Defying the Odds to Learn Innovative Farming in Uganda: Experiences of Small -Scale Farmers in Bududa District

Michael David Sumani[1], Blackson Kanukisya[2], Mpoki Mwaikokesya
[1]Department of Community Education and Lifelong Learning,Kyambogo University, Uganda
2 Department of Educational Foundations, Management and Lifelong Learning, School of Education, University of Dar es Salaam

Abstract

This paper examines the learning processes undertaken by small -scale farmers in Bududa district in Uganda to navigate their way through the challenges of achieving innovative farming practices. As such, a qualitative case study was conducted in which 22 crop farmers provided data through interviews and Focus Group Discussions (FGDs). The Social Cognitive Theory was adopted to guide the study. The findings revealed that by learning from fellow farmers, experts, the unit on a farm and use of indigenous knowledge systems, farmers achieved innovative practices. It was recommended that agencies offering agricultural extension services ought to integrate informal arrangement such as farmer –to-farmer learning in order to facilitate effective development of innovative farming skills among farmers.

Keywords*: adult learning, innovative farming practices, small scale farmers*

Introduction

Generally, small scale farmers from most developing countries of the world grapple with many crop farming challenges some of which affect their learning and development of innovative farming skills. Small-scale farmers in Uganda seem not to be exceptional to the challenges due to the fact that reports still reveal farmers hardly access experts, and they face poor quality of farming technologies and biophysical factor (MAAIF, 2016; Ssebaggala & Matovu, 2020). These challenges and many others are of great concern to many stakeholders in the agricultural sector.

Meanwhile, world over, intensifying farmer education on adoption of innovations seems to be the most universally advocated for strategy by stakeholders in the agricultural sector for overcoming farmers' challenges as it has continued to emerge in a number of scholarly papers (Bragdon & Smirth, 2015; FAO, 2015; Ingrama, et al., 2018; Kummer, Leitegeb, et al., 2017; Sontakki & Subash, 2017; Tambo & Wunsher, 2017). The dominant argument in most of these papers centres on learning innovative farming as the best therapeutic for farmers' farming

challenges. Perhaps that informs Tambo and Wünscher (2017)'s definition of innovative farming as new or change(s) in farming processes or products aimed at giving farmers a leap forward in their livelihood activity which is farming in this case. Additionally, other scholars view the relevance of innovative farming not only in solving farming challenges, but also in achieving socio-economic empowerment of rural farmers (Duveskog, 2013; World Bank, 2012), precision farming thus increased production (Karegowda et al, 2021; Sunil, 2021), sustainable farming and adaptation to climate change (Spiegiel et al., 2016; Sumane, et al., 2017). Besides the relevance, popularity of learning innovations seems to arise from the assumption that every human activity requires constant innovation to remain sustainable (Serdyukov, 2017). Making specific reference to farming, Munchhausen & Haring (2012) avers that learning innovative farming is a precondition for handling change successfully. Similarly, Sumane, et al. (2017) claim that a major shift towards more sustainable agriculture may not only necessitate new forms of knowledge, but rather new content and new process of learning as well. In other words how such knowledge is acquired for the said change or improvement in farming to be achieved has to be of great concern to stakeholders.

But what is learning? Perhaps the definition by Mayer (2008) may capture key aspects of what learning is in the context of a farmer. Mayer states that learning is a relatively permanent change in person's knowledge or behaviour due to experience. Understandingly, three aspects are captured in the definition; duration (long term as opposed to short term), centrality of change (behaviour), cause of change (learners' experience in the environment as opposed to psychological interventions). Moreover, for farmers, learning may also take different forms such as formal, nonformal and informal. For the purpose of this paper, two forms, nonformal and informal learning are emphasized. Accordingly, the definition by OECD (2005) was adopted to operationalise the use of such concepts in this paper. Thus, non-formal learning refers to learning through a programme but is not usually evaluated and does not lead to certification while informal learning refers to learning resulting from daily work related, family and leisure activities.

Meanwhile, it can be argued that since farmers play a pivotal role in crop production chain, they have to remain active learners in order to succeed in their role which is assumed to be executed amidst a myriad of challenges. This argument is supported by a body of literature that recognizes the pivotal role of farmers' learning as the engine of innovations in farming (Barrantes & Yague,

2015), the 'heart' and 'soul' of agricultural sector (MAAIF, 2016), a tool for facilitating change on-farm (James, 2019) and an avenue through which farmers share knowledge on farming innovations (Tran, et al., 2019).

For Uganda, perhaps appreciating farmer learning as the 'heart and soul' of agriculture sector suggests why the overall objective of Uganda's agriculture extension policy is to assist farmers to become aware of and be able to adapt to improved technology and management practices in their farming enterprises (MAAIF, 2016). As a way of emphasizing overall objective, Barungi et al. (2016) state that the policy aims at farmer education provisions that goes beyond technology transfer to facilitation, beyond training to learning by the farmers. However, despite the good intent of the policy and other reforms in farmer education in Uganda, contradictory reports showing that farmer education services remain inaccessible by a large population of Ugandan farmers continue to emerge (Barungi, et al, 2016; Sebaggala & Matovu, 2020). As a result, farmers' innovative skills are reported to be less developed (Kabahemba, 2019; Lybbert et al, 2017; Ssebaggala & Matovu, 2020; World Bank, 2019).

