of soil control measures was low, despite the high erosion and the increasing conventional agricultural services [16]. The study was guided by one general question: how does agroecology align with the local discourses on soil erosion control in practice?

2. Theoretical Perspective on AE

According to FAO [25], 10 elements are argued to make agroecology holistic and context-specific in practice: Diversity; Synergies; Efficiency; Resilience; Recycling; Knowledge Co-creation and Sharing; Human and Social Values; Culture and Food Traditions; Responsible Governance; and a Circular and Solidarity Economy. These elements are interlinked in a way that makes agroecology bring the ecological, economic, and social

aspects into play, to define a feasible and appropriate approach for a specific context [27,32]. For instance, (1) Diversity emphasizes the integration of different enterprises that support each other in a farming system. This feeds into one of the parts of (2) Synergies—the complementarity of combining different enterprises. Synergy also touches on the cooperation and partnerships of different actors working together at multiple scales. Here, then, already the ecological and social elements (actors) are brought into play. Other social elements are linked with (3) Human and Social Values, which foster bottom-up approaches that enable rural people to be agents of their change. This is closely connected with (4) Co-creation and Sharing of Knowledge, through participatory development of context-specific solutions among different stakeholders, to fit the environmental, social, economic, cultural, and political systems.

In improving the livelihoods of rural people, particularly smallholder farmers, agroecology emphasizes dignity, equity, inclusion, and justice. It builds the autonomy of women and youth as central to the sustainability of farming systems. The element that fosters this further is (5) Culture and Food Traditions, being central to developing sustainable farming systems' understanding that cultural identity and sense of place are often closely tied to landscapes and food systems. Agroecology also argues for the hybridization of the ecological, social, and economy elements. The core element, in this case, is (6) Efficiency, aiming at optimizing the use of locally available resources, and designing farming systems with biological, socio-economic, and institutional diversity and alignment in time and space, to attain optimum output from minimum input. The other element is (7) Resilience which, in the farming system, is based on diversity enabling recovery from shocks and stresses; it emphasizes both ecological and socio-economic resilience. Efficiency, synergies, and resilience are also based on (8) Recycling, through using outputs of one system as inputs into another system. Through (9) Responsible Governance, traditional and customary models of governance enhance synergy among stakeholders, and provide incentives for the long-term investments that are necessary to protect soil, biodiversity, and ecosystem services; it also calls for the inclusion of (10) a Circular and Solidarity Economy that brings producers and consumers together, so that producers can increase their incomes while offering a sustainable good-quality product. However, mixed opinions about the potential of agroecology enabling sustainable transitions still exist in literature among scholars [31,32].

We argue that the AEs would be relevant to sustaining the adoption of soil erosion control, if they could be situated within the local discourses on soil erosion control, as proposed by the standpoint theory [33,34]. Scholars recommend using, as a starting point, the communities themselves, analyzing first where they are, and then stepwise identifying entry points for adapting their practices [34,35]. Therefore, in this study, the motive was to find out if the AEs related to the local discourses on soil erosion control.

3. Materials and Methods

3.1. Case Study in the Rwenzori

The study was conducted in the Rwenzori Mountains, at the border between Uganda and the Democratic Republic of Congo. The Rwenzori Mountains experience a tropical climate with bimodal rainfall (March-May: 286 mm, 23.3 °C and August–November: 375 mm, 22.9 °C), and average annual rainfall of 884 mm [36]. The soils in this area are erosion-prone Leptosols, which are predominantly loamy sand [36,37]. In this area, the main cultivated crop is *C. arabica* grown as a mono-crop, under which approximately 60% of the land is prone to erosion due to steep slopes [37–39]. Soil erosion is also high, due to population pressure and degrading farming practices [16,38]. The population explosion in this region has also been associated with other environmental disasters, some of which co-occur with soil erosion, such as landslides. For a detailed description of the Rwenzori, regarding landslides and erosion, as well as related disasters, reference is made to the several disaster-related studies that have been conducted in the Rwenzori [40–43]. Within the Rwenzori Mountains, the study was conducted among smallholder farmers in Kyondo

sub-county, located in Kasese district at 0°11′12.0″N, 30°05′17.0″E (Latitude: 0.186667; Longitude: 30.088050) at altitude 1300–1800 m above sea level (Figure 1).

