EVIDENCE-BASED INFORMATION PRACTICE FRAMEWORK FOR MAIZE POSTHARVEST HANDLING BY RURAL SMALLHOLDER FARMERS IN SELECTED DISTRICTS IN UGANDA

by

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Abstract

This study examined the influence of evidence-based information practice (EBIP) on the access to and use of evidence-based or scientific research information for improved maize postharvest handling practices by rural smallholder farmers in selected districts in Uganda. This study used a convergent parallel mixed methods approach, with data collected from 320 rural smallholder maize farmers, 22 extension workers, and four information officers. The researcher employed thematic data analysis for the qualitative data using ATLAS.ti version 24. The quantitative data were analysed using descriptive statistics (frequencies and percentages) with Pearson's chi-square tests used for relational inferences. SPSS version 29 was used for these analyses.

The findings revealed that EBIP largely influenced smallholder farmers' access to and use of evidence-based information, although this was not fully articulated and implemented. Rural smallholder farmers had intermittent access to and use of evidence-based information. The main barriers to the implementation of EBIP included inadequate funding, unawareness of sources of evidence-based information, limited knowledge and skills in information and communication technologies and lack of scientifically researched information that was translated and repackaged into simple formats for easy access and use by farmers. This study identified a significant relationship between access to evidence-based information and the quantity of maize preserved after harvest. The findings also highlighted the need for convenient and adequate sources of evidence-based information for maize postharvest handling, updated knowledge and skills for extension workers and information officers, and a harmonised approach to maize postharvest handling EBIP implementation.

This study proposed a model based on these findings to address the difficulties affecting the implementation of EBIP for effective maize postharvest handling decisions and practices among rural smallholder farmers in Uganda. This model can be adopted by stakeholders such as the Ministry of Agriculture, Animal Industry and Fisheries and the Department of Extension Services. Overall, the findings emphasised the importance of EBIP in improving maize postharvest handling practices and reducing postharvest loss among rural smallholder farmers in Uganda. Furthermore, this study highlighted how EBIP

can empower librarians in Uganda to collaborate with other stakeholders in translating evidence-based information stored in scientific databases to meet specific community information needs.

Keywords: Practice theory, Access and use of information, EBIP, Evidence-based library and information practice, Ranganathan laws of librarianship, Community libraries, Scientific researched agricultural information, Evidence-based practice, Knowledge translation and repackaging.

Declaration

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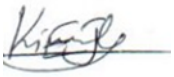
I declare that this thesis entitled, Evidence-based Information Practice Framework for Maize Postharvest Handling by Rural Smallholder Farmers in Selected Districts in Uganda, is my original research project and that all sources used or quoted have been adequately acknowledged and referenced. Furthermore, I declare that this work, or any part, has not been previously submitted for examination at the University of South Africa (UNISA) or any other higher education institution for another qualification.

I confirm that I have submitted this work to originality-checking software and that it meets the required standards for originality. I take full responsibility for the content and integrity of this research.



Signature

Submission date: 21 January 2025

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Dedication

I dedicate this work to Jesus Christ, who is my Lord and Saviour, for the wisdom and strength. I also want to dedicate it to my husband, John Mayende, and my children, Shadrach, Gloria and Daniel, for their support, love and encouragement always.

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List of abbreviations

AGORA: Access to Global Online Research on Agriculture

DOAB: Directory of Open Access Books

DOAJ: Directory of Open Access Journals

EBI: Evidence-based information

EBIP: Evidence-based information practices

EBP: Evidence-based practice

FAO: Food and Agricultural Organisation

HINARI: Health InterNetwork Access to Research Initiative

ICTs: Information communication technologies

IFAD: International Fund for Agricultural Development

NARO: National Agricultural Research Organisation

OARE: Online Access to Research in the Environment

PICO: Population, Intervention, Comparison, Outcome

PRISMA: Preferred Reporting Items for Systematic and Meta-Analysis

UBOS: Uganda Bureau of Statistics

UNISA: University of South Africa

WFP: World Food Programme

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CHAPTER 1

INTRODUCTION AND RESEARCH BACKGROUND

1.1 Background to this study

Access to scientifically researched information is important to support proper decision-making, practices, community growth and empowerment. The online availability of scientific research information through open-access initiatives and support from development partners has improved access to and use of scientific information to facilitate evidence-based practices and decision-making in developing countries (Baker & Musker 2017; George 2022; Kankam, Acheampong & Dei 2024). Initiatives such as Research4life promote access to and use of scientific research in various areas, including health, food and agriculture, environment and law, through knowledge programmes. These knowledge programmes include the Health Internetwork Access to Research Initiative (HINARI), Access to Global Online Research on Agriculture (AGORA) and Online Access to Research in the Environment (OARE) (Research4Life 2024). Furthermore, the Directory of Open Access Books (DOAB) and Directory of Open Access Journals (DOAJ) initiatives have contributed to improved access to evidence-based, high-quality information for researchers and communities to improve their livelihood practices (DOAB 2024 & DOAJ 2024). Despite these developments, the literature indicates that African rural communities lack access to scientific information. Many reasons have been cited for this lack, including cost, unreliable information communication technology (ICT) infrastructure, lack of awareness of sources of scientific information, lack of evidence-based information practice (EBIP) knowledge and skills and the way in which information is packaged (Baker & Musker 2017; Malapela 2017; George 2022; Pelicioni, Michell, Santos & Schulz 2023). Inadequate access to scientific research information about better postharvest technologies contributes to rural smallholder farmers' reliance on ineffective and unproductive tools, which leads to loss of their hard-earned food and income (Baker & Musker 2017; Sugri, Abubakari, Odjo & Ostermann 2024; Sugri, Owusu & Bidzakin 2021). In this context, this study examined the influence of EBIP on access to and use of evidence-based information (EBI) on maize postharvest handling by rural smallholder farmers in Uganda. The findings will contribute to improved smallholder farming practices and reduced loss.

EBIP is not a new concept in the field of library and information science. It originated in evidence-based practice (EBP) in health sciences and was exploited by librarians to repackage scientifically researched evidence for access at the point of healthcare to influence medical

decisions (Koufogiannakis 2013 & Marshall 2014). EBP seeks to bridge the gap between scientific communication and practice (Luo 2018). EBP has been used in information science to influence the repackaging and translating of evidence to enable access to relevant, credible, reliable and referable information for human practices (Luo 2018). It has also improved librarians' ability to advocate for library support and highlighted their contribution to parent organisations and society at large (Thorpe 2021).

In library and information science, EBP has become a key component at both personal and institutional levels for effective decision-making, and has progressively improved service and advocacy (Bell 2022 & Thorpe 2021). EBP has positioned librarians as highly valuable experts in repackaging, translating, searching and accessing evidence in health sciences and other disciplines (Bell 2022). EBIP refers to a systematic process of promoting gathering, packaging, translating and applying integrated researched evidence, while prioritising end-user needs and expert knowledge to ensure user satisfaction (Lloyd 2012; Reich & Hager 2014; Rovio-Johansson 2018; Steglitz, Warnick, Hoffman, Johnston & Spring 2015). Hodges and Stathers (2012) highlighted that access to appropriately packaged, relevant and credible EBI improved daily practices.

It is important to note that information generated in research needs to be accessible to influence practice. This is a long-standing 'law' of library and information science, as reflected in the concept 'books are for use' (Ranganathan, 1931). Research generates evidence to answer human questions and contribute to life improvement, and this information must be translated and repackaged to suit specific needs and improve human practices (Mbagwu, Lyaka, Kiwelu, Nyantakyi-Baah & Holmner 2020). The value and impact of EBI are clearly demonstrated in the actions and decisions of individuals who have accessed and used that evidence (Bell 2022).

EBP has been implemented in developed countries for over 20 years and is a recognised part of medicine (Ruchon & Grad 2018). It has been widely implemented in countries such as the 'USA, UK, Australia, Canada, Sweden, Denmark and Japan' (Marshall 2014:19), and is steadily gaining momentum in developing countries (Booth 2008 & Mbambo-Thata 2006). EBP is reported to be one of the best healthcare improvement techniques that helps the incorporation of scientific evidence in healthcare (Rehfuess, Durão, Kyamanywa, Meerpohl, Younge & Rohwere 2016). EBIP, which originated in EBP in health sciences, is now internationally recognised. There is an international peer-reviewed journal entitled, *Evidence-based Library and Information Practice*, published by the University of Alberta, along with a conference that has been supported since 2006 (Koufogiannakis 2013). EBP has also influenced practices in

other disciplines, including library and information science (Luo 2018), agriculture and education (Aynalem, Yazew & Gebrie 2021; Azami, Sharifi & Alvandpur 2020; Franzen & Bannon 2016; Haselow, Stormer & Pries 2016; Koufogiannakis 2013; Ochoa & Pinto 2020; Thorpe & Howlett 2020).

In Uganda, the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) is mandated by law to provide access to evidence-based maize postharvest handling information to rural smallholder farmers, with the aim of improving their practices, reducing food loss and improving household incomes (Balungi 2016; Uganda Bureau of Statistics 2020). Lack of access to and use of maize postharvest EBI by rural maize smallholder farmers contributes to poor postharvest handling practices, which results in food loss and reduced incomes (Agwaru, Matsiko & Delve 2004; Atube, Malinga, Nyeko, Okello, Alarakol & Okello 2021; Bisheko & Rejikumar 2023; Bushman, Lund, Wang, Garrett & Manyonga 2021; FAO & Nuwagaba 2019; Lowe & Sanyu 2017; Teferra 2022; Viola 2017).

Through the EBIP process, evidence is appraised, packaged and translated to facilitate better use. Furthermore, linkages between users, experts, information professionals and researchers are established to improve the available support. This means that the application of the concept of EBIP in maize postharvest handling may nurture a linkage between Ugandan agricultural extension service providers, information providers, smallholder farmers and researchers to provide farmers with access to relevant EBI. This will influence their maize postharvest handling practices, which has been reported in the literature as a challenge (Sobalaje 2020). A study focused on indigenous agricultural knowledge (Okello-Obura 2018) reported that despite scientific information being available to researchers in Uganda, such information was scarce among smallholder farmers and the majority of farmers only used indigenous knowledge. It has been demonstrated that communities that access sufficient credible information to support their daily practices show better human development results than those without such access (Garrido & Fellows 2017; Mwantimwa 2018; Opolot, Obaa, Isubikalu, Ebanyat & Okello 2016). The quest for credible, well-translated and packaged EBI that is relevant and referable to support better practices, problem-solving and decision-making by rural smallholder maize farmers in Uganda remains enormous. This issue cannot be ignored.