Nonetheless, there is documented evidence that some small-scale farmers in Uganda are innovative in their farming activities (Mukadasi, 2018; UBoS, 2018). Such evidence raises the fundamental question with regard to how farmers learn to develop the innovative farming skills to sustain their livelihood activity.In fact, one wonders how such farmers learn to defy the odds that block the rest. Thus, this study aimed at examining the learning processes undertaken by such farmers to acquire the desired knowledge and skills to navigate their way through the farming challenges. Additionally, by understanding how farmers learn, farmer educators and other stakeholders in the agricultural sector can maximize their efforts in creating learning platforms and environment where farmers can thrive in their sustainable farming agenda.

Empirical studies on how farmers learn innovative farming

How farmers learn has attracted sizeable empirical studies perhaps due to its implication on farmer education provisions. Previous studies conducted in line with this highlight a wide range of methods through which farmers prefer to non-formally learn to achieve innovative farming practices. Although such studies had their areas of focus, their take on how farmers learn is of interest to the current study. Thus far, some believe farmers learn innovative farming through experiential learning (Brown & Bewsell, 2010; Maertens, et al., 2020), others are for group

learning (Prager & Creaney 2017; White & Sheath, 2011), while some claim it is through co-designing (Bragdon & Smith, 2015; Deffontaines, et al., 2020; Sumane, et al., 2017). Others completely differ from all the above and rather advocate for an eclectic approach; integrating hands-on learning facilitated through demonstration methods, one -on-one with experts, farm visits and discussions (Franz, et al., 2010; Seymour & Barr, 2014). Despite the differences, the dominant theme that emerges from all the cited empirical studies emphasizes learning by doing as the most preferred method of achieving innovative farming practices. However, further examination of the foregoing empirical studies suggests that they may not be conclusive in explaining how farmers learn as it may be noted in the subsequent section.

Firstly, the studies focused on non-formal learning arrangement and ignored the informal opportunities through which farmers might also learn. Yet, enormous body of literature exists to confirm that much of work -related learning is acquired informally (Barrantes & Yague, 2015; Boileau, 2017; Cameron & Harrison, 2012; Pamphilon, 2017). The assumption is that everyone can learn from activities they engage in. Thus, this particular study considered both forms of learning because they appear to complement each other. In support of complementarity, Kanukisya (2021) argues that, the different forms of adult learning should not be treated as discrete entities but rather with the understanding that they complement each other. Secondly, the previous studies focused on preferred methods of learning rather than describing the process of learning. This particular study considers the sources of learning and describes the learning processes undertaken by farmers to acquired knowledge and skills on innovative farming. Thirdly, the studies seem to be sharing experiences of farmers from countries of the north except a study by Maertens et al. (2020) which was conducted in Malawi. This particular study shares experiences of Ugandan farmers with the focus on a rural district of Bududa as a Ugandan case of rural small -scale crop farmers. Aware of such gaps, the choice of the theoretical framework to guide the current study was studiously made to help in understanding the farmers' learning process as explained in the next section.

Theoretical framework

The study is informed by observational learning construct of Social Cognitive Theory (SCT), which has more relevant and explicit principles (observation, imitation and modeling) to provide a theoretical lens in describing how farmers learn to achieve innovative farming practices.

According to Bandura (1986), observational learning occurs when an observer's behaviour changes after observing the behaviour or actions of his/her model. Bandura further asserts that such learning occurs through the four learning stages of: *attention* (observe behaviour accurately in order to imitate it): *retention* (remembering aspects of behaviour to accurately imitate): *production* (practise behaviour) and *motivational process* (incentives to learn influenced by anticipated reinforcement). These stages were believed to be more elaborate in illuminating the learning processes farmers undertake to acquired knowledge and skills from whatever source and how such knowledge may be put into practice.

On the other hand, Bandura (1986) and other proponents of observational learning (Eyyam, 2016; Nabavi, 2012) are explicit on the three types in which individuals influence others' behaviour. Thus far; 1) *live modeling* (involves individuals in homes or neighbourhood demonstrating or acting a behaviour), 2) *symbolic modeling* (involves famous people whose character exhibited as real or fictional through media influence others who consume it), 3) *verbal instructional modeling* (involves description and explanation by society including wise saying that influence behaviour). Thus, the three models guided easier understanding of the different sources from which farmers learned innovative practices that helped them navigate their way through the challenges of farming.

Meanwhile, SCT has proven to be a successful theory in understanding how farmers learn innovative farming as evidenced by Bijani et al. (2017), Raeisi, et al. (2018) and Valizadeh et al. (2019) that used it to understand how personal (cognitive) and environmental factors play a role in determining farming practices of farmers engaged in innovative farming. Others have used SCT to prove that observation of neighbour's farming behaviour is a critical form of learning in the farming community (Burton, 2012). As such, this study contends that observation learning whose principles are related most to the purpose of the current study is suitable to illuminate the learning processes undertaken by farmers towards defying the odds to achieve innovative farming practices.