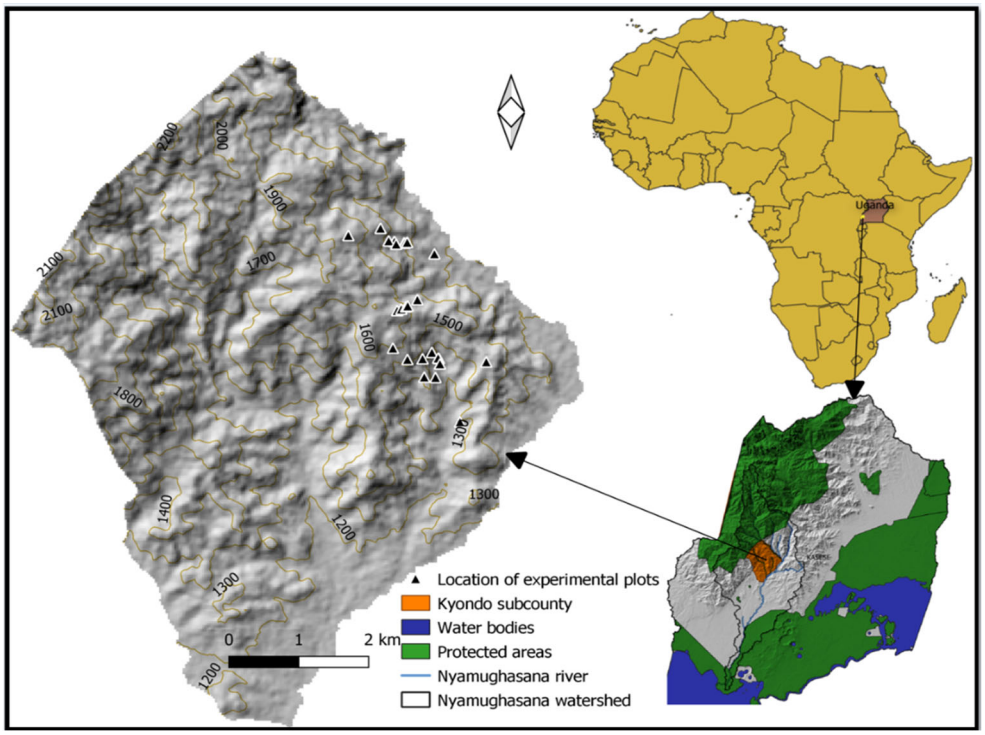

Figure 1. Sites for the experimental plots on which interviews were conducted in the Rwenzori mountains.

Kyondo sub-county has a total population of 27,400 inhabitants [44]. The area is part of the Rwenzori Mountains, dominated by a local culture that promotes conservation-friendly livelihood systems related to agroecology [21,41,42,45–47]. For many years, conventional agricultural advisory services to avert soil erosion have been implemented in this area, but with limited success [16]. Although some organizations were known to have introduced agroecology in the Rwenzori Mountains [21], it had yet to be tested for its potential to enhance the uptake of soil erosion control measures and other issues that confront the smallholder farming community.

3.2. Data Collection

The participants of this study included the following categories: smallholder coffee farmers; farmer advisers; researchers; local leaders (cultural, religious, and political); and agroecology experts (Table 1). To collect data from these categories, three methods were triangulated: field observations, individual interviews, and Focus Group Discussions (FGD). This approach had been used in related studies on environmental issues, particularly on landslides, and had been deemed successful [45]. The specific questions that guided the data collection were structured around three themes: the soil erosion control measures; the attributes of the soil erosion control measures that could enable sustainable adoption; and the strategies for implementing sustainable soil erosion control measures.

Table 1. Empirical study data sources.

Method	#Participants	Date, Location	Characteristics	Selection Criteria
Interviews	25	August 2019, February 2020, Kyondo sub-county	Coffee farmers	-Being affected by soil erosion. -Belonging to a farmer organization that promoted soil erosion control.
FGD 1	09	June 2020, Nyamughasana Valley farmers head office, Kyondo	Coffee farmers	-Participation in the farmer interviews.
FGD 2	07	August 2020, Nyamughasana Valley farmers	Cultural leaders and religious leaders	-Mentioned in the farmer interviews.
FGD 3	06	December 2020, Mountains of the Moon University campus	Agroecologists	-Agroecologists at Mountains of the Moon University. -Agroecology experts from Uganda Coffee Development Authority.
FGD 4	06	March 2021, Mountains of the Moon University campus	Extension Advisor, National Research Institute	-Belonging to government extension and research.
FGD 5	11	May 2021, Nyamughasana Valley farmers	Farmers, Agroecologists, Conventional Extension Advisors, cultural, religious, and political leaders	-Participation in any of FGD1, FGD2, FGD3, and FGD4.
Observation	25	From August 2019 to May 2021, coffee fields	Smallholder C. arabica fields, Kyondo sub-county	-Farm field of the interviewed farmers.

FGD: Focus Group Discussion. #: Number.

The farmer interviews were conducted at the farms, to enable combining the interviews with field observations of the soil erosion control measures being implemented. The specific farmers considered for interviews were those belonging to a farmer association called Bukonzo East Training Team (BETT), mainly situated in Kyondo sub-county (Figure 1). Moreover, with this farmer association, as well as in this sub-county, a soil erosion control experiment had been conducted between 2018 and 2020. Farmers (25) that had hosted soil erosion control experiments participated in the interviews. The number 25 was determined as the saturation point, as recommended for qualitative research [48]. The data generated from the farmer interviews guided the questions for the FGDs.

From the 25 interviewed farmers, 11 were selected for FGD 1, based on their vested knowledge and experiences, as exhibited in the interviews. FGD 1 was to triangulate the content of the farmer interviews. During preliminary interviews with the farmers, participants for FGD 2, FGD 3, and FGD 4 were suggested. The cultural and religious leaders were believed to have traditional views that related to nature conservation [42]; as such, FGD 2 was conducted to find out if their views on soil erosion control connected with the AEs. This was followed by FGD 3, the purpose of which was to connect the views of the agroecologists with those of the farmers and with the AEs. FGD 4 was the baseline comparison, as it was the dominant agricultural advisory system. FGD 5 brought together the representatives of FGDs 1–4, to triangulate the different views. This representation (Table 1) of actors along the value chain integrated different knowledge, experiences, and interests.

