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WHAT DOES THE REFLECTIVE LEARNING OF UGANDAN COFFEE FARMERS MEAN FOR AGRICULTURAL EXTENSION AND ADVISORY SERVICES?

Robert Ochago*Muni University, P.O. Box 725, Arua City, Uganda.*

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ABSTRACT

Whereas reflection is essential for learners to make sense of their challenging experiences, little is known about how farmers reflect on their challenging experiences in agricultural practices. This study explores how farmers reflect on their challenges in coffee value chain practices. Using qualitative methods, including focus group discussions and individual interviews with 91 coffee IP farmers from diverse backgrounds, the study identified various challenges—pests and diseases, low and poor coffee quality, and untrustworthy and unreliable coffee buyers—that impact their livelihoods and production. Findings reveal that farmers' reflection varies in frequency and depth, with many engaging in informal discussions with fellow farmers in their communities and a smaller number using individual reflective methods. The research highlights that people who actively engage in reflective practices make more informed decisions, resulting in adaptive methods that improve resilience and sustainability in their farming operations. The study stresses the need to create an atmosphere that promotes structured reflection and peer-to-peer sharing, which will lead to better agricultural practices and outcomes in coffee sector.

*Corresponding Author: Robert Ochago**Email: ochagor@gmail.com**© The Author(s) 2024.*

INTRODUCTION

Coffee is a vital part of Uganda's economy, and its importance is growing. Coffee is grown by more than 1.7 million people; it accounts for roughly 20-30% of the country's export revenue (UCDA, 2019, 2020). Uganda's government policy and strategy rely on the coffee sector to achieve its middle-income status and vision by 2040. However, farmers in this sector confront numerous challenges, including insect pests and diseases, recurrent drought, reduced soil fertility, low product pricing, high input costs, and poor-quality coffee seed varieties (Ochago et al., 2024). As the coffee sector grapples with

these complex challenges¹, farmers' ability to reflect on their challenges becomes critical for adaptation and resilience. Reflection is a cognitive process that enables people to critically assess their actions, learn from their experiences, and devise new methods for future situations (Raelin, 2001; Sadler, 2010). Indeed, research in formal and non-agricultural settings confirms the importance of reflection in transforming experience into learning (Cajiao and Burke, 2016; Di Stefano et al., 2015; Raelin, 2016). Several conceptual studies have been

¹Complex farming challenges have several dimensions, that are rooted in interactions across diverse organizational and social settings, and involve a variety of actors

conducted to expand on the potential benefits of reflective learning within experiential learning (Moon, 2013; Raelin, 2007, 2016). Similarly, empirical studies quantifying changes in individual learning output as a result of reflection gained traction (Cajiao and Burke, 2016; Di Stefano et al., 2015). Few studies, though, consider how reflective learning encourages experience-based learning (Esterhazy and Damşa, 2019; Evans, 2013). In the context of coffee farming, reflection could help farmers to identify appropriate methods, reduce risks, and increase productivity. However, the nature and extent of reflection among coffee farmers is not clear. Existing research in agricultural practice indicates that farmers learn to overcome challenges by reflecting on previous challenges, discussing practical ideas with others, and working together to address challenges (Akpo et al., 2021a; Laforge and McLachlan, 2018; Lubell et al., 2014; Okumah et al., 2021; Vellema et al., 2013a). These studies, however, do not go into detail about what reflection entails or how farmers reflect. To fill this gap, Ochago et al. (2021) found that several learning outcomes are generated when farmers reflect on challenges. Farmers' reflection is an iteration between individual critical reflection and experimentation of value chain activities. While this study is comprehensive, it would benefit more from zooming in on how farmers reflect on their challenges in coffee farming.

This study investigates how coffee farmers reflect on their challenges. It explores the elements of farmers' reflection, including challenges, reflection activities, and reflection outcomes. This study contributes to the literature on agricultural resilience by developing a deeper understanding of reflective practices among coffee farmers. It underlines the possibility of implementing targeted programs that provide opportunities for reflection, ultimately leading to better practices and sustainability in coffee cultivation.

Literature review

This study summarizes existing research on the challenges that coffee farmers face, reflective activities, and learning outcomes resulting from reflecting on their challenges.

Challenges faced by coffee farmers

Coffee farmers encounter a range of interconnected challenges. This study focuses on smallholder coffee farmers' value chain challenges. In the coffee production

process, increased incidences of pests and diseases decrease coffee yields and quality (Ochago et al., 2024). Climate changes, particularly drought, add a layer of complexity. Research indicates that drought threatens coffee yields (Kath et al., 2022). Coffee yields are also heavily influenced by temperature and precipitation changes, particularly during the growing, blossoming, and backing stages, which affect flower bud formation (Kath et al., 2023). Furthermore, rising temperatures cause beans to ripen before they are fully mature, affecting their size and quality (Ahmed and Stepp, 2016). Besides, poor postharvest handling and harvesting practices lower the quantity and quality of coffee (Hameed et al., 2018). Moreover, there are low and inconsistent prices in the coffee market (Ochago et al., 2024).

Reflective activities

Reflection can refer to various aspects of thinking, learning, and being (Hibbert, 2012). Reflection, a higher-order cognitive ability, is defined as a specialized type of thinking, a deliberate inquiry into what we learn from experiences (Dewey, 1933). People say they reflect when they think deeply about how to solve a complex problem, according to Moon (2013).

Gibbs (1988) Reflective Cycle is a prominent theoretical model of structured reflection (Kolb, 2014). This iterative model is divided into six sections: description, feelings, evaluation, analysis, conclusion, and action plan. In short, concrete experiences stimulate reflection, which is deepened by analysis, resulting in new understandings to inform changes in a future event. Another widely used model is that of (Boud et al. (2013), who identified three levels of reflection: descriptive, affective, and evaluative. In the context of the current study, Mezirow (1981) model identifies three central components of reflection: what (content), how (process), and why (premise). Reflection specifically includes what (challenges, learning activities, learning outcomes), how (one reflects/thinks/makes sense of their challenges to generate learning outcomes), and why (farmers act the way they do when faced with challenges during their farming process).