However, some critics of the theory present limitations of SCT in predicating behaviour. For instance, Nabavi (2012) observes that the theory is too complex and difficult to operationalise. It is a view shared by Wayne (2018) who also criticizes the theory for being too broad. These seem to be valid criticisms especially when one attempts to apply the theory in its entirety. We were

alert to such a pitfall. As a result, only one construct (observational learning) was adopted due its precise four steps of acquiring and producing behaviour. Secondly, Wayne (2018) criticizes the theory as loosely organized, with sole focus on the dynamic interplay between persons, behaviour, and environment without precision on which of the three is more influential than the other. This also seems to be a genuine observation especially where there is lack of clarity on the relationship between the study variables. It is a caution to any researcher to keep reflecting on the focus during analysis of data, something that was so much adhered to for the current study.

Methodology

Understanding the learning processes undertaken by small-scale farmers (bound to a process-*how*), compelled employing a qualitative study to allow the researcher gain detailed information on how such learning is undertaken by farmers. It is commended for seeking in-depth understanding of phenomenon than merely explaining it (Merriam, 2009; Ponelis, 2015). Thus, a qualitative case study design was adopted to enable the researcher provide thick description on how farmers from one district learn because of its potential for allowing in-depth information from individual farmers' point of view (Harrison, Birks, Franklin & Mills, 2017; Merriam, 2009). On the other hand, the study site was Bududa district as a Ugandan case because; amidst land scarcity the district is famous for being a food basket for Eastern Uganda and beyond (UBOS, 2018; UIA, 2019). Innovative farming practices learned by farmers were presumed to be among the contributing factors to abundant crop production. Meanwhile, through quota sampling Bududa Town Council (with lowest), Bushika Sub-County (with highest) and Bumayoka sub-county (with moderate) number of innovative farmers in the district were selected (Bududa District Local Government, 2019). The purpose was to capture variations in farmers' experiences.

Data were collected through face to face interviews with each of the 22 participants who were purposively selected and two FGDs with groups of farmers from two of the three selected sub-counties in the district. In order to maintain anonymity, participants were assigned codes for identification. Data analysis followed Braun & Clarke (2006) six step framework of thematic analysis.

Findings

The findings of the study revealed the challenges farmers faced and they were tied up into four themes namely: 1) those related to biophysical factors; 2) available technologies; 3) technical factors; and, 4) socio-economic factors. The coping strategies small-scale farmers employed to address these challenges included learning from the advice of fellow farmers, learning from advice provided by experts, learning from the unit on a farm, and using indigenous knowledge systems. We provide explanations as follows:

Learning from fellow farmers

A couple of participants mentioned that they used informal approaches to acquire knowledge and skills about innovative farming from their fellow farmers. For instance, some reported that they had to pay a visit to a model's farm and observe the activities with or without consent of the owner as confirmed by one of the participants that:

> When I see a good practice by another farmer in this community, I usually find a way of visiting such a farm and observe what that person does so that I copy from him. By observing you also learn how can manage your own farm. I don't know how many times I have visited Mzee Tumwa's farm without him knowing. My banana maintenance practices were mostly learned from farm. (FBUD4)

Although not mentioned, it is apparent from the excerpt that such learning incidentally takes place as the learner-farmers are pursuing their other tasks and later follow up is intentionally planned although it is still informally done. It was also noted that others would informally attend mean training or engage in discussions with their models as reflected in the interview comments below:

> I visit other farmers and share with them some of the challenges and through such discussion solutions to my challenges are got. Like this irrigation system I use here, I got ideas from the owner of Sabunyo farms. I paid him a visit and he inducted me on how he gets better and cheap materials for irrigation. I took some pictures so that I share with my people who help me on this farm. It has made me to continue with my farming activities during dry season. (FBUM4)

Basing on the above statements it can be noted that informal farmer to farmer learning especially where one would engage in discussion with their models enabled one to arrive at workable solution to their prevailing challenges. It can also be noted that a variety of learning methods

would be employed in the learning. For instance, discussion, observations, documentation (refer to excerpt by FBUM4 specifically) and listening seem to be ubiquitous as learning took place.

It is also apparent that the prompt for learning involving farmer to farmer learning is the good practice observed. Thus, it may be argued that learning starts with *attention-reflection-practice*. A learner-farmer pays attention to the experience of the model as exhibited in their farming practices. This can further be interpreted to mean the time when the learner draws cognitive imageries about his activities (in this case the past experience) and those of their models. To the learner, it can be noted that the learning process involved making comparisons and judgment on the current situation, the gap, the expected situation and what it takes to reach the ideal situation.

Learning from advice provided by experts

The other theme which emerged from the analysis of findings was that experts have been the farmers' source of learning to combat the challenges some farmers face. Participants' approach with regard to seeking advice from experts was exhibited in various forms such as directly contacting professionals, attending workshops as illustrated by the interview comments from some participants who said that:

> When '*kamasa'* (coffee stem borer) became a challenge to my coffee, I talked to extension worker of our sub-county. He came and checked and advised me to paste neem leaves extract on the affected coffee stem. In that way I learned proper care for my coffee garden and avoided attack by insects without using spays, (FBUM2)

> We have been attending several workshops and experts share a lot on good farming practices. One of such workshops was organised by Coffee a cup. I was guided on where to get the right seedlings for coffee and how to cater for them after planting in order to have successful germination. (FBUD4)

> If you get a problem you need to quickly get a solution. There are experts. They prefer working with organised groups because extension services are demand driven. Their corrupt tendencies notwithstanding, they may be of help once they are contacted by organised group. (FBUM5)

Although the three interview voices seem to confirm how farmers learn from advice provided by experts, the third excerpt points to the challenge one may encounter with such a source of learning. From the comment made, it appears some farmers stay away from some experts because some experts tend to be corrupt. This in essence seems to be a huge hindrance to the would-be source of not only reliable but technical farming knowledge.