3.3. Data Analysis

The data were audio recorded, transcribed, and analyzed, following thematic content analysis [49]. The codes were: (1) discourses on soil erosion control measures; (2) attributes of soil erosion control; (3) strategies for enabling sustainable adoption of soil erosion control measures. To ascertain the soil erosion control measures promoted among the smallholder farmers, we used the grounded theory, as there were limited existing studies and theories to explain this empirical non-suggestive data [50]. The analysis of the data focused on finding connections between the local discourses and the 10 elements of agroecology that had been recommended by studies as being central to sustainability. We thus set out to analyze the specific context of soil erosion control against the elements of agroecology as elaborated in Section 2 (theoretical perspectives). Specifically, we analyzed the local discourses and practices through the lens of the AEs, reflecting the attributes of the appropriate soil erosion control measures and the strategies for enabling the sustainable adoption of soil erosion control measures.

4. Results

4.1. Discourse on Soil Erosion Control Measures

Various soil erosion control measures were presented by the government farmer advisors, but were only partially implemented in the coffee fields (Table 2). Despite the training sessions that had been conducted by the advisors, only the methods that were demonstrated through farmer institutions were known of and were, to some extent, being implemented in the coffee fields by the smallholder farmers. The low adoption was attributed, by farmers, to the inappropriate introduction of soil erosion control measures. Consider this example: *"most soil erosion control is based on theory. Well, a lot of soil erosion control measures such as water catching trenches and terraces have been suggested but in practice, these are difficult to implement"* (FGD 1, 2020).

Table 2. Soil erosion control measures were identified in the coffee fields in the Rwenzori area.

Soil Erosion Control Method	Source of Data				Status of Soil Erosion Control Method at Farm Level (Field Observation)
	Farmer	Farmer Institutions	Government Extension	Field Observation	
Trenches	✓	✓	✓	✓	Insufficiently implemented with only one trench per acre
Zero tillage			✓		Not implemented
Undersown legume covers (live mulch, such as *Mucuna pruriens*)	✓	✓	✓	✓	Implemented via the experiment study (*Mucuna pruriens* and *Millettia dura*)
Contour bands			✓		Not implemented
Trash bands	✓	✓	✓		Not implemented
Stone bands			✓		Not implemented
Agroforestry	✓	✓	✓		Partly implemented
Terraces			✓		Not implemented
Mulching	✓	✓	✓		Partly implemented
Integrated trenches with stabilizers			✓		Not implemented

4.2. Attributes of Soil Erosion Control Measures for Sustainable Adoption

As indicated in Table 2, various soil erosion control measures are known by the different actors, but few are implemented on family farms. Based on field observations, some measures were only partially implemented. For example, trenches in most cases were not completely constructed or had been refilled by the eroding soil, and agroforestry trees were only scantly implemented in the fields. The limited implementation was associated with the different attributes of the soil erosion control measures elaborated below.

4.2.1. Social Acceptability and Context-Specificity

Various soil erosion control measures, whose adoption had been influenced by culture and tradition in context, were presented. Consider this elaboration, for example: *"the extension advisors told us to dig trenches, but these literally look the same as the traditional graves in the fields. We did the trenches but shortly stopped because we feared these could bring bad luck to our fields"* (FGD 1, 2020). The findings further indicated that smallholder coffee farmers were mainly traditional societies with cultural beliefs and indigenous knowledge that either promoted or was against some soil erosion control measures. Some practices were recommended by the cultural traditions, but at scales that did not make a meaningful impact. As elaborated in this example: *"the Ficus natelensis is an agroforestry tree that we grow to mark the grave of the family heads, these trees improve the microclimate where they grow and the coffee under them is normally better. However, we cannot just plant many Ficus natelensis as would be recommended by experts because these trees are reserved to only mark burial sites of elders"* (Interviewee 7, 2019).

4.2.2. Economically Feasible

The costs of the soil erosion control measures were commonly associated with the labor and equipment (financial investment) required. This was found to be a big influence on the soil erosion measures that would be adopted and sustained. Generally, the adoption of soil erosion control measures was considered a non-urgent cost, as soil erosion measures competed with other daily basic needs, e.g., clothing, food, and health. Take, for example, the following interview response: *"If it was not for our family labor, those trenches you see in the coffee field would not be there, but we use our free labor. From the coffee sold, we can't afford to pay for the labor and other daily needs of the family. We need solutions where we use several alternatives that can be reused, require little input but produce bigger returns"* (Interviewee 18, 2020).

4.2.3. Multiple Benefits

According to the findings, the smallholder farmers adopted methods that served more than one purpose. For example, cover legumes were preferred since, besides controlling erosion, they were used as livestock feed, to improve the fertility of the soil, and as a source of income through the sale of seeds: *"The coffee no longer yields well, we need plants to grow under the coffee so that when they are catching the soil, for us we are getting either food or pasture for our animals. We need to have different enterprises that produce several benefits"* (FGD 1, 2020).

The different actors (farmers, government extension, religious and cultural leaders) also had different expectations for implementing soil erosion control; thus, multiple benefits were expected if a soil erosion control measure was to be supported by different actors. This was clear both in the interviews and in the FGDs. For example, *" . . . us from the government particularly are interested in the long-term safety of the land and avoiding disasters such as landslides but most farmers are interested in having short term benefits such as a high yield and income"* FGD 4, 2021.