1.2 Uganda

This subsection provides the context of this study and offers a summary of Uganda, where the study was conducted. Uganda is administratively divided into four regions (Central, Eastern,

Northern and Western), as shown in the map below (Figure 1). This study was conducted across four districts, each representing a region. The selected districts (shaded in grey on the map) were Adjumani (Northern), Iganga (Eastern), Mubende (Central) and Kabarole (Western). These districts were selected for this study because a 2019 report indicated they were the major maize producers in their respective regions (Uganda Bureau of Statistics 2019).

Figure 1: Administrative map of Uganda

(Source: National Online Project 2023)

Uganda occupies an area of 241,551 km^2, of which 196,904.3 km^2 comprises land and 44,650.6 km^2 is water and swamps. Uganda's agricultural land was estimated to encompass 43.6% of the total available land mass in 2015 (Uganda Bureau of Statistics 2019). The World Bank Group (2024) report released on 27th June 2024, reported that Uganda, as a developing country, had a per capita income of $980 between August 2023 and May 2024 (Sebudde, Whyte, Chansa,

Ayiko, Lukwago & Ataanov 2024). Uganda is a predominantly agricultural country with many natural resources, including fertile soils, regular rainfall and deposits of minerals such as copper, gold and petroleum, which were recently discovered. Uganda has a total population of 40.3 million people, with a growth rate of 3.0% per annum (Uganda Bureau of Statistics 2019). In addition, Uganda has a variety of library and information providers that are named according to the end-users they serve: academic libraries, school libraries, community/public libraries, special libraries and national libraries (Bushman, Lund, Wang, Garrett & Manyonga 2021). Library and information providers can work alongside researchers and agricultural extension service providers to translate, repackage and monitor access to EBI for farmers, which reflects the core goal of information services.

1.3 Problem statement

Most maize smallholder farmers in Uganda lack access to EBI to support effective postharvest handling (Ariong, Okello, Otim & Paparu 2023). Importantly, the EBIP process provides a practical approach for information providers to integrate research into practice (Barends & Briner, 2014). Through the process of asking, acquiring, appraising, aggregating, applying and assessing the evidence (Janati, Hasanpoor, & Sadeghi-Bazargani 2018), EBIP influences the practical approach of packaging, translating and facilitating access to and use of relevant, credible, reliable and referable EBI to empower users for improved practice (Mwantimwa 2018; Rovio-Johansson 2018).

The literature has confirmed that maize smallholder farmers in Uganda and other developing countries lacked access to EBI for effective postharvest handling, meaning they have persistently adopted uninformed decisions and practices (Agwaru, Matsiko & Delve 2004; Ariong, Okello, Otim & Paparu 2023; FAO & Nuwagaba 2019; Lowe & Sanyu 2017; UBOS 2020). This has led to a loss of income estimated at over $4 billion annually (Balungi 2016 & Shee, Mayanja, Simba, Stathers, Bechoff & Bennett 2019). Efforts to link maize postharvest handling information in Uganda are implemented through the Department of Extension Services in the MAAIF. Despite the Ministry's efforts, the literature showed that access to and use of maize postharvest handling EBI was inadequate, and postharvest loss had not been reduced because moulds and termites destroyed maize and increased aflatoxin levels (Shee et al. 2019; Tibagonzeka et al. 2018). Ariong, Okello, Otim and Paparu (2023:18) reported that the information smallholder farmers received 'was not useful for post-harvest handling'. This supported an earlier study by Agwaru, Matsiko and Delve (2004) that reported similar findings.

If this problem is not investigated, smallholder farmers will continue to adopt uninformed decisions and practices, leading to significant postharvest losses and a continued loss of income. In addition, the persistence of moulds and termites will further degrade maize quality, and increase health risks associated with aflatoxin contamination. The overall agricultural productivity and economic stability of smallholder farmers will remain compromised. To address this issue, it is essential to enhance the dissemination and accessibility of EBI concerning postharvest handling. Smallholder maize farmers need well-packaged and translated research evidence that can be easily accessed and is helpful to improve postharvest handling practices, such as storage, drying, credit, training and value addition (Ariong et al. 2023; Atube et al. 2021). This can be achieved by the EBIP process, whereby information providers and extension workers can adopt a practical approach to incorporating EBI in farmers' maize postharvest handling practices (Marshall 2014). Information that is critically evaluated retrieved from scientific databases, assessed and translated according to user needs, disseminated for application, monitored and assessed can improve farmers' mindsets and influence better postharvest handling practices.

There is a dearth of literature on the influence of EBIP on access to and use of scientific information for maize postharvest handling in Uganda. In addition, no empirical study has explored the influence of EBIP on librarians' daily practices of translating and repackaging maize postharvest EBI for smallholder farmers or its contribution to access to and use of maize postharvest handling evidence by extension services providers and rural farmers in Uganda. Therefore, this study sought to address this gap by examining the influence of EBIP on access to and use of maize postharvest handling EBI by rural smallholder farmers in selected districts of Uganda. This study aimed to clarify the unique demands for access to and use of EBI to improve extension services and better support user practices in farming communities. Furthermore, this study recommended a practical model that can influence access to and use of EBI for improved mindsets and daily maize postharvest handling practices by rural smallholder farmers. In the long term, this will help reduce postharvest loss and improve Uganda's household incomes and food security.

1.4 Research purpose

This study examined the influence of EBIP on the access to and use of maize postharvest handling EBI by rural smallholder farmers in Uganda. The goal was to propose a useful model to address the difficulties in improving access to and use of EBI for maize postharvest handling practices by rural smallholder farmers in Uganda.

1.5 Research objectives

The study objectives were as follows.

1. Determine the status of maize postharvest handling EBIP by rural smallholder maize farmers in Uganda.
2. Identify the sources of access to and use of EBI on maize post-harvest handling by rural smallholder farmers and extension workers.
3. Establish the EBIP needs of rural smallholder farmers concerning maize postharvest handling.
4. Assess difficulties experienced by smallholder farmers and extension service librarians with the available EBIP related to maize postharvest handling.
5. Propose an EBIP model for maize postharvest handling for rural smallholder farmers in Uganda.

1.6 General research question

What was the influence of EBIP on access to and use of maize postharvest handling EBI by rural smallholder farmers in Uganda?

1.6.1 Specific research questions

Table 1 presents the research dashboard showing the specific research questions that unpacked the overarching research question, and the possible sources of information used to answer these specific questions.

Research dashboard

A research dashboard is a visual summary representing important aspects of a project to support consistency, monitoring and focus (Pauwels, Ambler, Clark, LaPointe, Reibstein, Skiera, Wierenga & Wiesel 2009; Sarikaya, Correll, Bartram, Tory & Fisher 2019). In this study, the researcher used a research dashboard to monitor the flow and ensure consistency of the study objectives, research questions, concepts to be measured in each question and data sources.

Table 1. Research dashboard

Research objective	Research question	Concepts	Data source	Target population
Determine the status of evidence-based information practices (EBIP) in relation to access to maize postharvest handling evidence-based information (EBI) by selected maize smallholder farmers in Uganda.	To what extent does EBIP influence access to and use of EBI for maize postharvest handling practice by selected smallholder farmers in Uganda?	Ask, acquire, appraise, aggregate, apply, assess, access, use, evidence, maize postharvest handling practice	Structured questionnaire, personal interviews, focus group discussions, document analysis	Smallholder farmers, information providers, extension officers
Identify the sources of access to and use of maize post-harvest handling EBI by rural smallholder farmers and extension workers.	How and where do smallholder farmers access maize post-harvest handling EBI?	Extension services sources, evidence, libraries databases, Internet, sources media, convenient, adequate	Structured questionnaire, observations, personal interviews, focus group discussions, document analysis	Smallholder farmers, information providers, extension workers
Establish the EBIP needs for rural smallholder farmers concerning maize postharvest handling.	What are the specific maize postharvest handling EBIP needs for rural smallholder farmers in Uganda?	EBIP, drying, storage credit, threshing, value, addition, training, library, access, needs	Structured questionnaire, personal interviews, focus group discussions, document analysis	Smallholder farmers
Assess the difficulties experienced by smallholder farmers and extension service providers with access to maize postharvest handling EBIP.	What are the difficulties smallholder farmers and extension service librarians experience with the available maize postharvest handling EBIP?	Inadequate, EBIP, drying, storage credit, value addition, training, convenient, adequate	Structured questionnaire, observations, document analysis	Smallholder farmers
Propose an EBIP framework for maize postharvest handling by rural smallholder farmers in Uganda.	What can be done to ensure implementation of EBIP within the extension services and contribute to	Ask, acquire, appraise, aggregate, apply,	Structured questionnaire, document	Smallholder farmers, information providers,

	access to maize postharvest handling EBI by selected rural smallholder farmers in Uganda? Why?	assess, access, use, maize postharvest handling, EBIP credit, value addition, training	analysis, personal interviews, focus group discussions	extension workers

1.7 Scope and delimitations

Delimitations are characteristics that define the study scope. They comprise self-restrictions that ensure the study is focused (Miles 2017). This study was conducted in four districts in Uganda (Iganga, Mubende, Kabarole and Adjumani) that are major maize farming areas (UBOS 2019). It focused on the influence of EBIP on access to and use of EBI for maize postharvest handling by smallholder farmers. This study was conducted from November 2023 to May 2024.

1.8 Justification for this study

The Longman Dictionary of Contemporary English (2003) defines justification as a good and acceptable reason for doing something. To justify the need for a study, the researcher should identify a clear gap, clarify how filling this gap will contribute to knowledge and show why the study is important (Rojon & Saunders 2012; Wald, Harland & Chandima 2024). The justification for this study was that this empirical research aimed to generate knowledge that advances library and information science practice in the areas of access to and use of EBI, EBIP and farming community information services.

There is a dearth of literature examining the influence of EBIP on the access to and use of scientific information in Uganda. In addition, there is a research gap concerning EBIP and maize postharvest handling practices among rural smallholder farmers in Uganda. The model proposed in this study filled this identified gap in the literature and sought to address the difficulties experienced by rural smallholder farmers, extension workers and information officers when accessing, disseminating and using EBI on maize postharvest handling.