While there is limited evidence of farmers' reflective activities, they may use a variety of reflective strategies to analyze and respond to their challenges. These reflective activities may be collective and/or individual. For instance, in groups, farmers discuss their challenges

and lessons learned from successes and failures during and after training, exchange visits, look-and-learn (observation), and experiments (Akpo et al., 2021b; Vellema et al., 2013b). Collective activities enable farmers to network and share coping solutions for their farming challenges (Šumane et al., 2018). Klerkx and Aarts (2013) emphasize the importance of social networks in supporting learning and knowledge exchange, particularly in areas with limited access to formal education and resources.

Reflective learning outcomes

Reflective learning is the process of critically analyzing experiences to inform future practices (Schön, 1987, 2017). In farming, reflection enables farmers to critically analyze their experiences, evaluate outcomes, and adjust their practices as needed. Some studies have shown that farmers who engage in reflective practices are better equipped to navigate challenges, resulting in innovations in crop management, sustainable practices, and increased productivity (Ochago et al., 2021). Furthermore, farmers experiment to determine whether they can use such knowledge to address challenges (Funes-Monzote et al., 2014; Meynard et al., 2012).

METHODOLOGY

Case study research design

To answer the research questions, I use data from coffee farmers in Kapchorwa, Manafwa, and Namisindwa districts in Uganda's Eastern region. Using the case study research method, I gathered qualitative data from 91 purposively sampled coffee IP farmers. Because there is little evidence of farmers' reflections, case studies provide practical results to understand farmers' reflections (Yin, 2009). Moreover, the methodology used in this study includes interviewing several cases. This methodology allows the author to increase the external validity of the results by collecting data from several cases (Yin, 2018). The study included two sub-steps: focus group discussions (FGDs) and follow-up interviews (FI), which were conducted using interview checklists I created based on existing literature.

Case selection

Purposive sampling was used to ensure that the participants represented a varied group of coffee farmers. Farmers who had been producing coffee for at least five years were considered eligible, indicating that

they had the experience to provide relevant responses. Coffee farmers from value chain innovation platforms were selected. Because there was no sampling frame, I relied on key informants to authenticate a list of farmers compiled by two Makerere University research assistants who interacted with target farmers. The initial phase, using a snowballing technique, was to locate and interview important key informants in Kapchorwa, such as IP facilitators/leaders/group leaders. Using a checklist, key informants were interviewed individually. Three of these questions are pertinent to this paper. 1) The value chain challenges faced by coffee farmers, 2) the reflective activities undertaken by coffee IP farmers to address these challenges over the last five years, and 3) the learning outcomes. After three interviews, the key informants grasped the goal of the study, which led to the selection of focus group participants. A target sample size of 16 participants was chosen to provide a comprehensive data collection while also allowing for in-depth analysis of individual viewpoints. The aim was to have at least four members of each gender from each IP represent each sub-county in Kapchorwa. In a one-day meeting, the author convened with the Kapchorwa district IP coordinator and IP facilitators to create a list of potential FGD participants. The IP facilitators then called potential FGD participants to check their availability. The phone calls ceased at the sixteenth respondent. The day before the FGD, each IP facilitator made personal contact with participants to remind them about the event. Sixteen (16) farmers were specifically selected from the Kapchorwa district for focus group sessions. A similar method was followed for the remaining two districts. Consequently, 15 and 12 participants in Manafwa and Namisindwa were chosen respectively (Table 1). Similarly, with the assistance of the district coordinator, IP facilitators, and focus group discussion participants, another list of potential farmers was compiled to triangulate the FGDs. The saturation point was reached during the sixteenth interview after collecting and analyzing data simultaneously (Gioia et al., 2013). Consequently, sixteen people were interviewed at Kapchorwa. A similar method was followed in the remaining two districts.

As shown in Table 2, most respondents, 59 percent, were men. The average age is 47. Nearly all the participants (91 percent) were married. Almost half (44 percent) of those interviewed had completed secondary education, which took an average of 11 years.

Table 1. Respondents interviewed.

District	Sub County	Innovation platform	Type of interview		Total
			Focus group discussion	Individual interviews	
Kapchorwa	Municipality-Western	Arokwo coffee IP	6	4	10
	Division				
	Tegeres	Chema coffee IP	0	4	4
	Kabeywa	Kabeywa coffee IP	5	4	9
Manafwa	Municipality-East and Central Divisions	Mt. Elgon women in coffee IP	5	3	8
	Bukhofu	Bukhofu coffee IP	4	6	10
	Bukusu	Bukusu coffee IP	2	2	4
	Nalondo	Busyula coffee IP	2	4	6
Namisindwa	Butta	Butta coffee IP	7	4	11
	Bumbo	Bumbo Coffee IP	4	9	13
	Bukhoho	Bukhoho Coffee IP	4	7	11
	Mukoto	Mukoto Coffee IP	4	0	4
			43	47	90

Table 2. Respondents' demographic information.

Respondents' demographic information		Respondent district			Total	Percent
		Kapchorwa	Manafwa	Namisindwa		
Respondent Sex	Male	12	19	22	53	59
	Female	19	10	8	37	41
Total		31	29	30	90	100
Respondent's education level	None	1	0	0	1	1
	Primary level	6	13	14	33	37
	Secondary level	15	12	13	40	44
	Certificate	1	0	0	1	1
	Diploma/College	7	2	0	9	10
	University	1	2	3	6	7
Total		31	29	30	90	100
Respondent marital status	Married	28	26	28	82	91
	Not married	3	3	2	8	9
Total		31	29	30	90	100
Respondent household status	Household head	15	18	23	56	62
	Spouse	16	10	6	32	36
	Child	0	1	1	2	2
Total		31	29	30	90	100

Data collection procedure

Focus Group Discussions

FGDs aimed to gain in-depth insights on how farmers in the study site reflect on their challenges by asking questions to identify their key challenges, reflection activities, and reflection outcomes. Each sub-group formed a focus group discussion that was held in a

meeting room, with respondents seated semi-circularly. Writing supplies such as flip chart papers and various colored marker pens, and audio recording equipment were used. The discussions were audio-recorded with the participant's permission. Because I had been introduced to the research site twice before to data collection and was in the presence of farmers' trusted IP

leaders, I orally requested permission to record the conversations. Furthermore, participants received a comprehensive description of the study's purpose and methodology.