4.2.4. Quick and Repetitive Benefits

Soil erosion control measures that produced quick, repetitive impact were preferred for adoption and could be continuously adopted by smallholder farmers. Measures that took a long time to produce the desired impact were only accepted if there was a subsidy and if they were to be implemented for a short time. A case in point was elaborated:

> *" . . . In 2018 we planted Mucuna and Milletia trees, the Mucuna was growing fast within three months and the soil was already covered and the coffee tree leaves green. All of us who were involved have continued to cover our soil with Mucuna and even other farmers are learning from us. We like it because we are recycling the Mucuna seeds. However, we did not see the benefit of the Millettia dura trees at first harvest, therefore we have not planted more unless the trees are provided free again"* (FGD 1, 2020).

4.3. Strategies for Sustainable Adoption of Soil Erosion Control Measures

In addition to having the appropriate attributes for adoption, the strategies used in the process of soil erosion control adoption were important, in sustaining erosion control measures on the farm. Strategies in the soil erosion control process were suggested, for developing the control measures through to their implementation in the field; these included: (1) engagement of multiple actors with clear roles; (2) a participatory approach to engagement; (3) concurrent action by the different actors; (4) motivation through a reward and penalty system. These strategies are further elaborated below.

4.3.1. Engagement of Multiple Actors with Clear Roles

Different roles in the soil erosion control process were identified: (1) developing the appropriate soil erosion control measures; (2) implementing the soil erosion control measures; (3) penalty and reward system; (4) awareness-creation for perception change. These roles were foreseen to be implemented by different actors, including the farmer households, cultural and religious institutions, farmer advisors from the government, and community-based research institutions, such as universities (Table 3). The extract below elaborates this scenario.

Table 3. Proposed roles of different actors in sustainable adoption of soil erosion control measures in the Rwenzori area.

Roles	Actor	Description of Role by Actor and their Relevance	Source of Data
Developing the appropriate soil erosion control measures.	Farmer families	Provide the indigenous knowledge and experience to inform the measures to be adopted.	FGD 1, FGD 2, FGD 3, FGD 5
	Farmer institutions	Linking researchers, farmers, government extension, cultural and religious institutions.	FGD 1, FGD 2, FGD 3, FGD 5
	Cultural and religious institutions	Indigenous knowledge of the beliefs of the local people, reflected in the soil erosion control measures.	FGD 1, FGD 2, FGD 3, FGD 5
	Government extension and Uganda coffee development authority	Technical guidance.	FGD 1, FGD 2, FGD 3, FGD 4 and FGD 5
	Research institutions	Technical scientific knowledge guidance.	FGD 1, FGD 2, FGD 3, FGD 4 and FGD 5
Implementing the soil erosion control measures.	Farmer families	Provide labor and land to implement the measures.	FGD 1, FGD 2, FGD 3, FGD 4 and FGD 5
	Farmer institutions	Organize farmer families into farmer groups that work together on each other's farms.	FGD 1, FGD 2, FGD 3 and FGD 5
Motivation through the reward and penalty system.	Cultural and religious institutions	Short-term and long-term subsidies to family farms implementing soil erosion control measures. Fair price for coffee produced on farms that control erosion. Penalties for farmers not practicing erosion control.	FGD 1, FGD 2, FGD 3, FGD 4, and FGD 5
Awareness-creation for a positive attitude toward soil erosion control adoption.	Cultural and religious institutions	Creating confidence in the farmers, and building a positive attitude.	FGD 1, FGD 2, FGD 3, and FGD 5
	Farmer institutions	Training, using documented data from field experiences.	FGD 1, FGD 2, FGD 3, FGD 4 and FGD 5
	Farmer families	Farmer-to-farmer experience, sharing, and solidarity.	FGD 1, FGD 2, FGD 3 and FGD 5

> *"Different actors have different capacities but also different limitations. There is a need for a clear allocation of the roles for the different actors. Several things need to be done to enable sustainable adoption, but these cannot be done by one actor. For example, for us (government extension) we can support research on suitable measures, but farmers would instead expect us to give handouts from the government, yet this is not sustainable. The implementation of the erosion control measure is for the farmer"* (FGD 4, 2021).

The farmers noted that several roles to enable them to adopt were not being implemented. The different actors instead focused on awareness-creation, and mostly theoretical training. Thus, the farmers remained without a practical sustainable solution, except for the cover legumes (Mucuna pruriens):

> *" . . . in practice, soil erosion control has been one of the subjects avoided by several farmer advisors. Most measures are just told to us by word of mouth, for example, no demonstration on how trenches should be done. We only do them in our way, but they quickly get destroyed. There is a need for trainings and support on establishing the measures such that training and action are done concurrently"* (Interviewees 8,10, and 13).

Although several interventions to control the erosion had been tried, these were only short-lived, and were then abandoned in less than a year, particularly in instances where the actor who introduced the measures left the responsibility to the farmers (field observation). Thus, for sustainable soil erosion control adoption, the following roles and responsible actors were proposed, as indicated in Table 3 above.