This research also addressed the need for policymakers to consider access to and use of EBI as a measure to help reduce postharvest loss and increase food security and household incomes for rural smallholder farmers. Furthermore, this study highlighted the need for policymakers to consider information service providers and community libraries as among the stakeholders to be equipped, skilled and commissioned to disseminate maize postharvest handling EBI together with extension workers. The present researcher has observed the

persistent use of traditional methods for postharvest handling and the associated difficulties, despite research having been conducted to improve maize postharvest handling value chain practices.

The literature demonstrated there is inadequate access to scientific research evidence by rural smallholder farmers in Africa, including Uganda (Kato & Musoke 2021; Lwoga, Stilwell & Ngulube 2011; Muwereza 2024; Viola 2017). Furthermore, there is a gap between agriculture extension workers, researchers/experts, farmers and information officers that limits harmonised dissemination of EBI in rural farming communities, and little evidence is accessed by farmers. For example, maize tends to be sold cheaply immediately after harvest to avoid the loss associated with aflatoxins, moulds, weevils and other pests (Gohain 2017; Tibagonzeka, Akumu, Kiyimba, Atukwase, Wambete, Bbemba & Muyonga 2018). Postharvest loss has become a historical problem and has not significantly reduced in Uganda, which merits more research attention (Muwereza 2024; Tibagonzeka et al. 2018). The present researcher was also aware that although EBI on maize postharvest handling is available in AGORA and other collections, awareness about, access to and use of these collections by rural smallholder farmers, extension workers and information officers remains unknown. This research sought to address this gap in the literature.

The researcher was aware that as a developing country, Uganda has access to evidence-based agricultural information supported by developing partners such as the Food and Agriculture Organisation (FAO) through Research4life databases, specifically AGORA. This database brings together high-quality EBI on maize postharvest handling. AGORA and other collections (e.g. Google Scholar) archive EBI on maize postharvest handling and new scientific methods, but this knowledge is scanty among end-users (Mbagwu et al. 2020). Access to adequate and convenient EBI is known to empower communities to make the right decisions at the right time and may even reduce certain difficulties (Baker & Musker 2017). Although it is easy for urban populations to access and use scientific research information through the Internet, it may not be so for rural populations because of the lack of ICT infrastructure, knowledge and skills. However, rural smallholder farmers can access information when it is translated and repackaged in the form of videos, leaflets, webinars and talk shows presented in their localities (Baker & Musker 2017). The above reasons justify why this study was important in terms of establishing the influence of EBIP on access to and use of EBI to support improved maize postharvest handling decisions and practices for smallholder farmers.

1.9. Significance of this study

The University of South Africa (UNISA) (2020) noted that the significance of a study can be reflected in a statement that shows why the research problem is important and how it will provide the solution to human conditions and create impact. This study directly addressed the second Sustainable Development Goal (SDG) of zero hunger by examining maize (food) loss alleviation using access to and use of scientific information. This study was also significant to SDG 10 as it investigated reducing inequality in access to information by rural smallholder farmers, who may be left out of technology such as the Internet that eases access to information and is available to urban populations. This study also contributed recommendations based on the findings to clarify and address the EBIP needs of smallholder farmers, agriculture extension workers and librarians.

This study also offered a good ground for testing the evidence-based library and information practice framework for maize postharvest handling practices for rural smallholder farmers, who are not always considered as regular library users. Furthermore, this study investigated postharvest maize loss, which is an important concept as maize is a commonly used food for almost all populations in Uganda and most African countries. When implemented, EBIP empowers farmers and influences mindset changes to support improved decision-making and postharvest handling practices. The model proposed in this study provides a practical approach to alleviating observed difficulties that acted as barriers to the access to and use of EBI for effective maize postharvest handling by rural smallholder farmers in Uganda. It also provides a novel and practical way of implementing EBIP by extension service librarians that can link various stakeholders for effective service provision. The study findings highlighted a practical method for translating and repackaging maize postharvest handling EBI to improve access for rural smallholder farmers in Uganda. It also shed light on how EBIP can empower librarians in Uganda to collaborate in translating information stored in scientific databases to meet specific community information needs.

1.10 Originality of this Study

Generating new knowledge is central to empirical research and can be achieved in various ways (Gillespie 2014; Shibayama & Wang 2020). Originality varies by discipline, university, country and region (Edwards 2014 & Gillespie 2014). Therefore, there are various ways in which originality is commonly measured at the PhD level, including a) the first time the study is carried out; b) testing a theory or idea; c) multidisciplinary and uncommon methodology; d) applying a practice that has proven effective in another country or discipline; and e) studying an area in a

discipline that had been ignored for some time. Edwards (2014) noted that originality is understood and described when the study is completed. This study was original and adopted an uncommonly used design with multilevel population relationships. Furthermore, the findings are needed in this subject field.

No previous study examined the influence of EBIP on access to and use of maize post-harvesting handling information by rural smallholder farmers in the selected districts in Uganda. Furthermore, the researcher could not find any systematic study that examined either the use of research/EBI for maize postharvest handling or EBIP among agricultural extension workers in Uganda or elsewhere. Some empirical studies generally explored agricultural information for rural smallholder farmers in Uganda, ICTs and agricultural information needs in developing countries, and access to and use of agriculture information by rural farmers (Achola 2020; Agwaru, Matsiko & Delve 2004; Ariong, Okello, Otim & Paparu 2023; FAO & Nuwagaba 2019; Lowe & Sanyu 2017; UBOS 2020). However, none had specifically addressed maize postharvest handle evidence-based information. This study provides an avenue for incorporating EBIP in extension services and improving access to EBI for maize postharvest handling by rural smallholder farmers in Uganda and beyond. The EBIP process contributed to a practical approach to providing access to research evidence for rural maize farming communities. Ultimately, this will empower farmers to adopt better practices as a way of improving food security and reducing food loss, thereby supporting sustainable development.

The present researcher tested the existing EBP theory and technique in a unique way, as EBP theory tends to be more applicable in health sciences and has rarely been used in other fields (e.g. access to and use of EBI in maize postharvest handling). Furthermore, few researchers in the information science discipline have examined EBIP. There is also a paucity of information on this concept in Uganda and other developing countries, despite it being useful in ensuring the provision of relevant and credible information in the age of information explosion.

Therefore, this study contributed to new EBIP research frontiers for librarians in Uganda and developing countries (Booth 2008) and adds to the literature in this area. This study may also create awareness among policy- and decision-makers about the need to include librarians and other information service providers as stakeholders for best practices in information searching, retrieval and translation for relevant and referable EBI to support maize postharvest value chain extension services for rural smallholder farmers in Uganda and beyond. The adoption of a convergent parallel mixed method design and the multidisciplinary nature of this study positions this research among the few such studies conducted in library and information science. Hayman

and Smith (2020) and Granikov, Hong, Crist and Pluye (2020) concluded that use of mixed methods research is growing in library and information science.

1.11 Assumptions of this study

Below are the key assumptions underlying this study.

a) The responses provided to the research questions were made honestly.

b) Smallholder maize farmers needed EBI for effective postharvest handling; therefore, they offered the right research responses.

c) Extension services needed a relevant model to incorporate EBIP and enhance smallholder farmers' access to maize postharvest handling knowledge.

d) Extension services needed a framework to collaborate with extension service librarians to provide EBI to smallholder farmers.

e) Maize postharvest EBI for smallholder farmers was available in various collections.

f) The research methodology, including the pluralism assumption, chosen for this study was suitable for this study.

g) The theories and concepts chosen for this study were relevant in informing this study.

h) The conceptual framework, study objectives and purpose of the study defined the scope of this study.

1.12 Limitations

The following aspects were identified as threats to this study. The researcher used appropriate strategies to ensure this study was successful, as specified below.

1. There were extraneous variables that kept emerging in the field, such as harvesting and ploughing, but this study focused on postharvest handling. Therefore, the study boundaries, as defined by the conceptual framework, objectives and research questions, helped to balance variables.
2. During data collection, respondents who appeared to be insincere were asked to be sincere. Interviews, observations and focus group discussions were used to validate the questionnaire responses.
3. Language and literacy levels were anticipated to be a challenge. Therefore, the questionnaire was translated into four local languages that are commonly used in the four selected districts. In addition, five research assistants fluent in these local languages were employed to offer aid, as deemed necessary.

4. Time, distance and finances were challenges. However, the researcher used both physical movements and online means to reduce costs.

1.13 Conceptual framework

The perception of a conceptual framework varies considerably in the literature. However, a conceptual framework is commonly understood to be a researcher's presentation of relevant concepts or variables chosen to direct the entire study (Ngulube 2020; Grant & Osanloo 2014; Kivunja 2018). This framework can be diagrammatically presented or outlined and narratively explained to show the connections between concepts. The concepts may be drawn from various theories, disciplines, philosophies, frameworks, policies, legislation and experiences (Kivunja 2018). The present researcher developed a conceptual framework that incorporated various concepts that were deemed relevant to answer the main research question for this study. These concepts are briefly explained below and discussed in detail in Chapter Two.

1.13.1 Practice theory

A practical approach drawn from Schatzki practice theory, as described by (Lloyd, 2010), was adopted for this study. This theory suggests that for EBIP to influence maize postharvest handling, several practices are required. This study used the four concepts of practice theory: actions, sayings, goals and social values context.

1.13.2 EBP theory

Major components of EBP are the evidence, professional expertise, users' needs (i.e. the problems) and EBIP. This study incorporated these four components. Furthermore, there are six components associated with the EBIP process: ask, acquire, appraise, aggregate, apply and assess (Hasanpoor, Bahadori, Yaghoubi, Haghgoshayie & Mahboub-Ahari 2020; Koufogiannakis 2013; Smith & Rennie 2014; UNC Health Science Library 2024).

1.13.3 Maize postharvest handling value chain for rural smallholder farmers in Uganda

This study used maize postharvest handling value chain practices as one variable. Specifically, it examined smallholder farmers' access to and use of information on the major postharvest practices of drying, storage, value addition, financial support and continuous training (Shee et al 2019).

1.13.4 Information access and use

The variables pertaining to information access and use employed in this study were derived from the laws of library science (Ranganathan 1931), which indicate that scientific information

generated cannot affect decisions and practices or achieve the aim of its generation unless it is accessed and used.

1.14 Discussion of key concepts

The key concepts employed in this study were identified from the literature and considered suitable for understanding the study phenomenon. Based on these concepts, frameworks and models were selected that were relevant to the objectives and purpose of this study.