The ability to record the discussion and later play it back allowed for a more in-depth analysis of the conversations (Bryman, 2016). With my assistance, each FGD was facilitated in a central location by two trained research assistants: a moderator and a note-taker. The FGD started with a brief about the exercise to ensure participants were aware of the information to be collected, the approach, and what the collected information would be used for. Ground rules such as only one person should speak at a time; there is no right or wrong answer; one doesn't have to agree with what another person says; all views are important, and one should feel free to share his or her individual experience during the discussion. Participants were asked to speak freely about their responses in their native tongues (Kuksabin, and Lugisu). At this stage, participants were divided into two subgroups of 8 people. Eight participants remained in one room while the other category moved to another room. In the two separate rooms, a moderator and note taker assigned respondents codes for ease of interaction and capturing their responses. After this, the facilitator posed questions to guide the discussion. While everyone's opinion was captured, a hand vote with at least half the participants was used to achieve consensus. In the end, two FGDs were held per district totaling six. After a group discussion of 8 people about the study topic areas, a plenary was held to capture any new points or subtractions.

Finally, in the second step, FGD thematic areas were replicated at the level of individual coffee farmers. During this round of data collection, each research assistant conducted a face-to-face interview with a respondent at their home. The respondent chose the interview location, which alerted the field guide, who led the research team there. The results of the interviews were written down in notebooks and audio recorded. In Kapchorwa, respondent number sixteen reached saturation. The results for Manafwa were like Kapchorwa, the saturation point was reached at respondent sixteen. When the results were the same as Kapchorwa, we just interviewed sixteen people in Namisindwa (Table 1)

Data analysis

Thematic analysis was used to interpret the data gathered from focus groups and interviews. This analysis consisted of four steps: The initial step was familiarization. While I was involved in the entire data collection process, I had to carefully review all transcripts to thoroughly immerse myself in the data. After familiarizing myself, I coded all the interviews using Atlas ti 8, a qualitative data analysis program. Data iterations, established literature, and ongoing fieldwork all influenced the coding. I created codes from words and concepts frequently mentioned by participants during interviews in three coding rounds. The coding process started with reading through the field reports sentence by sentence and transcript by transcript to assign meaning to text chunks such as phrases, sentences, words, and entire paragraphs (Strauss & Corbin, 1998). Using words and concepts frequently expressed by participants during interviews, I created the first-order codes describing how farmers reflect. For example, to identify farmers' value chain challenges, the first-order codes that describe the challenges include coffee diseases for "*diseases of coffee like Coffee Berry Disease (CBD) are persistent*", coffee transportation for "*Transportation of coffee from the farm to the buying centers is difficult, especially during the rainy season since most the roads are seasonal*", low coffee prices for "*most buyers generally offer low prices for our coffee*", and so on. Then, combining the first-order codes (i.e., coffee diseases) to generate second-level codes (i.e., challenges at production) for challenges. Again, code groups, such as challenges at production, harvest, postharvest handling and marketing, and so on constituted the overall themes i.e., coffee farmers' value chain challenges. I repeated the same process for the reflective learning activities and learning outcomes. The final step was to interpret the themes to understand underlying patterns, convergencies, and divergencies within and between cases (Huberman, 2014).

RESULTS

The findings of this study indicate major elements relating to how coffee farmers explain their challenges and engage in reflective activities. The analysis of interviews and focus group discussions with 91 coffee farmers revealed three main themes: perceived challenges, reflective activities, and learning outcomes.

Each theme is captured below, along with accompanying quotes from participants to help illustrate the findings.

Coffee farmers' challenges

Farmers listed and prioritized their challenges along the coffee value chain as the first step in the reflection process, including coffee production, harvest, post-harvest, processing, and marketing. Pests and diseases pose significant challenges to coffee farmers during production. As an illustration:

Pests and diseases have affected my coffee plants, causing the cherries to ripen prematurely. Coffee stem borers, for example, [...] bore holes in the stems, interfering with the nutrients and water supply to the leaves and cherries, causing them to fail to fill properly, rot, or change color (as though dry). (Interview 022, male, Bukusu Coffee IP, Manafwa District).

Farmers recognize that the main challenges they face during the harvest, post-harvest, and processing stages are low coffee quantity and poor quality. While pest and disease infestations are to blame for both low quantity and poor quality, poor harvesting and postharvest handling practices by farmers and traders are also to blame, as explained by a farmer:

Nowadays, traders mix coffee with husks and sell it in other markets. Traders have done this, so some farmers have begun to mix their coffee with husks before selling it. The coffee is of poor quality. It earns very little money on the market. (Interview 045, male, Bukhokho Coffee IP, Namisindwa District).

Farmers consider the presence of a few untrustworthy and unreliable coffee buyers at the marketing stage as a key challenge. As explained by an individual farmer and FGD participants:

Middlemen are still in business, which means that buyers are very few. We have a few reliable coffee buyers in the three sub-counties: Municipality, Tegeres/Chema, and Kabeywa. These are primarily wash stations of Grate Lakes, Kabeywa, and Mt. Elgon women in coffee and other individuals. The issue is that they are frequently overwhelmed by supply and thus keep changing prices to favor them. (Interview 048, Focus Group Discussion Kapchorwa District).