4.3.2. Participatory Development of Appropriate Soil Erosion Control Measures

This was a role viewed as universal for all actors (farmers, farmer institutions, government extension, researchers, religious and cultural institutions) involved in soil erosion control. The role entailed the process of identifying possible measures, testing them, and adapting them to the local context. It was revealed that most methods were not appropriate for sustainable adoption, because they were developed without considering aspects regarded as important for other actors, particularly the farmers. Consider this example: " . . . . we all need to participate in developing the soil erosion control measures such that our expectations are all equally fulfilled. All of us have different expectations from controlling the erosion but also different limitations which must be addressed through joint action. But in most cases, experts come with their difficult methods for us to implement" (Interview 2, 2019). However, according to the extension advisors and researchers from the government, the role of developing the soil erosion control measures was for the technical people " . . . . erosion control is a highly scientific subject hence appropriate soil erosion control measures must be developed by pure scientists and researchers" (FGD 4, 2021).

4.3.3. Complementary Implementation of the Soil Erosion Control Measures

This role was mostly perceived by the FGD participants to be implemented by the farmers, supported by their farmer institutions, the government, and the solidarity of the consumers of their products through a fair price. The participants further perceived that, through participatory approaches, support to establish the measures could be through a pooled source of labor—for example, as was the organizing in the farmer family learning groups.

> *"In promoting the adoption of soil erosion control, it is good to keep in mind that the farmer is the end user and leads in implementing on the farmer. Therefore, the perception of the farmer towards the different measures determines a lot how they will be sustained on the farm, if the farmers believe in it, it will work but they also need to be supported in managing the costs for implementing and sustaining the soil erosion control measures . . . "* (FGD 5, 2021).

Similarly, the farmer interviews revealed that:

> *" . . . if we prove that the methods fulfill our expectations such as the quick impact of the methods, then we shall implement them. But some methods especially those that require too much labor may be difficult to implement alone except with the support of group members"* (Interviewee 4, 2019).

However, the extension advisors and researchers from the government emphasized that the role of implementation was solely a task of the farmers, as indicated in this example *" . . . policies to govern the implementation of the soil erosion control must be put in place such that those farmers that do not control erosion on their farms are held solely responsible for the consequences"* (FGD 4, 2021).

4.3.4. Awareness-Creation for Attitude Change

Soil erosion control was perceived as a silent challenge that did not easily manifest to the farmers; hence, it caused damage slowly, without the farmers realizing it. Therefore, farmers had a negative attitude towards dedicating their efforts to soil erosion control, because they did not directly connect soil erosion to low yields on their farms. An example can be cited in this narration:

> *" . . . yes, when it rains, we see that water is caught in the trench. Trenches have a quick impact but most farmers don't have the trenches so they cannot quickly see the erosion . . . most farmers still need to be educated about the negative impacts of soil erosion"* (Interviewee 11, 2020).

Thus, continuous awareness-creation in regard to soil erosion was vital to the sustainable adoption of soil erosion. Awareness-creation was perceived by the farmers as a role suitable for actors who were closely linked to the farmer families—that is, the farmer institutions, and cultural and religious institutions. Awareness-creation by these institutions was trusted as, in most cases, it was done not as a paid job but as a social responsibility.

> *"When a fellow farmer or your own church leader encourages protecting nature, we quickly trust them better than the scientists coming from outside the community. For cultural and religious leaders, we follow whatever they say is good for us because they care about our livelihoods and they are with us in all situations, but government workers mind only their pay"* (FGD 1, 2020).

Farmers had a negative attitude towards government institutions, and it would be an outright failure to place such institutions at the forefront of creating awareness of the adoption of soil erosion control.

> *" . . . When we hear it is government intervention again, our fears of having been forced to plant coffee come back. Maybe our farmer organizations and cultural institutions can help us but government advice, we are skeptical. Let researchers come and demonstrate their practices, we select what works then our traditional leaders are there to deal with non-adopters"* (FGD 5, 2021).

4.3.5. Participatory Approach of Engagement

For soil erosion control to be sustainably adopted, measures had to be selected following a participatory approach, with the farmers taking the lead. This would enable ownership of the measures, especially by the farmers who were central to the practical implementation in the fields. Consider this example from the FGDs,

> *" . . . we need to practically learn about the different soil erosion control measures, understand how it all works and its implications on our farms . . . . . it's not about experts teaching us one day and they leave us confused, it should be a long-term engagement so that after working together with experts we see what works and fits us, then we can expand it in our fields. This joint action will enable us all to learn especially the contextual fit of the different measures . . . "* (FGD 1, 2020).

Different knowledge and experiences existed about soil erosion control among farmers, researchers, and farmer advisors. Therefore, dialogue and joint action were required, to

prove to the different actors what worked in practice, without one actor deciding on which erosion control measures were to be adopted.

> *"When we engage farmers and other actors, we would be able to learn the weaknesses of our recommendations then adjust. The farmer is key because they make the final decision to implement or not to implement. We tried several times to teach the farmers, but they did not learn, and we also learned nothing. Now is the time we all come together as experts and learn from each other but also un-learn the ways that do not work"* (FGD 4, 2021).

4.3.6. Concurrent Action by Different Actors

Several actors were identified for participating in promoting soil erosion control: the farmer families; farmer advisors from the government; the farmer institutions promoting organic coffee production; researchers (e.g., Mountains of the Moon University); and the cultural and religious institutions. These actors were mainly creating awareness about existing soil erosion control measures through organizing farmer training meetings. Participants of the FGDs identified that there was a gap in the way that the process of soil erosion control was being handled. They suggested that the actors should not only do what they thought was right, but should plan together and implement together, to create synergy. This manifested in several ways, for example:

> *" . . . soil erosion control is composed of intertwined processes. The implementation of practices by the farmer needs the researcher to follow up and guide on adaptation meanwhile the bylaws be also implemented at the same time to ensure that all farmers in the landscape are implementing. If these things are not being done at the same time, then for sure always expect a mismatch in progress resulting into short term attempts to controlling soil erosion"* (FGD 5, 2021).