Meanwhile, subsequent interviews also revealed that some experienced farmers also act as experts. Some farmers made revealing statements to confirm that they learned from fellow farmers who were contacted in the context of experts as opposed to being mere fellow farmers. The farmers claimed:

> Mr. Wakinya [*referring to fellow farmer*] mobilized and sensitized us on planting banana friendly trees that also act as support for our bananas. These trees are also used as animal fodder while they are in their tender age. With such trees some of the problems caused by rain storms are partially solved. For example we use the poles to stake our mature banana plants. (FBUS4)

> We have other farmers with a lot of knowledge. For example Mzee Kuloba [*Name of fellow farmer*] is a resource on coffee issues. Any issues related to coffee I usually seek his advice. For me I have always managed most challenges by opening up to friends and other experts whom I know have much experience about the issue at hand. (FBUM3)

> I used to have issues with the quality of artificial fertilizers government used to supply under NAADS programme. The fertilizers would make my crops wither, made the soils so hard especially during dry season. This seemed to be a common challenge here because other farmers had similar complaints. I thought about it deeply and shared with other farmers. Some of those consultations helped me learn how to make liquid manure (bio-syrup). This experience was from a colleague who had received some training by Agriterra Uganda about the same. He once offered to train me about the same for two days on his farm. I acquired a lot of knowledge from that training. We now make local and very cheap manure. I no longer cry of poor soil nutrients. (FBUS1)

Basing on the interview comments cited above, two issues relating to learning process manifest. The first one is where the farmer-expert sees the need and steps out to mobilize the rest and shares workable farming solutions with them in a non-formal learning arrangement. The second one symbolizes scenarios where affected farmers themselves solicited advice from fellow farmer-expert. Although the two approaches seem to have been effective in helping farmers address their farming challenges, it may be argued that the former assumed somewhat a top-down approach while the latter signifies a bottom-up approach to addressing farmers challenges. The risk with the former may lie in the inability to address specific or/and individual farmer's farming challenges. However, where the farmers were initiators, it is apparent that the learning process undertaken involved: reflection-consultation-observation-practice.

Furthermore, the findings also revealed that farmers informally learned from experts through consulting their written and published ideas as reflected in the interview comments from some participants who claimed:

> I also do research by reading about some farming practices. The internet has a lot of information for us farmers. Experts have almost written about every farming challenge. I know some may not be appropriate to some places so the best you do is include description of your area in the search for solutions. (FBUM4)
>
> I like reading. I have read about many issues. That has made me manage some challenges. Of late banana wilt is no longer a problem. I did some research on ways of making bio-pesticides for banana wilt. I used to hear from other farmers but thought I needed an authority for me to take it full blast. That is exactly what I did. I know how to guide other farmers in case they get such attack to their bananas. (FBUD6)
>
> I personally read a lot about farming. I also interest myself in watching TV and listening to radio programmes related to better farming methods. Every Thursday, I buy monitor newspaper because it has information on progressive farmers in Uganda with details on what they are doing on their farms. I apply some of those practices I watch or read about. (FBUD2)

From the excerpts it can be noted that participants sought advice of experts informally through reading especially while interacting with literature from experts. It can be further noted that observation and listening facilitated the learning processes especially where audio-visual aids like televisions were involved. Moreover, the learning somewhat exhibited both intentional and incidental informal learning processes. For instance, although listening and watching planned TV programmes may be intentional some incidental learning processes may also suffice. It is also apparent that the learning process involved: reflection-reading, reflection-observation.

Meanwhile, it may be argued that learning by reading or research may only favour those with higher level of formal education for instance to effectively do research on innovative farming through internet search. Secondly, the resources they use to enable them learn (computers, internet, power sources) may not be easily accessible to all small scale farmers. Some of these resources are not only inaccessible in rural communities but also present high maintenance and operational costs.

Further analysis of excerpts revealed that as a way of verifying certain knowledge sources, some participants intentionally consulted published works of experts. On one hand, this may imply giving little faith in informal knowledge generated by fellow farmers despite such knowledge

being experience based. On the other hand it is a form of continuous learning as a concerned participant attempts to verify such knowledge by consulting other authorities. Thus, the process seems to amplify the relevance of lifelong learning to learning innovative farming practices.