Another thing I would like to mention is that we don't have a ready market for coffee. We used to

have societies that encouraged us to grow coffee and usually paid us well. Because we no longer have cooperative societies, we end up selling to middlemen who cheat us and mix up our different coffee grades, resulting in bad coffee. (Interview 049, Focus Group Discussion, Manafwa District).

Reflective learning activities

Next, farmers discussed the root causes of their challenges. For example, to better understand the emergence of these pests and diseases, results from follow-up interviews revealed that the pest and disease infestation is increasing by the day. First and foremost, farmers link persistent pest and disease infestations to inadequate pest and disease management knowledge and skills. These farmers, in particular, complained about inadequate knowledge about various coffee pest and disease-resistant varieties, management-pruning, stumping, spraying, soil amendments, and so on.

[...] We lack adequate knowledge of agronomic practices in coffee farming, from nursery to harvesting,[...]. Furthermore, the number of extension agents who can provide us with information is limited. Except for a few farmers in the farmer groups who occasionally attend training, we don't know how to manage our coffee as farmers in this community. (Interview 049).

We have limited knowledge of recommended coffee farming practices, such as coffee seedling bedding, planting, etc. To demonstrate a lack of knowledge of coffee nursery operations, participant A stated that when coffee is brought from the seed bed, instead of putting them in a nursery bed first, I just planted and the seedling died. (Interview 050, Focus Group Discussion, Namisindwa District).

Farmers blamed their inadequate pest and disease management knowledge on limited access to quality extension services. These farmers insist that public or government extension service providers are best placed to provide them with necessary pest and disease management knowledge, even though this is not happening. Government extension workers are ill-equipped to pass on necessary knowledge and skills to these farmers. First and foremost, these extension workers rely on their class notes (they have basic coffee knowledge, particularly theory) rather than practical aspects. They are wanting in current coffee research. In addition to their basic knowledge, government extension

workers are few (some cover about three sub-counties) in comparison to the number of farmers in need of extension services. Thus, the majority of farmers are not reached by extension workers. As an illustration:

During planting, extension workers are insufficient to provide advisory services, [...]. [...] One extension worker works in several sub-counties. Despite their small number, these extension workers are inexperienced and rely on their classroom knowledge, which is more theoretical than practical. (Interview 049).

.... the extension workers should also move around and visit farmers at random, rather than waiting to be sought after all the time, as some of them are difficult to locate. The extension workers travel from the subcounty to the district and back, but not to the farmers' villages. They get one informant who gives them ground information that is usually not true, and then they make a report based on such incomplete/false information, although they would have been moving from farmer to farmer and solving problems. They must enjoy their work, even if it is exhausting. [...]. We urge the government to address the extension gap, conduct regular checks and supervision on farmers, and provide timely inputs such as seedlings. (Interview 025, male, Bukhofu coffee IP Manafwa District)

Secondly, farmers have limited access to pest and disease-resistant seedlings. Indeed, coffee farmers rely on seedlings supplied primarily by the public (government), private sector, and civil society organizations. Community nursery operators, whether government or private sector, are the primary suppliers to coffee farmers, either directly or through the Uganda Coffee Development Authority. However, due to their supply of immature/poor-quality seedlings, the actions of these community nursery operators are questionable.

Nursery operators supply immature seedlings in our community, whether they are private businesses or those contracted by the government (via UCDA). The reason for this is that farmers who were recruited to supply seedlings on behalf of the district were ill-trained. These are more concerned with cost than with quality. Furthermore, such seedlings are not delivered in time for planting; for example, the seedlings were delivered in September 2017 and many died. This is contrary to the proper planting season, which is April when there is enough rain.

(Interview 030, male, Bumbo coffee IP, Namisindwa District).

Since I began growing coffee, coffee nursery operators have always given us young, immature seeds. When such seeds are planted, they die, and those that survive are vulnerable to pests and diseases, especially if the plants are more than two years old. Coffee borers attack the stems and leaves of the plants, causing the plants to die. It would be beneficial for the government to send out coffee extension workers because, as much as we want to do coffee as a business, we lack actual knowledge on managing coffee from the nursery bed to harvest. (Interview 049, Bukhofu coffee IP, Participant B).

When immature seedlings are planted in the standard and recommended holes, the entire plant is swallowed by the soil, and such plants die when it rains. Furthermore, the districts of Manafwa and Namisindwa have few nursery operators or those who do seedling production as a business, resulting in an insufficient supply of seedlings in (and to) their respective farming communities.

We don't have enough nursery operators during planting, so seedlings are always in short supply relative to the number of farmers. In most cases, we must obtain seedlings from or through UCDA, which is expensive. Some farmers fail to plant coffee or plant faulty seedlings. Going to the research station (NaCORI Buginyanya)/UCDA as an individual is also challenging due to transportation costs. (Interview 049, Bukhofu Coffee IP, participant A)

The Uganda Coffee Development Authority (UCDA) has certified only a few nursery operators, explaining the low number. Besides that, due to their limited capacity, i.e., their lack of knowledge and skills about nursery operations as well as other inputs such as potting materials, the few certified nursery operators are unable to meet the seed requirements of farmers in their respective communities:

We lack nursery operating materials such as potting bags as nursery operators. These are not available and are expensive to afford in large enough quantities to supply adequate seeds per farmer. Because nursery operators are few, no serious agro-input stockiest deals in nursery materials in our community. As a result, we (farmers) frequently buy seedlings from UCDA. This supplier also buys from other nurseries and thus offers seeds at exorbitant

prices that farmers cannot afford. As a result, most farmers are unable to plant coffee. Others plant low-quality seeds, such as those from fellow farmers or their stock. (Interview 049, Bukhofu Coffee IP, participant A)

Another challenge is that the harsh weather does not allow the nursery beds to be ready in time for planting—the seeds die before they are mature enough to be planted. (Interview 049).