1.14.1 Evidence

Evidence refers to scientifically researched information and technology that is documented, implemented and proven (through practice) to influence decisions and solve societal problems (Parmar 2018). In this study, evidence was defined as well-documented research information that had been scientifically proven to be useful and could contribute to effective maize postharvest handling in Uganda.

1.14.2 EBP

EBP refers to the process of integrating the best available evidence into expert knowledge while considering the specific needs of individuals. Better results can be realised if EBP is performed adequately and conveniently (Alatawi 2020). EBIP has its origin in the use of EBP in medicine (Eldredge 2016). The literature shows that for over 20 years, health science librarians have exploited EBP to facilitate access to relevant evidence for healthcare practices (Koufogiannakis 2013). These librarians provide training, search for evidence, help in formulating questions for systematic reviews and package the evidence for use, thereby contributing to the availability of knowledge in health practices (Eldredge 2016; Janati et al 2018). EBP has also influenced the movement of research to practice in other disciplines, such as library and information science (Luo 2018), agriculture and education (Aynalem, Yazew & Gebrie 2021; Azami, Sharifi & Alvandpur 2020; Franzen & Bannon 2016; Haselow, Stormer & Pries 2016; Koufogiannakis 2013; Thorpe & Howlett 2020; Ochoa & Pinto 2020). Research seeks to generate evidence to answer human quests and improve life (Mbagwu, Lyaka, Kiwelu, Nyantakyi-Baah & Holmner 2020). However, Mbagwu et al. (2020) emphasised that to create an impact on human life, research must be appropriately packaged and made available to end-users.

1.14.3 EBIP

EBIP is the practical approach of packaging and translating research into daily information practice work (Luo 2018 & Janati et al 2018). This process is encapsulated in the ‘6As’: *asking* end-users for specific evidence, *acquiring* and *appraising* that evidence, *aggregating* the

evidence, *applying* it and then *assessing* the evidence through monitoring and evaluating its use to influence human practice. EBIP contributes to access to EBI for end-users in health sciences, improves library and information science practice and creates an impact in other sectors. In Uganda, limited access to information means smallholder farmers are not empowered to make informed decisions on maize postharvest handling practices, which leads to losses in terms of the quantity and quality of maize (Atube et al 2021; FAO, WFP & IFAD 2019).

Ask

'Ask' is the practice of seeking to address relevant scientific information needs for specific end-users while following an approved systematic review protocol that sets boundaries and eliminates irrelevant evidence. This is known as the Participants, Intervention, Comparator and Outcomes (PICO) model (Komba & Lwoga 2020; Koufogiannakis 2013). In relation to EBIP in this study, the end-users are the rural smallholder farmers who should be asked for their specific EBI needs. These needs may include farm inputs; credit; drying, value addition and storage of their farm crops; and continuous relevant training (Anderson, Learch & Gardner 2016). The framework proposed in this study suggests policy- and decision-makers should include professional librarians to support the EBIP process and ensure rural smallholder farmers' specific maize postharvest EBI needs are clearly asked and documented. The framework also includes the need for collaboration between smallholder farmers, librarians and agricultural extension workers when asking for users' needs.

Acquire

'Acquire' is the practice of searching for credible, relevant and available evidence about the question under focus (Koufogiannakis 2013). Once rural smallholder farmers' specific maize postharvest handling EBI needs are identified, the acquisition process can begin. The framework proposed in this study includes the possible sources of relevant and quality evidence-based maize postharvest handling information for rural smallholder farmers in Uganda.

Appraise

'Appraise' is the practice of selecting the most relevant, trustworthy and useful evidence (Tod, Booth & Smith 2022) to answer the question under focus. Once the specific maize postharvest handling EBI needs are identified and information is acquired, the process of appraisal begins. The framework proposed in this study includes the component of critical appraisal for relevant and quality evidence-based maize postharvest handling information for rural smallholder farmers in Uganda.

Aggregate

'Aggregate' refers to the practice of gathering and making available the appraised evidence from various sources and packaging it to suit the identified needs and end-users (Dalrymple 2010). This study noted that the appraised maize postharvest EBI needs to be translated and packaged according to rural farmers' needs and then disseminated to them.

Apply

'Applying research findings to practice is the foundation of evidence-based practice' (Dalrymple 2010:43). This is the process of putting into use or actioning the appraised evidence to solve the specific problem identified. Agricultural extension workers and librarians provide access to EBI as needed by rural smallholder farmers, and then monitor their practice to confirm that the identified evidence is applied or put into practice to improve maize postharvest handling practices.

Assess

'Assess' is the process of evaluating the performance or impact (Thorpe 2021) and monitoring the status of the specific problem to which the evidence was applied to measure the effectiveness and identify areas of improvement. After rural smallholder farmers have applied EBI to their practices, monitoring and evaluating the practice is used to ensure improvement. This process is performed by rural smallholders, librarians and agricultural extension workers. Areas of improvement and further EBI needs can be identified during this time and the process of EBIP will be improved accordingly.

1.14.4 Maize postharvest handling value chain

Maize postharvest handling refers to the practice of ensuring that the quality and quantity of maize are maintained after harvesting and subsequent processes, such as threshing, drying, transport, storage and value addition, to the time it is consumed by end-users (Shee et al. 2019). Maize loss is always registered post-harvest if the process is not well handled. EBI is therefore needed to ensure the right decisions and practices are adopted by smallholder farmers to avoid or minimise loss. The maize postharvest loss in Uganda from 2008 to 2016 was estimated at 320,000–465,000 tonnes in quantity and 50% in quality because of the aflatoxin levels (Shee, Mayanja, Simba, Stathers, Bechoff & Bennett 2019).

Maize is an important food crop for most Sub-Saharan African countries (Akumu et al. 2020; Manandhar, Malindi & Shah 2018; Mutambuki et al. 2019) and is the priority food crop grown by

55% of households in Uganda (Uganda Bureau of Statistics 2019 & 2020). Maize was introduced to Uganda in the 18th century and became the most used food crop in schools, prisons and families. Rural smallholder farmers grow maize for food and income (Mwebaze & Mugisha 2011). This means smallholder maize farmers in Uganda have specific postharvest handling EBI needs in areas such as harvesting, threshing, drying, storage, transport, marketing and value addition. For this study and given the time constraints, the researcher considered five concepts in the maize postharvest value chain as defined and discussed below.

Drying

Maize drying is the practice of conditioning maize for safe storage (Shee et al. 2019). For maize to retain its nutritional value, quality and quantity before consumption, all moisture must be safely removed. The process of removing moisture is known as drying. There are various safe maize drying techniques and technologies that are available in the market. These include thin layer drying in the sun on a crib and mechanised technologies, such as continuous flow dryers. This study investigated drying to clarify how smallholder farmers dried their maize and how the extension libraries supported these farmers with EBI to improve their practices. Smallholder farmers need to easily access maize drying information to reduce the postharvest handling loss resulting from poor methods of drying maize. Agricultural extension librarians are mandated to harness the EBI available about maize drying in agricultural databases (e.g. AGORA), translate this information, make it available to smallholder maize farmers and monitor its use in terms of empowering farmers to improve their maize drying practices.

Storage

Storage is the practice of preserving maize in a safe place before use (Shee et al. 2019). Access to EBI on maize storage will help smallholder farmers understand the best ways to store their maize to maintain its quality and quantity. Maize storage requires facilities that keep the maize in its dried state and desired condition without interference from atmospheric/weather conditions, and free from attack by insects and animals (e.g. weevils and rodents). Smallholder farmers should, therefore, store maize in clean, dry and safe storage facilities. However, because of a lack of EBI and other difficulties, farmers experience loss of maize through poor storage facilities. Maize can be stored in traditional granaries, hermetic bags and other advanced storage facilities. Through access to evidence-based storage information, farmers' mindsets can be changed to empower them to practice better maize storage that maintains maize quality and quantity. Storage was considered a relevant practice to investigate in this study because it is a specific EBI need for smallholder farmers.

Value addition

Value addition is the practice of improving the maize in terms of quality, quantity and products. Agricultural extension librarians must translate evidence-based value-addition information and make it accessible to farmers so that they can add value to their maize and increase their income. Smallholder farmers often harvest maize when it is half ready for roasting and eating on the cob. They also sell their maize cheaply without any value addition; buyers then add value and sell at a higher price, but farmers do not benefit (FAO 2019; Kato & Musoke 2021).

High-quality maize, especially in large quantities, fetches more money in the market than poorly dried and stored maize in small quantities. Maize that is processed into flour, cornflakes, and other products is also more expensive than maize sold fresh as cobs or dry but unprocessed. Smallholder farmers are unaware of the best ways to add value to their maize so it returns more income. Although maize postharvest handling research has generated information in these areas, it does not trickle down to farmers sufficiently. Therefore, this study investigated how smallholder farmers accessed EBI concerning value addition.

Financial support

Financial support is the practice of ensuring smallholder farmers have access to a source of finances to support postharvest handling. Financial support can also enable access to EBI. Urban dwellers and the corporate world can easily access loans and improve their household lives; however, rural communities, of which over 70% are smallholder farmers in Uganda and most African countries, are often unaware of and cannot access credit to support their farming activities. Mbagwu and Benson (2018) emphasised the need for EBI concerning credit for rural smallholder farmers. Access to credit facilities from financial institutions will enhance maize postharvest practices, such as acquiring better drying and storage facilities. This study investigated types of credit to support maize postharvest practices and how smallholder maize farmers accessed credit-related EBI.

Continuous training

This encompasses the practical process of transferring postharvest knowledge and skills to farmers, including field visits aimed to improve practice and problem-solving (Stewart, Langer, Rebelo, Silva & Muchiri 2016). Continuous training is a process whereby farmers and extension workers are consistently updated with EBI for effective postharvest handling. Agricultural extension services in Africa are mostly reported to be ad hoc and donor/project activities. This means that farmer training ceases when the project is no longer funded. Therefore, the concept

of continuous training should be embraced by agricultural extension librarians to ensure that EBIP is not an ad hoc activity, but rather a permanent activity that can influence smallholder maize farmers' mindsets for effective maize postharvest handling.