Informally learning from the unit on a farm

Some participants acquired knowledge and skills on innovative farming practices informally through observing, monitoring and comparing characteristics of plants from flourishing units on their farms. The knowledge acquired through the foregoing methods would then be replicated elsewhere in a trial and error process and discovery learning would ensue as reflected in the interview comments of some participants who narrated that:

> Banana bacteria wilt attacked almost all banana species but '*Mundizi'* (short chubby bananas) were most vulnerable. For heaven's sake my wife used to pour ash under one of that mundizi [*Pointing to the mat just adjacent to his kitchen*]. She did that without knowing she was immunizing against banana bacterial wilt, only to discover later when I saw that it was the only stool still surviving the banana wilt. I uprooted some suckers from that very stool and planted elsewhere but unfortunately these were also attacked. I kept on wondering. Then something clicked in my mind that probably by pouring ash in the other plant we must have killed the bacteria. I tried transferring the suckers again but this time before I could plant, I put ash and compost manure in the hole. This time they survived. That is how I have been able to maintain that banana variety until now. (FBUD4)

> I learnt that human urine is a fertilizer and pesticide in a very funny way. […], that place [*he points at a urinal near his makeshift bathroom*] was a particular spot where we urinate. Little did we know we were actually applying urine as manure and pesticide. I noticed that all suckers around that spot were never affected by banana bacteria wilt. All the suckers looked better than the rest. This made me think deeply. I developed an idea that probably such successes might have been as a result of our urine. That is how I developed the idea of mixing urine with ash to treat banana bacteria wilt. (FBUD7)

Another participant explained how he learned that the fertilizer he had been given was of poor quality. He said after applying the fertilizers he kept on monitoring the health of leaves specifically *'lwayoyo'* (protruding leaf sheath). He claimed that after comparing the leaf sheaths of bananas subjected to the new manure with those on which his locally made manure was applied, he could tell that the supplied manure was ineffective. This angered him and he stopped applying the new manure but rather continued with his locally generated bio fertilizer.

Owing to the above cited voices, they all seem to suggest success on the farm calls for great commitment from the farmer especially in paying attention to every small detail with regard to behaviour of their crops. Thus far, attention plays a pivotal role in learning and the methods noted to facilitate such a process of learning include observation, monitoring, comparison and reflection Moreover; it is more of individual learning process. However, it seems that the participants' prior experience somewhat indirectly plays a big role in such learning.

Secondly, it can be noted that the learning individuals go through while learning from one unit on their farms is informal. There is no prior arrangement but rather incidental learning while on farm. There is always a risk with such knowledge. The source, the learning process and resultant knowledge appears to be tacit, traditional and somewhat from intuition. As a result, despite being practice-based knowledge as findings seem to suggest, knowledge from such sources may be displaced or pushed to the margins due to the strong beliefs by most stakeholders in the standardized scientific or expert knowledge. However, as the practice seem to suggest, recognition of such sources of knowledge may be equally important. That being the case, it may be argued that the formal or scientific institutions need to gain access to such knowledge and subject it to further verification thereby fostering its transfer beyond the boundaries of a particular community or family.

Learning through indigenous knowledge systems (IKS)

Some participants claimed to be using indigenous knowledge systems to manage challenges posed by unfavourable weather changes. It was revealed that such knowledge is acquired through learning methods such as monitoring and comparing ecological happenings in the area including the direction from and/or to which the wind blows and particular spots where thunderstorm emerged as reflected in the interview excerpts below:

> *Nga ifuula ye season inyoowa yakhukulira khu Tsekululu ukhwo, yang'apa umanya oli itsa khwilayo'* literally translated in English to mean; 'unless thunderstorm for first rain season is heard from that Tsekululu hill, rather know such rain will disappear. (FBUD5)

> [...], you can't be a farmer without knowledge on weather forecast. Our first season rains is preceded by thunderstorm right from that Mabono hill not Nabisakala [*he points to the different hills*]. We then monitor for emergence of a flock of *Kamakumeti* (folklore birds). When those two things happen it is a clear sign that the first rain season is due and you can plant annual crops. (FBUM5)

> I can't plant onions in between November and January because I know a dry spell is likely to set in and I may make losses. In such situation I have to rely on passion fruits because they are less affected by weather rather they just require proper care in terms of nutrients and weeding to avoid attack by pesticides. (FBUS9)

Basing on the excerpts a number of observations can be made. Firstly, it can be noted that rural farmers are always well versed with their area's natural happenings which are associated with weather changes. Secondly, the area's natural happenings seem to trigger informal learning. For instance, it is unlikely that one would predict when thunderstorm would happen and therefore plan how to learn from such an occurrence. Likewise the emergence of folklore birds seems to have been unpredictable. However, as revealed by some participants, the happenings often offered opportune moments for learning informally. It is evident that community biophysical occurrences triggered incidental learning exemplified in informal learning processes. The form of learning notwithstanding, it is noted that the happenings were used to predict weather thereby suggesting when and what to plant. In that regard it may be argued that indigenous knowledge system (IKS) is among the strategy for mitigating challenges of climate change. Moreover the learning process involved, viz awareness-reflection-analysis-prediction.

However, what may appear to remain challenging is on how such knowledge is passed on to the young farmers and whether the young farmers perceive it as useful knowledge. For instance, subsequent interviews with other participants led to 31 year old farmer who castigated indigenous knowledge systems as unreliable source of knowledge on farming as he queried, "you see, we no longer live in the old days of our parents who predicted the changes in weather using natural happenings like movement of the wind and birds in the sky" (FBUM1). Such a statement speaks volumes. It downplays the presumed critical role played by IKS in mitigating farming challenges. As a result it may be argued that use of IKS in learning and the presumed impact in mitigating farming challenges may be pushed to the margins. Further it delineates the use of IKS as a reserve of the elderly since they seem to be perceived as the custodians of such knowledge. Perhaps a counter argument may be that the scientific sources quite often seem to be inaccurate in precision farming. For instance, due to some factors relating to climate change, weather forecast at times may be inaccurately done. In such circumstances farmers may continue to rely on their IKS which in such circumstances appear to be reliable because they are experience-based knowledge.