Furthermore, nursery bed work necessitates a significant capital investment, which we do not always have, particularly for the purchase of seeds, inputs such as fertilizers, and pest and disease control. (Interview 048).

Moreover, the nursery operator's limited capacity is due in part to how the operator handles transactions. The certified nursery operators/farmers (registered as UCDA coffee seedlings suppliers) face delayed payment for the seedlings supplied, so most of them avoid doing business with UCDA, the would-be quality regulator. Aside from community seedling suppliers, the government occasionally provides free seedlings through Operation Wealth Creation (OWC).

Farmers, on the other hand, complained about the uncertainty of seedling sources, such as nursery location, variety, and age. Furthermore, seedlings are frequently supplied outside of the planting season (dry season) and are not accompanied by follow-up extension services. Farmers attributed the failure of the army (men in uniform) to accompany seedlings with necessary extension services to a lack of agronomic knowledge, as explained below:

The government through Operation Wealth Creation continues to supply us with seeds from unknown sources. These coffee varieties are susceptible to pests and disease, are not weather resistant, and do not include additional services such as advisory/training. Of course, we do not blame the soldiers who bring us inputs because they are not trained agricultural professionals, but the government, which should have ensured such services, does not appear to notice. We assume they know that other agencies provide extension services (advisory) and that their primary responsibility is providing inputs. When we still had our cooperatives, these extension services were always available and free to all coffee farmers, which is no longer the case. All we're told now is that "you have

to spray your coffee," but with what? This is what we call hanging information. As a result of our lack of general coffee knowledge of coffee maintenance, we end up messing up our coffee. To whom it may concern, we are growing coffee. (Interview 049, Butta coffee IP, participant C)

Similarly, farmers in Manafwa District complained that the new coffee varieties were inferior to those they had in the 90s.

New coffee varieties do not last as long as old traditional varieties; after 10 years, coffee depreciates completely, whereas old varieties take 45 years or more, so returning to my garden and collecting seeds from my garden was a good idea, and I recommend other farmers do the same. (Interview 050, participant C).

Aside from the fact that these new coffee varieties have a short lifespan, the cost of production is high in terms of inputs such as pesticides. According to a farmer, there is inadequate knowledge about, unavailability of, affordability of, and effectiveness of agro-chemicals such as pesticides:

Fertilizers and pesticides are counterfeit and expensive. This has scared me and many of the farmers in the community away from using them. (Interview 002, female, Kabeywa Coffee IP, Kapchorwa District).

Equally, most farmers cannot distinguish between genuine and counterfeit agrochemicals. Farmers attributed their lack of knowledge about pesticides and their use to less regulation of the agrochemicals and less extension support, as follows:

The research stations are operational, but no pest and disease control chemicals have been realized or authorized. I wish we had these knowledge centers at the village level where farmers could go, but the government extension workers don't even know how to use coffee chemicals. Also, they are unaware of what research is being conducted on coffee to determine what kind of extension is required by coffee farmers, and as a result, they lose credibility and are unable to assist farmers because they end up sharing outdated information, providing us with counterfeit inputs, and directing us in the wrong direction, causing us to fall behind. (Interview 047, male, Bumbo Coffee IP, Namisindwa District).

What's more, farmers have limited access to coffee management equipment, such as cross cutters, scissors,

pruning saws, sprayers, and so on, and what they do have is defective.

Another concern is that as an IP, we purchased pruning saws, but there aren't enough for everyone, so in most cases, one has to wait for another while pests spread to other areas. (Interview 050, participant D)

Inadequate spraying equipment because we have to borrow from one another, [...]. (Interview 050, participant C).

Coupled with the already depleted and infertile soils, most farmers in the study site reported an increased need for soil amendments, i.e., fertilizers, as a pest and disease management remedy. Farmers, on the other hand, have limited access to fertilizers.

Because of a lack of agricultural inputs like fertilizers, the quality of the coffee is poor. The stockists at the nearby trading centers supply counterfeit and expensive inputs that cause this shortage. Furthermore, our soils haven't been tested to determine which nutrients are deficient, so applying fertilizers at random without considering whether they are appropriate for the soil types is a waste of time. (Interview 010, male, Arokwo coffee IP, Kapchorwa District).

Farmers cannot afford agrochemicals because they are too expensive. Farmers have a limited income to support purchases. Village Savings and Loans Associations (VSLAs) savings are the most reliable sources, which cannot meet every member's financial needs during production.

I grow coffee, but managing it is difficult due to a lack of capital for purchasing pesticides to spray against pests and diseases, fertilizers, and labour for pruning and stumping. (Interview 042, male, Bukhokho Coffee IP, Namisindwa District).

Little capital for purchasing farm inputs such as pesticides, chemicals such as fungicides for spraying against, and artificial fertilizers, all of which are very expensive and that I cannot afford individually, so I don't use purchased inputs [...]. (Interview 009, female, Chema coffee IP, Kapchorwa District).

Besides, the fertilizers supplied by stockists in nearby trading centers are counterfeit (fraudulent). Similarly, some farmers admitted to having limited knowledge of soil and water conservation, while those who did have some knowledge could not put it into practice due to logistical challenges.

Also, very few farmers are aware of existing inorganic fertilizers because we lack demo farms that could serve as learning centers for other farmers to learn how to use such inputs. (Interview 049).

Even so, the soils throughout the study site have never been tested to determine which nutrients are deficient, so applying fertilizers at random without regard for whether or not they suit the soil types is a waste of time.

[...]. I believe we should have our soils tested and advised on which fertilizers to apply to regain fertility. (Interview 50, participant B).

Besides this, our soils have not been tested to determine which nutrients are deficient, so my random application of fertilizers without regard for whether these suits the soil types is a waste of time. (Interview 010, male, Arokwo coffee IP, Kapchorwa District).