> *"We all need to move together such that when farmers are implementing the practices, we are also motivating them to continue because it is a big job but benefits us all . . . We should attack the challenge from all corners at the same time so that the constraints are addressed from the different complexities. Not us doing our part when the others are doing nothing then we go back to zero"* (FGD 2, 2020).

4.3.7. Motivation through a Penalty and Reward System

Soil erosion control was viewed as an ongoing intervention on the farm, that was done for the benefit not only of an individual farm but for the entire community. Once erosion had been controlled on one farm, neighboring farms would benefit, through the reduction of runoff and flooding. However, there was no reward for those who controlled the erosion, and no penalty for those who did not. This resulted in a short-lived adoption of the control measures. This was exemplified in the following:

> *" . . . there is basically no difference between us, who control soil erosion, and those who do not. Sometimes government threatens to penalize nonadopters but that never happens. We try to control the erosion but when we realize that the government is not concerned, we also relax our efforts. But we know that if nonadopters are penalized, the fines would be used as rewards for the adopters. This system should not be a one-off act but rather continuous. Other rewards can be realized through ensuring a better price for the coffee on those farms that adopt soil erosion control"* (Interviewee 7, 2020).

Government extension staff indicated that farmers had to be persuaded to adopt soil erosion control measures in their fields, as the government would otherwise be tasked to provide relief aid, in case soil erosion-related disaster occurred. This showed clearly in the following FGD:

> *"When we talk about erosion control, the farmers take it to be to the benefit of the farmer advisor and the government. In most cases, they don't directly see the loss due to the erosion and in the short term, they do not realize the benefit. Therefore, they think they are doing it for us and deserve a reward for controlling the erosion"* (FGD 4, 2021).

In line with the above (perception, reward, and penalty measures), localized instruments, such as by-laws and ordinances which in detail described measures to enforce sustainable implementation of soil erosion control, needed to be put in place. This would bring out the context-specific issues and measures that were feasible to implement.

> *" . . . . . bi-laws and ordinances would be more practical to implement at a local level reflecting the national policies which rather have general recommendations that are not easy to translate into the local context. We need to have clear regulations which are easy for the local people to understand and put into action"* (FGD 5, 2021).

According to the farmers, the responsibility of implementing the reward and penalty system was seen as most relevant for the cultural and religious institutions in their communities. An example cited from the FGDs, in line with this, follows:

> *" . . . but also, to penalize nonadopters is not easy for the government and political leaders (policymakers). This is why soil erosion control is always not taken seriously. However, our cultural and religious leaders who act without seeking an electoral mandate are very transparent. We believe in the cultural and religious leaders because they have respect for nature, are transparent, and have natural powers to oversee that life in the mountains is not at risk"* (FGD 1, 2020).

5. Discussion

5.1. Soil Erosion Control Measures and Their Adoption in the Context of Agroecology

Soil erosion control measures have been known of for a long time, and have been recommended, but cultural beliefs have hindered their implementation. Measures such as terraces were not efficient, because they had not been developed within local context beliefs and convictions, as opposed to the AEs 3 and 6 (Human and Social Values, and Efficiency). Water trenches were also not sustainably adopted, because they were not socially acceptable, and were costly to maintain. This is contrary to the AEs 7 and 8 (Resilience and Recycling). Hence, even when a certain practice was introduced, adoption was only short-lived, as it was not within the context [16,51].

The limited adoption also related to the approach of the different actors introducing the soil erosion control measures. For example, FGD 4, 2021 showed that the government extension advisors were recommending methods irrespective of whether they were relevant for the local context in which they were to be implemented. The same had been reported on government programs [52]. On the other hand, the farmer institutions were selective, regarding methods to propose for adoption (Table 3). They considered the local context, which was important in fulfilling the social, economic, and ecological aspects [26,51]. Thus, the measures recommended by the farmer institutions were adopted more, as had been proposed by Jeanneret et al. [22]. This confirmed that soil erosion control measures conforming to the AEs 3, 4, 5, 6, 7, and 8 (Human and Social Values, Co-creation and Sharing of Knowledge, Culture and Food Traditions, Efficiency, Resilience, and Recycling) could be sustainably adopted, as opposed to those that did not.

Discourse on soil erosion control measures indicated that different actors expected different benefits from the soil erosion control measures. As such, implementing a method that served one purpose and fulfilled the aim of one actor could not be sustainably adopted. This could explain why some soil erosion control methods, such as water trenches, were not implemented, long after the external intervention had ceased. In other words, once the actor whose interests were fulfilled by a particular soil erosion control measure withdrew, the farmers did not perceive the intervention as beneficial. On the other hand, field observations indicated that the cover crop legumes that were introduced in 2018 were, until the time of this study, being implemented, because cover legumes fulfilled the expectations of the different actors: controlling the erosion, providing livestock feed, suppressing the weeds, and generating income from the sale of seeds. Thus, soil erosion control measures that aligned with the AEs 2, 6, and 7 (Synergies, Efficiency, and Resilience) were seen to be more sustainably adopted.