1.14.5 Rural smallholder farmers

Rural smallholder farmers are families that live in villages, own less than 5 hectares of land and depend on household labour for agriculture; this constitutes 85% of all farmers (Atube et al 2021). Rural smallholder farmers are part of rural communities in Uganda that engage in farming for daily survival using traditional means. They often experience postharvest difficulties, are without a clear source of information, and have low levels of education, income and technological infrastructure (Baker & Musker 2017; George 2022; Kankam, Acheampong & Dei 2024). These rural smallholder farmers can be generally categorised as community library users. They need evidence-based technological information to supplement indigenous and rudimentary commonly known methods (Atube et al. 2021; Kato & Musoke 2021; Tibagonzeka et al. 2018).

The Uganda Bureau of Statistics (UBOS) (2019:79) reported that in 2018, Uganda's rural smallholders produced 2,773,000 tonnes of maize and registered a loss of over 23.8% (Shee et al. 2019). The key function of the Department of Extension and Skills Management in the Uganda MAAIF is to 'support the provision of advice and information services to farmers' (Uganda Ministry of Agriculture 2016: 46). To reduce postharvest handling difficulties, the framework proposed in this study includes library and information providers among the important stakeholders in the maize postharvest value chain to support extension services to rural smallholder farmers in Uganda and beyond (Hodges & Stathers 2012).

1.14.6 Access

Access refers to 'the ability to identify, retrieve, and use information effectively for social, political, and economic advancement' (The World Online Encyclopedia 2019:1). Information access is an old concept in the field of library and information science. It existed before the times of Professor Ranganathan, who stated that 'a book is for use and a user is his own book' (George 2022 & Ranganathan 1931). This means that for someone to use a book, the book must be available, and the user must be able to access that book. This concept was relevant to this study in the sense that EBI should be made available and easily accessible to support prompt use and eventually influence smallholder farmers' practices.

1.14.7 Practices

Practices are groups of actions that are performed by a knowledgeable individual or group of people within the stated guidelines to produce desired results (Rovio-Johansson 2018). Practices are activities performed in a social context and certain environment (Lloyd 2010, Kemmis et al. 2017; Kemmis 2022 & Mahon et al. 2017). This study examined maize postharvest handling practices for smallholder farmers in the rural setting, including maize drying, storage, credit access, value addition and continuous training. It also investigated information practices, such as access, use and EBIP. Furthermore, with input from agricultural extension workers and information officers, this study examined practices such as the EBIP, information access, and packaging, translation and dissemination of information.

Effectiveness is the process whereby an intervention achieves the desired results (Brzozowski & Keydar 2017). This study investigated EBIP as an intervention to achieve a link between researchers, agricultural extension workers, library and information providers and rural smallholder farmers to support improved access to maize postharvest handling EBI.

1.15 Methodology overview

This study was grounded in the pragmatic paradigm, which prioritises understanding the research problem and question from multiple angles (Creswell & Clark 2018; Mavodza 2020). Pragmatism embraces diversity in the research approach and encourages exploration from various global perspectives without bias towards any single method. It allows the combination of qualitative and quantitative elements, which provides flexibility to ensure balanced research and knowledge generation (Morgan 2014). The study adopted a mixed methods approach that integrated both qualitative and quantitative techniques. (Granikov, Hong, Crist & Pluye 2020; Leavy 2017; Morse & Linda 2016; Ngulube 2022; Saunders, Lewis & Thornhill 2019). Specifically, this study employed a convergent mixed-methods design. Data were collected from multiple sources (extension officers, information officers and smallholder farmers) with a total sample size of 448 respondents/participants. The quantitative and qualitative data were collected simultaneously. The quantitative and qualitative data were analysed separately, interpreted together and then compared for similarities and differences, as recommended by Dawadi, Shrestha and Giri (2021) and Morse and Linda (2016). Details of the methodology are presented in Chapter 4.

1.16 Outline of dissertation chapters

This section outlines the structure of this dissertation, which is organized into seven chapters. It also highlights the topics discussed in each chapter.

Chapter 1: Introduction and background of the study

This chapter introduced this study and provided background information. It presented the research problem, study rationale, objectives, questions, justification and originality statement, along with a definition of key terms, the theoretical and conceptual framework, and a brief outline of the methodology. It concluded with a chapter outline and summary.

Chapter 2: Conceptual framework of this study

Chapter 2 discusses the conceptual framework that guided the data collection for this study. The conceptual framework represented various concepts chosen from practice theory, the evidence-based library and information practice model, the Ranganathan laws of librarianship and the maize postharvest handling value chain model/framework. This model may become a cornerstone for the EBIP framework for maize postharvest handling by smallholder farmers in Uganda. The chapter also discusses Schatzki practice theory ontology as described by Lloyd (2010). It highlights the 6As of the EBIP process: asking, acquiring, appraising, aggregating, applying and assessing (Eldredge 2016 & 2012). The concepts from the maize post-harvest handling value chain framework in Uganda (drying, storage, value addition, credit and continuous training) are also discussed, which were important for this empirical study.

Chapter 3: Literature review

Chapter 3 discusses relevant studies that were reviewed in relation to the research topic. It provides a review introduction, body and conclusion. The review introduction covers the significance of the review, approach, general research question for the literature search, inclusion and exclusion criteria, the analysis and presentation of the findings and a summary of what was found in the review. The body of the review covers the discussion of the findings from the included literature, which are presented thematically using keywords that were derived inductively and deductively based on the nature and objectives of this study. These keywords included: EBIP, rural smallholder farmers, maize postharvest handling EBI needs, rural smallholder farmers and extension workers as sources of maize-postharvest handling EBI and

difficulties smallholder farmers experienced when accessing and using maize-postharvest handling EBI. The review conclusion provided a summary of the findings, identified knowledge gaps for the present research and highlighted areas for further research.

Chapter 4: Research methodology

Chapter 4 presents the methodology employed to conduct this study and draw conclusions and recommendations from the findings. This includes the research paradigm, approach, study design, population of the study, sampling methods, sample size, data collection instruments, data analysis, validity and the limitations of this study.

Chapter 5: Presentation of the Study Findings or Results

Chapter 5 presents the findings or results that were derived from the quantitative and qualitative data. These are presented in relation to the research objectives and questions.

Chapter 6: Interpretation and Discussion of the Findings

Chapter 6 interprets and discusses the research findings or results in the context of the objectives of this study and extant literature.

Chapter 7: Summary, Conclusions and Recommendations

Chapter 7 provides a summary of this study and presents the conclusions and recommendations drawn from the findings or results.

1.17 Chapter Summary

This chapter introduced this study and provided background information about EBIP for maize postharvest handling by smallholder farmers. The chapter also defined the important concepts that underpinned this study and provided information on the historical setting of Uganda and study context. Smallholder maize farmers' access to EBI for effective postharvest handling served as the core problem. Therefore, this study investigated the influence of EBIP on the access to and use of maize postharvest handling information by rural smallholder maize farmers in Uganda. Based on the findings, this study also developed a model for addressing the challenges faced by rural smallholder farmers, extension workers and information officers in implementing access to and use of EBI. Furthermore, the chapter highlighted how librarians in Uganda can collaborate in translating information stored in scientific databases to meet specific community information needs. In addition, the chapter described the research purpose and aim, objectives and research questions that guided the data collection and interpretation of the

findings. It is important that any study is justified and original to provide new knowledge; therefore, this chapter provided the justification for and clarified the originality of this study. The chapter also discussed the study delimitations, which were important to set boundaries around what was investigated. Finally, the chapter gave an overview of the methodology and concluded with a chapter outline and summary.

CHAPTER 2

CONCEPTUAL FRAMEWORK OF THIS STUDY

2.1 Introduction

This chapter discusses the conceptual framework used to guide this study. A conceptual framework can be formulated from theories, models, personal experiences and the study context (Ngulube 2020; Van der Waldt 2020). This study drew on four concepts from the theory of practice (i.e. sayings, actions, goals and social context), the six components of the EBIP process (6As: ask, acquire, appraise, aggregate, apply and assess), the maize post-harvest handling value chain in Uganda, and access to and use of EBI to form the conceptual framework. Furthermore, this chapter discusses the legislation and policies that guide access to information in Uganda, which sets the context for this study. Table 2 presents a summary of the concepts used in this study and the corresponding theories, models and policies.

Table 2. Concepts and their origins

No.	Major concepts	Theory/model/policy	Components used in this study
1	Practice, information practice	Schatzki Practice theoryas described by Lloyd (2010), Kemmis et al. (2017), Kemmis (2022) and Mahon et al. (2017)	Sayings, actions, goals and relationships or social context
2	Evidence-based information practice	Evidence-based library and information practice model (Koufogiannakis 2013; Hasanpoor et al 2020; UNC Health Science Library 2024)	Ask, acquire, appraise, aggregate, apply, assess
		Evidence-based practice (Eldredge 2016)	Evidence hierarchy and components (evidence, expert knowledge, individual preference, practices
		Evidence-based medicine (Smith & Rennie 2014; Law & MacDermid 2024)	Origin

3	Access to and use of evidence	Uganda Information Access Act 2003 (Uganda 2003)	Rights of information access to all Ugandans
		Uganda Constitution, Rep. of Uganda, 1995	Rights of information access to all Ugandans
		Ranganathan laws of library and information science (Ranganathan 1931; Anderson et al. 2019)	Access, use of evidence
4	Maize postharvest handling	Rural smallholder farmers' maize postharvest value chain in Uganda framework (Shee et al. 2019:1104)	Drying, storage, value addition and marketing
5	Agricultural extension information services	Uganda Agricultural Extension Information Services Policy 2016	Extension information services

2.2 Conceptual framework

Scholars' perceptions of a conceptual framework vary considerably, but it is commonly understood that a conceptual framework reflects a researcher's presentation of relevant concepts chosen to direct the entire study (Elliotti 2022; Grant & Osanloo 2014; Kivunja 2018; Ngulube 2020; Ngulube & Mosha 2023). This framework can be diagrammatically presented, outlined and narratively explained to show the connections between concepts (Elliotti 2022). The concepts can be drawn from various theories, disciplines, philosophies, frameworks, policies, legislation and experiences (Elliotti 2022; Kivunja 2018). The present researcher chose to use a conceptual framework because of the nature of this study, whereby no single theory would be able to support all of the variables examined. The conceptual framework diagram (Figure 2) shows the relationship between the independent, intervening and dependent variables.