Moreover, the organic manure, which would otherwise supplement inorganic fertilizers regardless of soil testing, is insufficient to cover farmer's coffee gardens. Aside from the fact that fertilizers are expensive and often counterfeit, very few farmers are aware of the existence of inorganic fertilizers because they cannot access a fertilizer application demonstration farm as a learning space. Others, in addition to being unaware of the existence of inputs such as fertilizers, do not know how to use them.

I was recently disappointed by a fellow farmer who, without thinking, opened a bag of Calcium Ammonium Nitrate fertilizer and spread it out to dry in the sun before applying it to his coffee. Because this farmer was unaware that nitrogen is volatile and easily evaporates, he lost everything. (Interview 025, Male of Bukhofu Coffee IP).

In reflecting on pest and disease infestations further, the government's restructuring of the extension system left a significant gap in agricultural extension and advisory service provision to farmers. This restructuring left farmers ill-equipped to take on the role of availing or seeking inputs relevant to managing coffee pests and diseases. Accordingly, farmers reported that the real reason these pests and diseases were not a problem in the 1970s and 1990s was because the government of Uganda took charge of extension service provision, including the provision of agro-inputs as well as physically sending its agents/officers to spray farmers' coffee fields. In addition to the foregoing, coffee was

harvested from August to November during the cooperative regime and then subjected to free service delivery by government extension agents. Furthermore, in the Kapchorwa district, such agents trained a segment of the community on how to control disease and pests, which is no longer done. The agents (government extension workers/agricultural officers) would then scout for pest and disease infestations, report on them, and provide basic advisory services. Other inputs provided besides advisory services include coffee seedlings, agro-chemicals (fertilizers, pesticides, and fungicides), production equipment etc. For instance:

Previously, the government would send extension workers to spray coffee against pests and diseases, and prune, and farmers would be provided with farm inputs such as fertilizers and wheelbarrows as either incentives or at a reduced cost, which farmers would pay for in affordable instalments. (Interview 037, male, Bumbo coffee IP, Namisindwa District).

When I first started growing coffee in the 1990s, cooperative unions would train us on coffee management practices such as spraying, pruning, and other pest control strategies like Coffee Stem Borer. Agricultural officers would spray these pests and diseases in our fields through cooperative unions. [...]. (Interview 032, male, Bumbo Coffee IP, Namisindwa District).

Coffee diseases were not as common as they are now. Of course, government intervention was a factor in the absence of pests and diseases back then. The government would assist farmers in spraying coffee through the agriculture office. [...] Interview 002, Kabeywa Coffee IP, Kapchorwa District.

The problem of coffee berry disease arose as a result of the Ugandan government's withdrawal of support. The government used to spray heavily to control coffee disease. A specific group of people in the community were trained to control disease and pests, which is no longer done. Having said that, I still expect the government to reinstate cooperatives [...]. (Interview 003, male, Kabeywa coffee IP, Kapchorwa District).

Farmers employ various reflective activities to process and respond to their challenges. These strategies often involved both communal approaches and individual. Results show that farmers' reflective activities are mainly collective or group-based. In monthly group

meetings and guided by group leaders, farmers reflect on action i.e., see, hear, and discuss their experience (challenges)—what happened, how it happened, and why it happened. Such gatherings invariably provide a forum for a guided and in-depth reflective dialogue. As just an example:

[...], we got together, talked about it, and [...]. (Interview 048, Focus Group Discussion, Kapchorwa District).

[...] We always sit down as a group and discuss good coffee agronomy, conservation, and management practices, such as mulching and tree planting, [...]. (Interview 049, Focus Group Discussion, Manafwa District).

Furthermore, farmers took advantage of jointly organized events such as training (demonstrations) to share and reflect (inaction) on their challenges both within and outside the IP.

Influential (model/contact) farmers shared information about coffee pruning, stumping, picking, and general management during our routine interactions and visits to his coffee gardens. (Interview 010, male, Arokwo coffee IP, Kapchorwa District).

I decided to start spraying my coffee after seeing my relative (paternal uncle) spray his coffee every year and get high yields. (Interview 017, Male, Butta coffee IP, Manafwa, District).

The farmers engaged in individual/personal reflection activities such as journaling:

So, I keep records of how much I bought the coffee, in bulk till the prices rise. The records help me decide whether to sell coffee cheaply or keep it later at a higher price. (Interview 49, FGD Manafwa-Busyula coffee IP B)

Learning outcomes

After knowing the causes of their insect pest and disease challenges, farmers proposed ways to address them. First, as a sustainable practice, most farmers decided to (re) organize themselves into groups for sharing experiences/information/knowledge, seeking training, and collective actions. In essence, there was increased collaboration, improved problem-solving among farmers, and greater knowledge transfer:

[...] and decided to form a farmer group, which we registered with the community development office. The group exists to gain access to coffee

management services, such as holding monthly meetings to share experiences with fellow farmers, seeking training from other stakeholders (local government, private sector, individuals, and group members), visiting fellow farmers' gardens and fields, and collectively purchasing certified coffee inputs. (Interview 048).

Subsequently, coffee farmers reflect on their interactions and information received through various sources such as training content along with trying out (experiment) to increase their knowledge of planting pest and disease-resistant varieties, use of indigenous methods of pest and disease management, soil amendments, planting shade trees, phytosanitary measures, and spraying. Making more informed choices regarding planting and management practices after reflection is an example of improved decision-making among farmers:

As suggested by other farmers, I turned to local pest and disease control techniques like using ash, red pepper, and mbego raisi. As advised by the extension workers, I used pesticides to spray. (Interview 011, female, Arokwo coffee IP, Kapchorwa District).

Moreover, engaging in reflection not only improves farmers' planting and management practices but also encourages them to take responsibility (own) their challenges and solutions, developing a sense of agency:

I removed all the affected coffee plants: If I had cut all the coffee with yellow leaf spots and planted new coffee, I would be looking forward to harvesting coffee in large quantities right now. [...]. I had no idea that each coffee tree would yield more than 5 kg. I will never allow such a loss to happen again. (Interview 033, male, Bumbo Coffee IP, Namisindwa District).