5.2. Attributes of Soil Erosion Control Measures for Sustainable Adoption

Several attributes that enabled a soil erosion control measure to be sustainably adopted were connected with the AEs. For example, social acceptability, multiple benefits, and quick and repetitive benefits, as manifested in the local discourses, pointed to the relevance of agroecological elements such as 4, 5, 6, and 8 (Co-creation and Sharing of Knowledge, Culture and Food Traditions, Efficiency, and Recycling) towards the sustainable adoption of soil erosion control measures.

The economic feasibility of soil erosion control measures was also considered important for adoption, and was mostly expressed in terms of cost for labor (interview 18, 2019); see also Nabalegwa and Asaba [16]. To address this, the local discourses pointed to the AEs 1,6, and 8 (Diversity, Efficiency, and Recycling).

Soil erosion control measures were expected to deliver more than one benefit, and to interact positively with existing crops. This correlated with the AEs 1 and 2 (Diversity and Synergies), which suggested that systems should build resilience based on positive interactions in diversity, and should be synergistic [25].

Quick and long-lasting impacts of soil erosion control measures were another attribute that enabled sustainable adoption of soil erosion control (Farmer interview 11, 2020). In the local discourses, this related to the AEs 6, 7, and 8 (Efficiency, Resilience, and Recycling).

5.3. Perspective on Strategies for Sustainable Adoption

5.3.1. Participatory Development of Soil Erosion Control Measures

The living environment of farmers, their beliefs, and convictions were currently not adequately integrated into the process of developing soil erosion control measures (FGD 1, 2020 and FGD 4, 2021). The participatory approach proposed by the AEs 2, 3, 4, and 5 was present in the local discourses: for example, FGD 1, 2020; FGD 2, 2020; FGD 3, 2020; FGD 5, 2021; and interview 2, 2019. Similar elements had also been considered important in participatory action research processes conducted in the Rwenzori area [27]. Similarly, calls for the consideration of traditional farming systems as a basis for transitioning into sustainable farming systems, and for the involvement of different fields, such as sociology, economy, anthropology, and ethics, had been indicated as important in sustainability [24,28]. This implied that consideration of these elements when developing soil erosion control measures could contribute to the sustainable adoption of the developed soil erosion control measures, as opposed to the non-participatory approach proposed by government extension advisors and the national research team (FGD 4, 2021).

5.3.2. Motivation through a Reward and Penalty System

In the local discourses, sustainable adoption of soil erosion control was reflected as requiring an external influence from the authorities, in the form of rewarding those who adopted, and penalizing those who did not (interview 7, 2020 and FGD 1, 2020). This connected with the landscape impact of adopting or not adopting, recognized through a system's interaction, which was considered critical in the agroecological systems reflected in AEs 1 and 2. The discourses pointed to AE 9 (Responsible Governance), where actors were to be held responsible for their actions and inactions, and AE 10, which provided for fair prices for products, to enable farmers to implement best practices.

The cultural and religious leaders were strongly placed at the center of ensuring that rewards and penalties were justly administered, because as a traditional society these were known to possess extraordinary powers. This built on AEs 3, 5, and 9, and was in agreement with the findings of recent scholars, e.g., Bwambale et al. [40] and Stacey [53]. This also built on the experience of government, that there were limits to what political and civil society could implement, particularly in regard to measures that negatively affected leadership positions [50,54,55]. Although policies were known to be vital in enabling the adoption of soil erosion control [11], the reward and penalty system was seriously recommended, based on context-specific regulations (FGD 5, 2021). The AEs also emphasized context specificity (AEs 4 and 5). It was known that national policies whose recommendations

were generalized were more difficult to implement than context-specific regulations, such as by-laws and ordinances [56].

Studies had indicated that there was a need for support to cover costs, if farmers were to sustainably adopt soil erosion control [57]. This was confirmed by the fact that local discourses also called for rewards, for farmers who adopted soil erosion control, which could be fulfilled through AEs 9 and 10 (Responsible Governance, and Circular and Solidarity Economy).

5.3.3. Participatory Engagement

Collective action by the farmers, government extension, farmer institutions, and cultural and religious leaders, through working, learning, and making decisions together (FGD 1, 2020; FGD 2, 2020; FGD 4, 2021) was encouraged as the key to ensuring sustainable adoption of soil erosion control. This approach fitted with agroecology not attempting to radically modify local farming systems, but optimizing their design and the use of local resources and skills, by emphasizing the inclusion of local knowledge and traditional cultivation methods, such as those that promoted agroforestry [58]. Moreover, farmers that used traditional methods were known to have a high-income potential [54]. This approach also connected with AEs 2, 3, 4, 9, and 10 (Synergies, Human and Social Values, Co-creation and Sharing of Knowledge, Responsible Governance, and Circular and Solidarity Economy), which highlighted joint action. In the Rwenzori region, the use of such participatory engagements had been linked with agroecological interventions, and these had been successfully adopted [21,27,32]. Participatory processes were viewed as being enablers of continuous adoption because, during the process, farmers got used to the control measures being practiced [51]. Contrary to this, the government extension and researchers suggested that some stages of soil erosion control be reserved for experts (FGD 4, 2021). In these roles, still, other actors—for example, government institutions—would participate, through AEs 9 and 10 (Responsible Governance, and Circular and Solidarity Economy).