Discussion

This study aimed at exploring how farmers learn to cope with challenges faced in achieving innovative farming. Observational learning was adopted as the lens to illuminate such learning processes. Thus, viewing the findings with the lens of observational learning, the learning process may be understood better in a number of ways. Firstly, it has emerged that farmer to farmer learning processes involved attention-reflection-discussion-observation-practice. These processes are predicted in the four stages of observation learning. For instance, the cognitive processes involved in identifying their fellow farmers (as models) and developing interest in their model's practices confirms the attention stage of observational learning. Meanwhile, retention stage is depicted in their ability to remember the good practices learned from their models. Yet, production stage of observational learning was ubiquitously present when learners (farmers) took a step to replicate what they learned. Finally, the motivation stage is reflected in their revealing statements made to acknowledge effects of the knowledge they acquired to their activities; *'.... I no longer cry of poor soil nutrients, (FBUS1); ... it has made me continue with farming activities during the dry season* (FBUM4)'. Moreover, the past experiences on farming practices were a precursor for learning thereby making comparisons of how the models' experiences can help the visiting farmer to change the status quo. Therefore, the findings are consistent with the four stages observational learning suggested by Bandura (1986). They also confirm that assertion by Eyyam (2016) that learning does not suddenly occur but rather follow the four consecutive processes of attention, retention, production and motivation.

Secondly, the findings also brought forth the determinants of the modeling process. The observers/participants did not observe everything around them; rather attention was paid to certain models who had initiated innovative farming practices worth paying attention to and of relevance to the observer if copied and applied on their respective farms. These findings are in agreement with Bandura (1986) that for a modeling process to be successful; the model ought to produce satisfaction the observer holds in the behaviour being learned.

Thirdly, the findings confirm how the different types of models highlighted by proponents of observational learning both directly and indirectly influence behaviour. Their activities directly or/and indirectly offered learning process that appeared to be coping strategies to the farming

challenges. Direct influence is seen in face –to -face consultations or observations on farms while indirect influence is through reading, listening to or watching documentaries about experts' works. When farmers imitate practices of fellow farmers which were learned through methods such as observation, discussion and doing, the learning process and practice confirm live modelling. Proponents of observational learning explain live modelling as learning behaviour from individuals around the learners' family, workplace, and neighbourhood (Eyyam, 2016; Nabavi, 2012). Meanwhile, learning innovative practices from published ideas of experts demonstrates symbolic modelling; understood as learning process involving acquisition of behaviour from models by reading or watching their real of fictional character through media (Bandura, 1989; Eyyam, 2016). On the other hand, learning through verbal instruction modelling was ubiquitously present while learning through IKS. For instance, it was noted that society's practices facilitated reflection and decision making on planting. As noted by Eyyam (2016), instructional modelling involves society norms and sayings that may influence behaviour. However, further analysis also revealed that certain personality factors determined how farmers learned the different strategies. For instance, level of education facilitated symbolic modeling processes from experts (by reading and doing research) and age determined how participants appreciated IKS as sources in mitigating challenges to innovative farming practices. Thus, confirming the vicarious observation learning ideas of SCT (Bandura, 1986).

Furthermore, the findings not only attest to the role played by informal learning processes in the farmer innovation process. They therefore corroborate previous scholars who held the same view (Sumane et al., 2017; Toillier et al., 2014). They are also consistent with assertion by previous scholars that farmers are actually innovators (Bragdon, & Smith, 2015; Kummer, et al., 2017; Sontakki & Subash, 2017; Tambo & Wunsher, 2017).

Conclusions and implications

In conclusion, it can be safe to say that farmers may defy the odds to achieve innovative farming practices by learning from advice provided by fellow small-scale farmers and experts or learn from the unit on a farm and use of IKS. And that learning from fellow farmers and experts may assume both non-formal and informal adult learning processes while learning from the unit on a farm and IKS exclusively adopts informal adult learning processes. Moreover, the first two

(learning from fellow farmers and experts), may be undertaken through discussion, listening, observation, reading and documentation. Likewise learning processes in the last two (from the unit on a farm and IKS), may be undertaken through monitoring, observations and comparing (which may involve critical reflections on past experiences) to gain new experiences. The learning processes farmers undertook were illuminated by the four processes of observation learning. Therefore, confirming that observational learning as one of the constructs of Social Cognitive Theory can predict how farmers learn to achieve innovative farming practices. Therefore, the theory provides more realistic insights into farmers' individual and social learning behavioral contexts that may be of implication to farmer education provisions.