Likewise, as a remedy to the problem of inadequate access to pest and disease-resistant coffee seedlings, farmers continue to receive the free seed, propagate their seed, and individually or as a group establish UCDA-certified coffee nurseries from improved or indigenous coffee plants. For example:

After training on nursery bed operations under the KIFANGO group, I was motivated to start up my nursery bed, which I later expanded to a fully-fledged commercial nursery site. (Interview 026, female, Busyula Coffee IP).

Farmers increased their productivity by reflecting on the practices described above and making evidence-based modifications, as mentioned:

[...], we had a small farm of coffee and thought that we were big farmers but when we moved around the community, I realized that there were better farmers of coffee so I was inspired to go and increase production and right now I don't regret having taken this step-in life. (Interview 49).

As farmers reflect on their market experiences, they become more aware of market trends, enabling them to make informed decisions about where and how to purchase inputs and market coffee. Coffee farmers tackled the challenge of counterfeit agro-inputs, such as agro chemicals-fertilizers, herbicides, and production equipment, through collective purchasing, purchasing from or through a reputable agency/agency registered farmer, and purchasing from or through company agents/agro-input village level agro-input stockists who also double as group members. As illustrated:

I decided to only buy my pesticides from the Bukusu coffee group because they have genuine products that are effective in pests and disease control. This limits my expenditure on counterfeit products from other agro-stockists. I got all this information from my IP members. (Interview 022, male, Bukusu coffee IP, Manafwa District).

As farmers reflect on their challenges, they become more involved in their communities, resulting in increased advocacy for coffee issues and participation in decision-making local decision-making forums. With the help of local government officials, coffee farmers developed by-laws to reduce counterfeit/fraudulent inputs and substandard output plus encouraging fellow farmers to listen to UCDA radio programs on coffee policies. Similarly, farmers are lobbying local governments to provide them with accredited standards for quality inputs. This is an example of enhanced community engagement, as stated:

We asked the government to provide us with accredited standards for the quality of inputs supplied to farmers that are not harmful to the soil and do not affect soil PH. Also, MAAIF's inspection team should be able to actively check and control the quality of inputs supplied to us. While inspecting, they should consider soil inspection because we believe there are many dangerous toxins in our soils that we are unaware of. At least one example shows that we cannot achieve high yields even with good agronomy. MAAIF, in collaboration with UNBS, should certify agro-inputs, and stockpile inputs, and

increase inspection. (Interview 050, Butta coffee IP, participant B).

Besides, through personal reflection of the challenges faced in coffee farming, many farmers learned about their weaknesses as stated below:

I was conservative and needed to be exposed to modern methods, and organize myself well to be known and recognized by different value chain actors on the market. I realized that everything starts with me. (Interview 007, male, Chema coffee IP, Kapchorwa District). I was not good at self-evaluation and critical thinking, an art I have developed as a result of facing coffee farming challenges over time. (Interview 001, female, Kabeywa coffee IP, Kapchorwa District)

[...]. For example, the time when my coffee used to rot, I thought about it and decided to stop putting it in sacs while in the house but instead spread it on the mat. (Interview 031, female, Bukhofu coffee IP, Namisindwa District).

Finally, many farmers reported feeling more resilient and ready to face uncertainties:

[...] we have realized that working together makes us achieve more (Interview 48 FGD, Kapchorwa) I get a lot of knowledge from fellow group members. [...] shows me that “*am not alone*” (Interview 49 FGD, Manafwa participant)

I have learned to be persistent and determined as a coffee farmer. Like any other business, coffee farming takes a lot of commitment to be accomplished with good profits. (Interview 042, male, Bukhoho Coffee IP, Namisindwa District)

DISCUSSION

Despite evidence that suggests that reflection is necessary for learners to make sense of their challenges and achieve their learning outcomes, little is known about how farmers reflect on their challenges. The purpose of this article was to investigate how they reflect on their challenges, specifically:

Coffee farmers' value chain challenges

The challenges identified by participants— insect pests and diseases, high input costs, and low product pricing—are consistent with previous research literature on the coffee enterprise. For instance, Cerda et al. (2017); ICO (2019); Liebig et al.(2016) emphasize the precarious pest and diseases situation faced by smallholder coffee

farmers, which cause up to 57 % coffee yield loss (Cerda et al., 2017), as well as low quality (Pimenta et al., 2018; Walker et al., 2019), resulting in low and volatile coffee market prices (Kidist et al., 2019). Harvesting and postharvest challenges, particularly farmer practices, add a layer of complexity. Poor drying and hulling practices cause for more than 60% of a coffee bean's overall quality loss (Hameed et al., 2018). Furthermore, low and fluctuating coffee market prices are caused by poor coffee quality, which stems from both pre-and post-harvest activities (Kidist et al., 2019). The farmers in this study expressed similar challenges, emphasizing the pressures that shape their reflective practices.

Reflective learning activities

The farmers' reflection process identifies challenges, determines root causes, and evaluates viable solutions. While in agreement with existing literature, for example, (Miller and Maellaro, 2016), the step-by-step process of reflection, in which farmers listed and prioritized their coffee production challenges, discussed the root causes of their challenges, proposed ways to address their challenges, and tried out the proposed ways (experiment), fall out of such literature. Guided meetings, training, workshops, and demonstrations allow farmers to interact and reflect on solutions to their problems/challenges through in-depth reflective dialogue. While the aspect of guided reflection does resonate with other literature on formal and non-agricultural educational settings, for example, (Cajiao and Burke, 2016; Di Stefano et al., 2015; Raelin, 2016), understanding and facilitating farmers reflective learning (which occurs in a non-formal and often rural agricultural context) requires more effort than one might expect. This is because the farming context differs significantly from the classroom setting, which the teacher or instructor controls.