5.3.4. Concurrent Implementation of the Different Roles

The different activities involved in soil erosion control complemented each other; thus, these activities being done at the same time were vital (FGD 1, 2020; FGD 2, 2020; FGD 3, 2021; and FGD 5,2021). For example, implementation of the control measures by the farmers were to be done concurrently with rewards for adopters and penalty measures for non-adopters (FGD 2, 2020). The AEs that were highlighted in the discourse on concurrent implementation included 1, 2, 4, 6, and 9 (Diversity, Synergies, Co-creation, and Sharing of Knowledge, Efficiency, and Responsible Governance). Non-concurrent interventions were blamed for the inconsistent adoption of soil erosion control and had resulted in wasting effort on the adoption of soil erosion control, and on implementing measures in a way that exposed the land to more erosion (FGD 2, 2020).

5.3.5. Clear Allocation of Roles in Soil Erosion Control

Different roles for the different actors were identified as key to the sustainable adoption of soil erosion control (Table 3). Roles were assigned to the different actors in accordance with the actor's relevance in fulfilling a particular role, and with how effectively the actor would be able to fulfill the assigned role. This need for actors to work together, in fulfilling the complexity of agroecology, was known to be important in ensuring sustainable transitions [29,55]. In the discourses, the different roles and relevant actors were linked mainly via different elements of agroecology, such as 2, 3, 4, 5, 6, 9, and 10 (Synergies, Human and Social Values, Co-creation and Sharing of Knowledge, Culture and Food Traditions, Efficiency, Responsible Governance, and Circular and Solidarity Economy).

5.3.6. Implementing the Soil Erosion Control Measures

Discourses on soil erosion control by the local actors indicated that once an appropriate soil erosion control measure was developed, its implementation in the farming system at

both field and landscape level was primarily the role of the farmer families; these were then supported through rewards and penalty measures (AE 9) and responsible markets (AE 10) that enabled the farmers to meet their costs (Table 3; FGD 2, 2020 and FGD 5, 2021). At this level, AEs 1, 2, 5, 6, 7, and 8 (Diversity, Synergies, Culture and Food Traditions, Efficiency, Resilience, and Recycling), which constituted an appropriate soil erosion control measure, were expected to already be inbuilt into the soil erosion control measure, and AE 6 had to be maintained during implementation (FGD 5, 2021). The role of government in ensuring the implementation of soil erosion control methods was not manifested in the discourses; rather, the religious and cultural leaders were considered appropriate. This could be connected to the fact that government actors were using the top–bottom approach (FGD 4, 2021). A similar finding was made in another study: that government extension as an actor in Uganda had less impact on soil erosion control, but that non-government organizations had tremendously contributed to the control of soil erosion [20].

5.3.7. Awareness-Creation for Perception Change towards Soil Erosion Control

It is known that unless farmers know that their soil is prone to erosion, they cannot adopt soil erosion control measures [59]. Therefore, apart from motivating farmers through rewards and penalty measures, continuous awareness-creation (FGD 2, 2021 and interview 11, 2020) were, in the local discourses, considered important in creating a positive attitude toward investing in soil erosion control. The same had been recommended by a study by the Ministry of Land, 2006. The cultural, religious, and farmer institutions were prioritized as the relevant actors in awareness-creation on soil erosion control adoption, because they were considered to uphold AEs 3 and 5 (Human and Social Values, and Culture and Food Traditions). These elements were considered to have the potential for creating a solidarity movement, through social capital building for joint action, which was necessary for the continued adoption of soil erosion control [60]. On the other hand, government extension, and academic and research institutions, were considered inappropriate for awareness-creation, due to top–bottom approaches that were contrary to AEs 4 and 5 (Co-creation and Sharing of Knowledge, and Culture and Food Traditions), and hence did not build into sustainable adoption (FGD 5, 2021).

6. Conclusions

The objective of this study was to find out if agroecology manifested in the local discourses on soil erosion control. Interviews and focus group discussions were conducted and analyzed, to ascertain the links between the local discourses on soil erosion control and the AEs. The results indicated that the AEs manifested strongly in the local discourses on soil erosion control measures, the attributes of appropriate soil erosion control measures, and the proposed strategies for sustainable adoption of soil erosion control. The results further suggested that for soil erosion control measure to be sustainably adopted, it should be developed through a participatory process that included: Co-creation and Sharing of Knowledge (AE 4); promoting Diversity (AE 1) and Resilience (AE 7) on the farm; being Recyclable (AE 8); being Efficient (AE 6), in order to reduce labor requirements; enabling adherence to the Cultural and Food Traditions (AE 5) of the local people; and promoting Human and Social Values (AE 3) for social acceptability. Once the appropriate soil erosion control measures had been developed, their continued adoption would require joint effort through Synergies (AE 2) among actors, and rewards and penalties for adopters and non-adopters, respectively, administered through Responsible Governance (AE 9), with resources, realized through a Circular and Solidarity Economy (AE 10), which redistribute resources to enable sustainability. According to standpoint theory, this manifestation of the AEs in the local discourse suggests that agroecology provides a panacea for enabling context-specific sustained adoption of soil erosion control. We recommend that the AEs should guide the participatory process of developing and implementing soil erosion control measures. Additionally, conventional agricultural advisors should be trained in agroecology, so as to ably support progress towards sustainable soil erosion control. The AEs should

also be the basis for the formulation of local regulations (by-laws and ordinances) on soil erosion control, for motivating and penalizing adopters and non-adopters respectively.

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