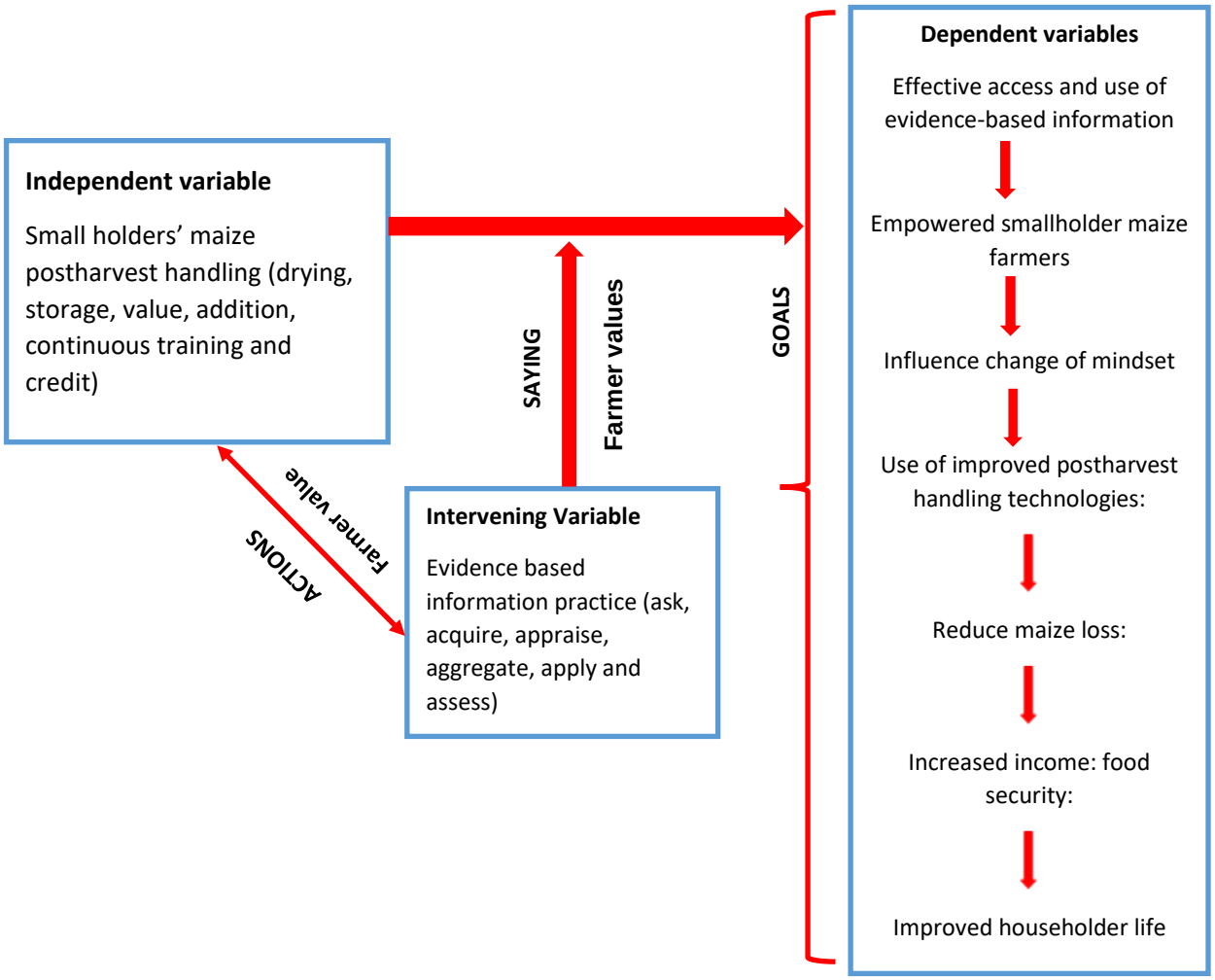

Figure 2: Sketch of the conceptual framework adopted for this study

(Source: Researcher developed 2024)

Figure 2 illustrates how the intervening variables, which were the EBIP components, influenced (action) the independent variable, which was the maize postharvest handling value chain practices. This led to the dependent variable (goal), which was access to and use of scientific information (saying) that empowered farmers with a changed mindset, improved postharvest handling technologies, reduced maize loss, increased income and increased food security in the social context (farmer values). The conceptual framework reflects causal relationships in the sense that it can explain the cause-and-effect relationships between independent and dependent variables (De Carlo, 2018). The dependent variable was the effect of the independent variable (cause) as it related to the intervening variable (the influence). For example, smallholder farmers' maize postharvest handling value chain practices (as a cause) resulted in reduced loss (as an effect) if there was an action of access to and use of EBIP for mindset change and better storage facilities that protected maize from weevils. The four

concepts of the theory of practice surrounded all variables (independent, intervening and dependent), meaning that practices were emphasised in all variables. The maize postharvest handling EBI (the ‘saying’ according to practice theory), prompts an action (mindset) to use improved technology (goal) to achieve better maize postharvest handling after accessing and using technological and scientific information about maize postharvest handling practices.

2.3 The theory of practice

Lloyd (2010) underscored various practices involved in information work. In this study, these practices included access, use, EBIP activities (e.g. ask, acquire, appraise, aggregate, apply, assess) and postharvest handling activities (e.g. dry, store, thresh, winnow, mill). Lloyd (2012) explained that practice was a visible action or group of actions that were performed by an individual or group within the stated guidelines and social relationships to produce the desired results. These actions are directly linked to the individual’s or group’s knowledge and understanding of the tasks to be implemented and the goals to be achieved. The origin of the word ‘practice’ can be traced to social work philosophers such as Ludwig Wittgenstein, Martin Heidegger, Pierre Bourdieu, Theodore Schatzki, Anthony Giddens, Harold Garfinkel, Bruno Latour, Judith Butler and Michel Foucault (Reckwitz 2007). The theory of practice was first mentioned in the ethnographic work of a French sociologist, Pierre Bourdieu, in the 1970s (Bourdieu 1977; Grenfell 2008; Reckwitz 2007; Schartzki 2002). Bourdieu highlighted habitus (individuals, groups or institutions) in a social agent as an active participant in the social context depending on the human knowledge acquired through upbringing or education experiences. Individuals’ present and future actions are therefore determined by personal knowledge within a prescribed objective or internal structure (Grenfell 2008). Furthermore, Kemmis (2022) suggested that transformation occurs when actions are taken in relation to the education or knowledge acquired in the interrogation of current or previous practices that need to be transformed.

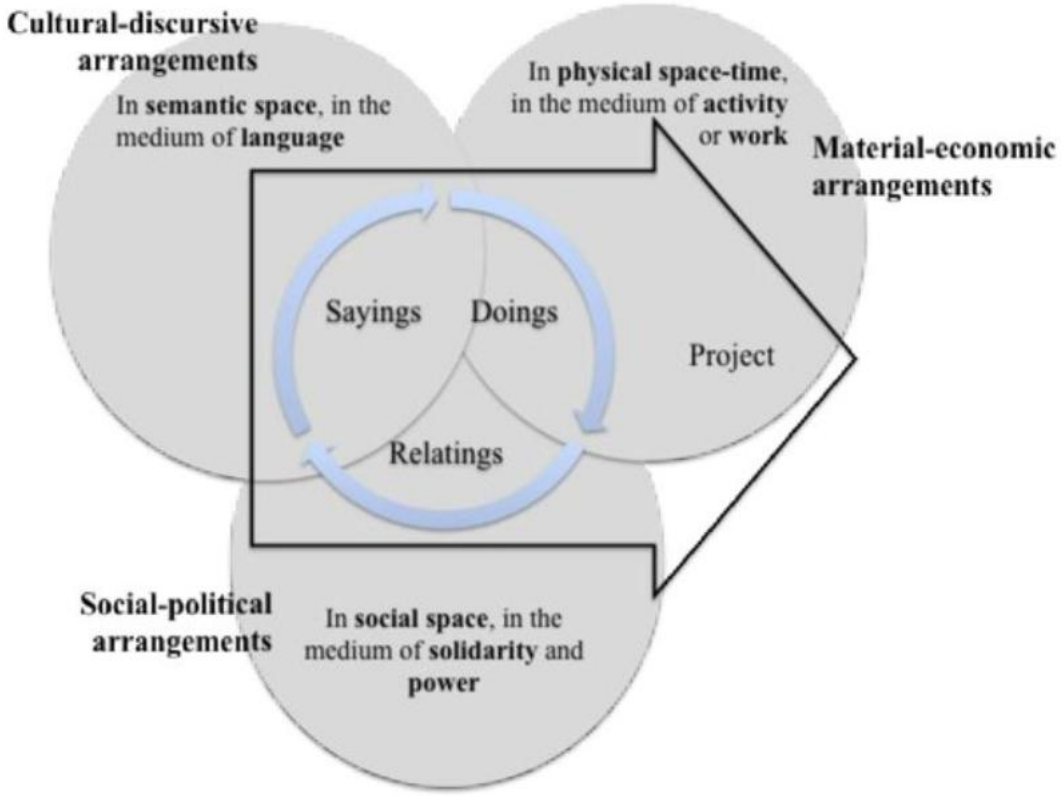

Figure 3: The theory of practice: sayings, doings and relationships

(Source: Kemmis, Wilkinson et al. 2014:34, as fronted by Mahon, Kemmis, Francisco and Lloyd, 2017)

Figure 3 shows how the four concepts of practice work together and are influenced by economic abilities and culture. In the context of this study, practices were applied in the social context of rural smallholder farmers, information officers and extension officers. These three groups: had different values; had different social-political, cultural and economic environments; were adults who learned by practices and experiences; and had preferences and expertise that should be considered when applying EBIP. Maize postharvest handling EBI is the knowledge or saying prescribed in this theory.

Over time, the theory of practice contributed to several scientific studies in various social sciences disciplines, including sociology, education, culture, technology, and library and information science (Pilerot, Hammafelt & Moring 2016). In the context of library and information science, the theory of practice has been applied in studies examining information practice and behaviour (Savolainen 2007), information seeking (Talja & McKenzie 2007), information literacy (Lloyd 2010; Schreiber 2014), and library collection, use and management (Huizing & Cavanagh 2011). This study adopted the four concepts of the theory of practice as described by Schartzki

(2002), namely, the sayings (ideas), actions (doings) and tasks (goals) in the social context (values) of the studied group (e.g. rural smallholder farmers) (Loscher, Splitter & Seidi 2019; Lloyd 2012). This study applied these four ideas as best situated in the field of information practice for access and use of information. In other words, EBIP is a practice that influences access to and use of EBI. Maize smallholders' postharvest practices or actions depend on the experiential knowledge they acquired over time from the evidence available to them. From this perspective, the outcome was effective access to and use of EBI to influence their mindset and practices.