Agricultural extension workers, for example, work with diverse farmers or farm households who face several challenges and whose participation in collective action (a major reflective learning space) is based on incentives. In other words, incentives such as altruism, access to knowledge/skills, income from extension-related activities, social benefits, and project benefits may influence farmers' reflective learning. Consistent with the idea of incentives, the aspect of embedding reflective learning activities in farmer contexts/settings is also critical. Farmers' reflective activities reveal an

important aspect of adaptive learning, which is critical in coffee farming. The role of personal reflection and collective learning emphasizes the significance of social capital in agricultural resilience (Pretty, 2003). These findings suggest that reflection is profoundly integrated in social networks and community interactions (Ajjawi and Boud, 2018; Di Stefano et al., 2015; Wilson and Beard, 2013). The findings add to the existing body of literature in this context by emphasizing the following: (1) Reflecting on the experience (challenges) is central to experiential learning (Raelin, 2016); (2) reflecting on the experience is a social activity that involves discussing the experiences (Hibbert, 2012; Sadler, 2010). As part of collective learning, farmers took advantage of jointly organized events such as experiments (demonstrations) to make decisions while practising or learning by doing (Cajiao and Burke, 2016; Farrell, 2012). There were two parts to the reflection sessions. The first section was a general discussion of what happened during the experiment/practice. The facilitator invites farmers to share general comments with the group about critical events, how practice went for him/her, positive and negative factors, and what could have been done differently. The second component was a post-experiment collective evaluation. This entailed an open discussion about what happened, how it happened, and why it happened.

Learning outcomes

Reflective practices are crucial for farmers navigating the complex challenges of the coffee value chain. The learning outcomes resulting from these reflections—from enhanced collaboration to increased awareness of sustainable practices—illustrate the potential for continuous improvement among coffee farmers. According to Kusnandar et al. (2019), reflection resulted in new forms of collaboration among farmers and between farmers and wholesalers, increasing market potential. This collaborative environment is crucial for sharing knowledge and developing solutions that work on the ground. Then, farmers who reflected on their experiences felt more competent to make informed choices regarding inputs, production methods, and market interactions. Similarly, farmers who discussed market access challenges became more conscious of their bargaining power and the value of cooperatives in attaining higher coffee prices. Finally, reflective learning assists farmers in identifying the root causes of value

chain challenges and developing solutions to overcome them, hence increasing resilience.

Implications

The contribution of farmers' reflective learning to transformative learning theories

Transformative learning, as articulated by theorists such as Jack Mezirow, stresses critical reflection in adult learning, in which people examine their beliefs, assumptions, and values considering new experiences. The lessons learned from coffee farmers, which emphasize critical reflection, contextual learning, community engagement, and personal narratives, can improve the use of transformational education in agricultural extension programs. For instance, farmers reflect on their actions in monthly group meetings, led by group leaders, by seeing, hearing, and discussing their challenges—what happened (increased insect pests and diseases), how insect pest and diseases infestation increased, and why. The foregoing emphasises both critical reflections, the context, collaboration and peer Learning, which all align with the transformative learning theories. According to Mezirow critical reflection leads to deeper insights and transformative change implying that farmers' reflective learning should extend beyond feedback and/or problem analysis (typical of agricultural development projects) to investigate how farmers make sense of their challenges and how it affects their respective abstract views about their challenges (Hibbert, 2012; Raelin, 2007; Ryan and Ryan, 2013). Moreover, this study supports the theoretical assertion made by (Helyer, 2015; Raelin, 2016) by demonstrating that (1) reflection is essential for coffee farmers to learn from their challenges in agriculture and the food system and (2) extracting more precise learning outcomes requires a guided reflection process. Furthermore, coffee farmers can reflect on their challenges on an individual basis (Ochago et al., 2021). However, the social theory holds that the self is defined not only by the individual's actions but also by how others perceive those actions (Säljö, 2004). Therefore, without the participation of peers, learning from challenging experiences is incomplete (Raelin, 2007).

The contribution of farmers' reflective learning to agricultural extension workers

The implications of coffee farmers reflecting on their challenges highlight the need for agricultural extension

workers to foster a culture of reflection, collaboration, and adaptive learning within farming communities. The culture of reflection can be fostered by organizing and facilitating group discussions. Group discussion can help farmers develop a habit of evaluating their experiences, learning from past decisions, and planning for future challenges. Extension workers can use such meetings to incorporate farmers' reflections on their challenges and successes into topic-specific training. Additionally, extension workers should encourage farmers to form or maintain peer groups where they can share experiences and insights, as well as learning more from experienced farmers to help newer farmers. Finally, extension personnel should encourage farmers to experiment with new approaches and evaluate the results to determine the best practices for their situations.

The contribution of farmers' reflective learning to Uganda's single spine extension policy and framework (edit further)

The Single Spine Extension System (SSES) is a structured approach to agricultural extension that aims to provide cohesive and consistent support to farmers through a uniform framework involving various stakeholders. Coffee farmers' reflections on their challenges have important implications for Uganda's Single Spine Extension Policy and Framework. Farmers' reflections can contribute to more successful and relevant agricultural extension services by acting as a feedback mechanism, encouraging local innovation, and fostering collaboration. Therefore, reflection can be incorporated into the SSES by creating formal platforms for farmers to share their reflections and experiences with extension agents and policymakers, which will increase communication and program relevance. Moreover, training extension workers in reflective practices and participatory approaches can empower them to facilitate better interactions with farmers, ensuring their voices are heard. Furthermore, extension training programs should include reflective activities that stimulate critical analysis of both successful and unsuccessful agricultural practices. Again, policymakers should be willing to alter the Single Spine Extension Policy depending on farmer views and input. This adaptability can boost the efficacy of extension services and ensure that they match the changing needs of the agricultural sector.

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