Owing to the above conclusions about the study, it is therefore important to suggest that: a) Farmer educators ought to adapt more innovative farmer education procedures that may encourage informal learning strategies like farmer-to -farmer informal visits and discussions. b) Since farmer –to -farmer extension has proven to be somewhat reliable, it can be adopted in agricultural extension services provisions. This will somehow solve the challenge of inaccessibility of farmer educators to the large population of farmers. c) When participating in farmer education, farmers ought to be given space to reflect on their past experiences in order to challenge the status quo and think critically about the ways of changing their future farming practices.

References

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice Hall.

Bandura, A. (1989). Human agency in social cognitive theory. *American Psychologist*; 44-1175-1184

Barrantes, C. & Yague, J. L. (2015). Adults' education and agriculture innovation: Asocial learning approach. *Procedia-Social and Behaviourial Sciences*; 19(1), 163-168.

Barungi, M., Guloba, M., & Adong, A. (2016). Uganda's agricultural extension system: How appropriate is the single spine structure. *Economic Policy Research Centre*, Kampala, Uganda.

Bijani, M., Ghazan, E., Validadeh, N., Fallah, N. (2017). Pro-environmental analysis of the farmers' concerns and behaviour towards soil conservation in the central district of Sari, County, Iran. *International Soil and Water Conservation Research*; 5(1), 43-49

Boileau, T. (2017). *Informal Learning: Lifelong learning in the 21st Century*. University of West Florida. https://www.researchgate.net/publication/320188378

Bragdon., S.H., & Smith, C. (2015). Small-scale farmer innovation; Geneva. Quaker United Nations Office. http://quno.org/areas-of-work/food-sustainability.

Braun, V. & Clarke, V. (2006). Using thematic analysis in Psychology. *Qualitative Research in Psychology*; 3, 77-101: Doi:10.1191/ 1478088706qp063oa

Bududa District Local Government (2019)..*Annual report 2018/2019 to Ministry of Agriculture, Animal Industry and Fisheries*. Department of production. Available at: https://maaif.go.ug/sites/.../MAAIF%20Annual%20Report_2017-2018.pd

Burton, R. J. F. (2012). Understanding farmers' aesthetic preference for tidy agricultural landscape: A Bourdieusian perspective: *Landscape Research*; 37(1), 51-71

Deffontaines, L., Mottes, C., Della, R., Lesueur, J. M., Cattan, P., & LeBail, M. (2020). How farmers learn to change their weed management practices: Simple changes lead to system redesign in the French West Indies. *Agricultural systems;* 179, 102769

Duveskog, D. (2013). *Farmer Field School as a transformative learning space in the rural Africa setting. PhD thesis submitted to Swedish University of Agricultural Sciences, Uppsala*

Eyyam, R., Dogruer, N., & Menevis, I. (2016). *Theories, approaches and models: The social cognitive theory.* Available at: http://www.ijonte.org/FileUpload/ks63207/File/chapter4

FAO (2015). *What challenges does agriculture, extension and advisory services face today?* Research and Extension, Branch of FAO of the United Nations.

Franz, N., Piercy, F., Donaldson, J., Richard, R. & Westbrook, J. (2010). How farmers learn: Implications for agricultural education. *Journal of Rural Social Sciences*; 25(1), 37-59.

Harrison, H., Birks, M., Franklin, R. & Mills, J. (2017). Case study research. Foundations and Methodological Orientations. *Journal of Qualitative Social Research*; 18(1)

Ingrama, J., Chiswell, H., Mills, J., Debruyne, L., Cooreman, H., Kourtsouris, A., Pappa, E. & Marchand, F. (2018*). Identifying functional characteristics that enable learning in demonstrations*. Paper presented at the 13th European IFSA Symposium, in Chania (Greece).http://ifsa.boku.ac.at/cms/fileadmin/Proceeding2018/1_Ingram.pdf

James J. (2019). *The modern evolution of agricultural extension*. Retrieved from: https://www.enablersofchange.com.au/the-modern-evolution-of-extension/

Kabahemba, B. (2019, January). *Finance Minister Kasaija labels NAADS and OWC Money loser for government: Better planning needed.* Nilepost online news.

Kanukisya, B. (2021). Conception and misconception of adult education in contemporary Tanzania. *Papers in Education and Development*; 38(1), 35-58.

Karegowda, A. G., Devika, G., & Geetha, M. (2021). Deep learning solutions for agricultural and farming activities. *In Deep Learning Applications and Intelligent Decision making in Engineering*, (pp. 256-287). IGI, Global.

Kummer, S., Leitgeb, F. & Vog, C. (2017). *Farmers' own research: Organic farmers' experiments in Austria and implications for Agricultural Innovation systems*. Canadian Center for Science and Education. http://dx.doi.org/10.5539/sar.v6n1p103

MAAIF (2016). *The National Agricultural Extension Policy*. Kampala, MAAIF

Maertens, A., Michelson, H.& Nourani, V. (2020). How do farmers learn from extension services? Evidence from Malawi. *American Journal of Agricultural Economics*; 103(2), 569-595. Doi:10.1111/ajae.12135

Maguire, M. & Delahunt, H. (2017). Doing a thematic analysis: A practical step by step guide for learning and teaching scholars. *All Ireland Journal of teaching and learning in higher education*, Vol. 8(3). http://ojs.aishe.org/index.php/aishe.j/article/view/335

Mayer, R. E. (2008). Applying the science of learning: evidence-based principles for the design of multimedia instruction. *American Psychologist*; 63(8), 760-769

Merriam, S. M. (2009). *Qualitative research: A guide to design and implementation (2nd edition*).San- Fransico, CA: Jossey-Bass.