Information access and use cannot be justified if no action or practices are recorded (Lloyd 2012), known as information practice. Information practice is not a new concept in the library and information science; it concerns what librarians and information scientists do or their activities around information to promote access to/use of information for user satisfaction. EBIP involves the integration of evidence in information practices (Eldredge 2016), as is understood in the context of this study. The theory of practice offers a better understanding of how users are connected to various forms of information in a social context. Similarly, users can interact with, interpret and apply information in the context of the information landscape (Lloyd 2010).

Effective EBIP is realised when actions are seen to solve a problem and move the user from an 'unknowing state' to a 'knowing state' through practice, from a 'problem state' to a 'solution state', and enable learning through a community of practice (Reich, & Hager 2014; Rovio-Johansson 2018). Similarly, Hodges and Stathers (2012) stated that smallholder farmers learned through practices that were relevant to their daily routines and situations. This means that the EBIP is effective if maize postharvest handling evidence is generated, gathered, documented, repackaged and disseminated (sayings), then supplied, used, implemented and monitored (doings), and finally evaluated and improved according to goals and plans (tasks). In this way, it will prompt access to and use of EBI that contributes to reducing postharvest handling difficulties, thereby empowering smallholder farmers and improving food security.

2.4 EBIP

EBIP is a systematic process of promoting gathering, packaging, translating and integrating research evidence, while prioritising users' needs and expert knowledge to ensure user satisfaction (Kloda, Koufogiannakis & Mallan 2011). It involves critically appraising the information sources for relevance, quality and credibility to support better-informed decisions and practices (Luo 2018). The major components of EBIP are the evidence, professional

expertise, users' needs (the problems) and the step-by-step EBIP process (asking, acquiring, appraising, aggregating, applying and assessing) (Eldredge 2012).

2.4.1 Origin of EBP

EBIP originated from the use of EBP in health sciences (Eldredge 2016; Law & MacDermid 2024) and evidence-based medicine theory (Smith & Rennie 2014). Health sciences disciplines have embraced EBP at the point of healthcare for many years (Biglan & Ogden 2008; Koufogiannakis 2013; Mackey & Bassendowski 2017; Mcmenamin, Sun, Prufeta & Raso 2019; Polit & Beck 2021). EBP is a strategy that comprises obtaining relevant scientific research and then packaging it to inform daily practice (Steglitz, Warnick, Hoffman, Johnston & Spring 2015). This was first used in psychology and medicine to improve expert decisions through scientific research knowledge (Spring, Marchese, Steglitz & Cochrane 2021). EBP helps to ensure provision of the most effective service by implementing relevant research (Ruchon & Grad 2018; Polit & Beck 2021).

EBP emerged in the 1980s when researchers started asking about the use of research findings in the real world (Polit & Beck 2021). In information science, EBP influences the access to and use of relevant evidence to meet various community and professional needs (Luo 2018). Librarians have always supported healthcare workers in their search for evidence, appraisal of evidence and use of evidence in interventions to solve medical problems (Koufogiannakis 2013). The involvement of librarians in the process of EBP connected library and information science to EBP. In this context, EBP is known as evidence-based librarianship, EBIP, or evidence-based library and information science (Booth & Brice 2004; Eldredge 2016; Koufogiannakis 2013; Marshall 2014). Like EBP, EBIP aims to incorporate research evidence in daily information science practices (Eldredge 2016; 2012; Parmar 2018). EBIP builds people's understanding about doing things in the right way, making the right decisions and realising new opportunities (Gohain 2017; Mbagwu & Benson 2018).

The relationship between the librarian and the library user is essential to measure satisfaction in terms of meeting users' unique needs in a social setting. Lloyd (2012) contended that EBIP concerned adopting scientifically researched ideas and systematically translating them into practice in a certain social domain. Effective EBIP promotes access to and use of EBI to influence decisions, solve problems and move the user from uncertainty to a solution state (Reich & Hager 2014; Rovio-Johansson 2018; Steglitz et al. 2015). This statement was consistent with Hodges and Stathers (2012), who noted that access to and use of appropriately packaged relevant and credible EBI by smallholder farmers will influence their daily decision practices. EBIP contributes to handling the challenges of information overload and the slow

dissemination of research findings in day-to-day information practices (Booth & Brice 2004). Library and information scientists promote 'the collection, interpretation and integration of valid, important and applicable user-reported, librarian-observed and research-derived evidence' (Parmar 2018:64).

2.4.2 Access to and use of evidence

Access to and use of EBI supports practice that is reliable, valuable and valid (Ruchon & Grad 2018). This study found the following five laws of librarianship (Ranganathan 1931) relevant to explain these two concepts. 1) Books are for use (first law), which implies the need to provide access to relevant evidence. In the context of this study access to relevant evidence for maize postharvest handling practices was important. 2) Every reader his/her book (second law), which implies the need to connect users to the specific evidence needed. Connecting rural smallholder farmers to specific maize postharvest handling evidence was important in this study. 3) Every book its reader (third law), which implies that evidence should be well organised or appraised, aggregated and assessed to facilitate its purpose. 4) Save the time of the reader (fourth law). As farmers have limited time to access and use information given their work, information providers must translate and package the evidence in a simplified manner for easy and quick access. At the same time, the evidence provided should be timely to alleviate postharvest handling challenges (e.g. climate change, weevils, termites, low prices) that cause postharvest loss. In other words, quick access to relevant evidence saves farmers time and improves their decision-making and practice to avoid postharvest loss. 5) The library is a growing organism (fifth law), which implies that continuous improvement is important. In EBP, staying up to date with new evidence is essential. New technologies for providing evidence and for maize postharvest handling are being discovered; therefore, rural smallholder farmers, rural information providers and extension workers all need to be updated.

Komba and Lwoga (2020) and Thorpe (2021) suggested that the high demand for access to and use of EBI for decision-making and problem-solving offers opportunity for librarians to embrace systematic reviews as a research methodology for filtering evidence and providing it to specific users through the EBIP framework. This will add value to librarians' service and enhance community engagement. Librarians who apply EBIP in their decision-making use well-documented research evidence, as well as evidence proposed by colleagues in the form of tacit knowledge and feedback from users. EBIP is an widely recognised concept in library and information science with an international peer-reviewed journal published by the University of Alberta and a conference that has been supported since 2006 (Koufogiannakis, 2013). EBIP has also been widely implemented in developed countries, such as the 'USA, UK, Australia,

Canada, Sweden, Denmark and Japan' (Marshall 2014:19) and is steadily gaining momentum in developing countries (Booth 2008; Mbambo-Thata 2006). Furthermore, the concept of EBIP stems from the broader concept of the implementation of research to bridge the gaps between research evidence and practice.

2.4.3 Evidence

In the context of this study, evidence is understood as researched scientific information that has been meticulously verified for quality, relevance, accuracy and credibility (Hutchfield 2010). Scholars have argued that evidence originates from primary research such as experiments, surveys and observations and secondary research such as systematic reviews, and is grouped according to the level of filters or appraisal from high- to low-quality (Edanz-Learning-Team 2023; Evans 2003; Hutchfield 2010; Walden University Library 2023). Evidence that is put into practice prompts actions, as in health science, where evidence is applied at the point of healthcare. In the context of this study and as noted in the theory of practice, research evidence (the sayings) when put into practice (the actions) to solve problems results in added value to maize smallholder farmers in postharvest handling (the goal).

Maize postharvest handling evidence in this study can be grouped into five categories by how it is packaged: 1) explicit information found in databases, the Internet, research bodies' websites and other collections; 2) tacit information found in maize postharvest handling experts; 3) farmers experience-based information that they have practiced over time and that worked for them; 4) technological materials; and 5) equipment found in factories or industries (Ahmad & Shausi 2020; Baributsa et al. 2020; Darfour & Rosentrater 2020; United Republic of Tanzania 2019).

2.4.4 Framework of EBIP

EBIP as a concept is implemented in a step-by-step process or framework that has evolved over time. Booth (2004) described six EBIP stages: 1) define the problem; 2) undertake and appraise research; 3) prototype and test; 4) implement the solution; 5) evaluate the outcomes; and 6) Engage in storytelling. Koufogiannakis (2013) also proposed six concepts, which are popularly referred to as the '6As': ask, acquire, appraise, aggregate, apply and assess. Thorpe and Howlett (2020) developed four phases of EBIP: 1) interpret the organisational context and strategic priorities; 2) apply the library's strategy; 3) measure the outcomes; and 4) communicate the impact of the library's strategic contribution. Another study (Thorpe 2021) added the concept of advocate/announce to articulate, assemble, assess, agree/apply and adapt. The present

researcher found the EBIP structure useful because it was not static but accommodative and supported growth.

This study employed the 6As proposed by Koufogiannakis (2013) as they were considered easily presentable, understandable and applicable in this research. The researcher tested the 6As in the context of Uganda and maize postharvest handling by rural smallholder farmers, and found them stable and relevant in terms of access to and use of EBI. The EBIP components (ask, acquire, appraise, aggregate, apply and assess) work in a flow from one to another. The feedback gained during the 'assess' step could either be areas of improvement or another need discovered and success stories during the EBIP (Figure 4).

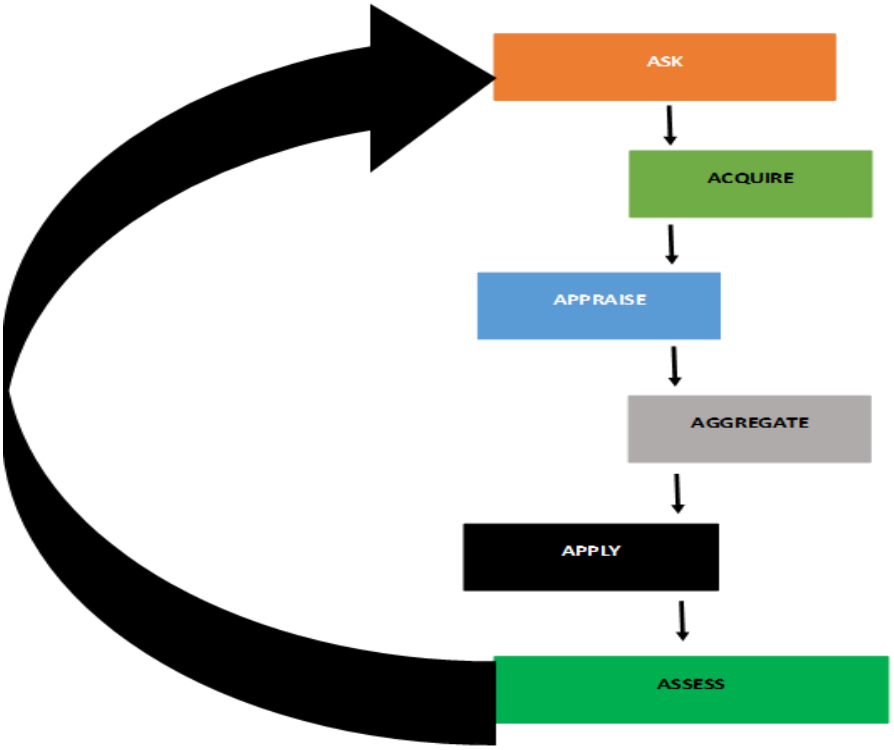

Figure 4: Evidence-based information practices process

(Source: Researcher developed 2024)

The EBIP process is continuous as shown in Figure 4. Rural smallholder farmers who are asked about their information needs should be given feedback on what worked and what did not work.