Mukadasi, B. (2018). Mixed cropping systems for sustainable domestic food supply of the small holder farming communities in Nakasongola District in Central Uganda. *Canadian Journal of Agriculture and Crops*; 3(1), 42-54

Munchhausen, S. A. & Haring, A. M. (2012). Lifelong Learning for farmers: Enhancing competitiveness, knowledge transfer and innovation in Eastern German State of Brandenburg. *Studies in Agricultural Economics*; 114(2012), 86-92.

Nabavi, R. T. (2012). *Bandura's Social Learning Theory and Social and Social Cognitive Learning Theory*. https://www.academia.edu/37627563/BandurasTheory.pdf

OECD (2005). *Oslo Manual. Guidelines for collecting and interpreting innovation data. Third Edition*. France. Available at: https://www.oecd-ilibrary.org/science-and-technology/oslo-manual_9789264013100-en

Pamphilon, B. (2017). *The farmer to farmer adult learning manual: A process and resources for development of farmers as peer educators.* Canberra, Australian Centre for International Agricultural Research.

Ponelis, S. R. (2015). Using interpretive qualitative case studies for exploratory research in doctoral studies: A case of information systems research in small and medium enterprises. *International Journal of Doctorial Studies*; 10(1):535-550.

Prager, K. & Creaney, R. (2017). Achieving on-farm practices change through facilitated group learning: Evaluating the effectiveness of monitor farms and discussion groups. *Journal of Rural Studies*; 56, 1-11

Raesi, A., Bijani, M. & Chizari, M. (2018). The mediating role of environmental emotions in transition from knowledge to sustainable behaviour towards exploiting ground water resources in Iran's Agriculture. *International Soil Water Conservations Research*; 6(2), 143-152

Serdyukov, P. (2017). Innovation in education: what works, what doesn't, and what to do about it? *Journal of Research in Innovative Teaching & Learning;* 10, (1), 4-33

Seymour, E. & Barr, N. (2014). *Framers preference for learning: A review of current data and literature.* Melbourne, Victorian Government. DOI: 10.13140/RG.2.1.3197.9684

Sontakki, B. S. & Subash, S. P. (2017). Farmer innovation system: Repositioning the way we look at farmer innovations. Agriculture under climate change: Threats, strategies and Policies, 383-391

Spiegel, P., Macoloo, C. & Cady J. M. (Eds.) (2016*). Small-scale farmer innovation: How agricultural research works together with farmers;* Hamburg, Misereor Foundation

Ssebaggala, R. & Matovu, F. (2020). *Effects of Agricultural Extension Services on Farm Productivity in Uganda*. Available at :https://aercafrica.org/wp-content/uploads/2020/06/Research-Paper-379.pdf

Sumane, S., Kunda, I., Knickel, K., Strauss, A., Tisenkopfs, T., Rios, I., Rivera, M., Chebach, T., & Ashkenazy, A. (2017). Local and farmers' knowledge matters! How integrating informal and formal knowledge enhances sustainable and resilient agriculture, *Journal of Rural Studies*, 30(1- 10). http://dx.doi.org/10.1016/j.jrurstud.2017.01.020

Sunil, M.R (2021). Connected farming: An IoT enabled solutions for Uganda's Agriculture. *Journal of the National Council for Higher Education*; 9(1), 4-14

Tambo, J. A. & Wunscher, T. (2017). Building farmers' capacity for innovation generation: Insights from rural Ghana. *Renewable Agricultural and Food Systems*. doi:10.1017/S1742170516000521

Toillier, A., Baudoin, A. & Chia, E. (2014). Assessing learning regimes leading to sustainable intensification at the farm level: A new perspective for management assistance for family farms. In Proceedings of the 11th European IFSA Symposium, Farming Systems Facing Global Challenges: Capacities and Strategies (pp. 385-395).

Tran, T. A, Nguyen, T.H. &Vo, T. T. (2019). Adaptation to flood and salinity environments in the Vietnamese Mekong Delta: Empirical analysis of farmer-led innovations. *Agricultural Water Management*, 216(C), 89-97. DOI: 10.1016/j.agwat.2019.01.020

UBoS - (2018). *Uganda Census of Agriculture: Crop area and production report*. Kampala, Uganda Bureau of Statistics

UIA (2019). *Elgon investment profile*. Kampala, Uganda Investment Authority

Valizadeh, N., Bijani, M., Hayati, H. & Fallah, N. (2019). Social cognitive conceptualization of Iranian farmers' water conservation behaviour. *Hydrogeology Journal*; 27, 1131-1142

Wayne, W. L. (2018). *Behaviour change models.* Retrieved from: https://www.bildeleekspert.dk/blog/2018/08/06/sotsiaalsete-normide-teooria/

White, T. D., & Sheath, G. W. (2011). Building rural capability through collaboration of Maori farm businesses. *In proceedings of the New Zealand Grassland Association* (pp.9-12)

World Bank (2012). *Agricultural innovation systems: An investment source book*. Washington DC. International Bank for Reconstruction and Development / International Development Association or The World Bank.