1. Ask: This involves looking for a specific need for relevant evidence. In the context of this study, the evidence needed was identified from maize smallholder farmers in relation to the goal, which was improved postharvest handling. Komba and Lwoga (2020) explained that the EBIP process occurs through a systematic review of a question that follows an approved

framework such as the PICO framework. This framework helps to define the boundaries of the review that aid in eliminating evidence that is not relevant (Koufogiannakis 2013). A well-defined question provides proper guidance for the remaining EBIP processes and yields a good outcome.

2. Acquire: This is the process of searching for credible, relevant and available evidence (facts, practice or tangible items) about the question identified. This evidence can be concentrated in a specific literature collection or database (Koufogiannakis 2013).
3. Appraise: This is the process of selecting or filtering the most relevant and useful evidence that can answer the question under focus.
4. Aggregate: This is the process of gathering the appraised evidence from various sources and packaging for the identified needs in relation to smallholder farmers' maize postharvest handling and their social context. Aggregating may include translating or repackaging the evidence in a way that is easy for the end-users to use.
5. Apply: This is the process of using the appraised evidence to solve the specific problem identified. It can involve training or generating tangible items and using them or the facts for decision-making.
6. Assess: This is the process of evaluating and monitoring the status of the specific problem to which the evidence was applied to measure effectiveness and identify areas for improvement. These areas for improvement become new evidence needs, which start the EBIP process again.

2.4.5 Goals or outcome expected from EBIP

The main goal of EBIP is to provide a quality service that is effective and efficient, satisfies both the consumer of the service and the service provider and ensures the safety of everyone involved in the process (Hasanpoor et al. 2020). This means that in the EBIP process, the user of evidence and the provider of the evidence both benefits. For example, the evidence-based medicine consultancy model proposed by Hasanpoor et al. (2020) clearly highlights the outcome of EBIP in a healthcare environment. When EBIP is implemented well, it contributes to quality care and patient safety, gives satisfaction to the healthcare professional and patient, and promotes service efficiency and effectiveness.

Values, norms, ethics and socioeconomic status should be considered when implementing EBIP (Hasanpoor et al. 2020). These issues are highlighted in the practice theory as social context. In medicine or health science, EBP involves a doctor or health practitioner, research evidence and patient preference. Similarly, EBIP implementation in maize postharvest

handling involves the agricultural extension workers, information officers, smallholder farmers and the researcher or technology expert. Consideration of rural smallholder farmers' culture, norms, values, ethics and socioeconomic status is important when implementing EBIP. Consistent with the model established by Hasanpoor et al. (2020), the outcomes expected from the application of EBIP in this study were access to and use of quality and effective maize postharvest handling EBI, and improved maize postharvest handling, mindset, food security, household income and development. These outcomes will provide satisfaction to farmers, extension workers, information officers and experts consulted in the EBIP process.

2.5 Maize postharvest handling by rural smallholder farmers

Maize postharvest handling EBI was applied in this study to the identified needs or problems for which smallholder farmers needed to use evidence to achieve better-informed decision-making and practice. A value chain is a set of linked activities that are important to describe a phenomenon (Uganda Ministry of Agriculture, Animal Industry and Fisheries 2016). A postharvest agricultural system for smallholder farmers describes linked activities carried out by farmers from after the maize is harvested to marketing and consumption. After harvesting, smallholder maize farmers are concerned with best practices for drying, storing, de-husking, transporting, marketing, value adding and consuming. These linked activities or practices are known as the maize postharvest value chain (Shee et al. 2019). This value chain is presented in Figure 5.

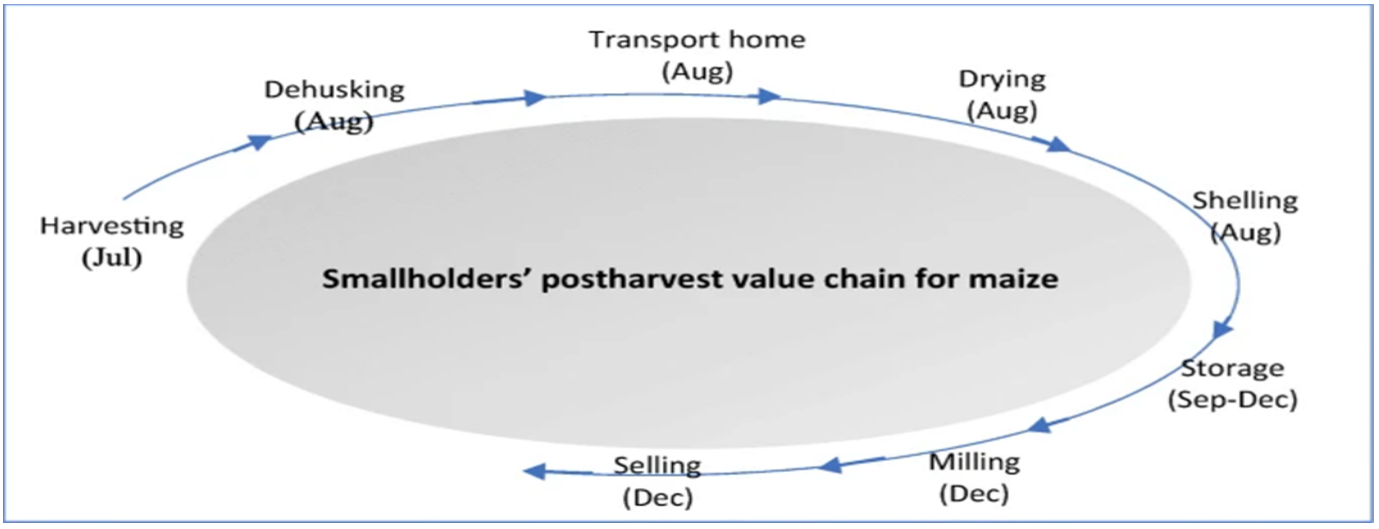

Figure 5: Smallholder farmers' postharvest value chain for maize in Uganda

(Source: Shee et al. 2019:1104)

Shee et al. (2019) advocated for a systematic smallholder maize postharvest value chain in Uganda that covered the 6-month postharvest activities (Figure 5). EBI needs and use by smallholder farmers become evident along this value chain, especially from harvest in July to selling in December. In This chain, maize is harvested in July, removed from the husks (de-husked) in August, dried in August, shelled in August, stored from September to December, milled (value addition of changing maize to flour) in December and sold in December. This study evaluated this value chain in relation to farmers' access to and use of EBI. Drying, storage, de-husking, transportation, marketing, value addition and consumption, climatic and credit information needs were identified as important concepts in the present study. This study sought farmers' perspectives on their maize value chain information needs in relation to access, use and continued training.

2.6. Framework for access to and use of information

A framework is a structured procedure or set of guidelines, rules, rights, ideas or beliefs that are agreed upon by a country, sector or group as 'laws' to be observed and followed when tackling certain issues, activities or solving problems (Cambridge University Press 2022). Uganda has legislation and policies that have been agreed upon by governmental bodies to govern information practice in all sectors. This study examined the frameworks that were relevant to governing access to and use of EBI to connect these available frameworks with the EBIP framework for maize postharvest handling by rural smallholder farmers in Uganda. In this conceptual framework, the concept of effective access to and use of EBIP was a dependant variable that worked as the result of the independent and intervening or mediator variables. The legislation and policies most relevant to this study were the Constitution of the Republic of Uganda 1995, the Information Access Act 2005 and the Agricultural Extension Services Policy.

2.6.1 Uganda Information Access Act of 2005 and Constitution of 1995

The Constitution of the Republic of Uganda 1995 (Article 41) and the Information Access Act 2005 (Part 2, Section 5, Clause 1) provides rights to all Ugandans to access and use information if it does not jeopardise the security of Uganda and the privacy of other persons (Parliament of Uganda 2005). Subsection 2 of the Act emphasises that the information accessed should be accurate and up to date (Parliament of Uganda 2005:5). Smallholder farmers are members of the public and have rights to access and use information as stated in the above legislation. Therefore, this study used concepts from the Information Access Act 2005 and the Constitution of the Republic of Uganda 1995, whereby the EBIP for smallholder farmers did not interfere in any way with national security or personal privacy; instead, it positively influenced their mindset.

2.6.2 Agricultural Extension Information Services Policy (2016)

The Uganda National Agricultural Extension Services Policy was developed and ratified to provide guidelines and standards for:

> *High quality, well-coordinated and harmonized pluralistic agricultural extension delivery system to promote the application of appropriate information, knowledge, and technological innovations for commercialization of agriculture, ensuring food security, expanding exports and contributing to socio-economic transformation and welfare of the population* (Uganda Ministry of Agriculture, Animal Industry, and Fisheries 2016:4).

The Policy describes the kind of maize postharvest handling information that is accessed by smallholder farmers in Uganda, which was the focus of this study. A specific objective of the policy is to support extension information development, which included technological innovations and indigenous knowledge. It also emphasises the need to monitor and evaluate the information access and use process.

2.6.3 Access and use of EBI by smallholder farmers

This study focused on EBIP by smallholder farmers in maize postharvest handling. This concept comprised the dependent variable or expected outcome of this study. Saweda et al. (2020:800) described the access to and use of information as ‘other services’ for smallholder farmers (Figure 6).

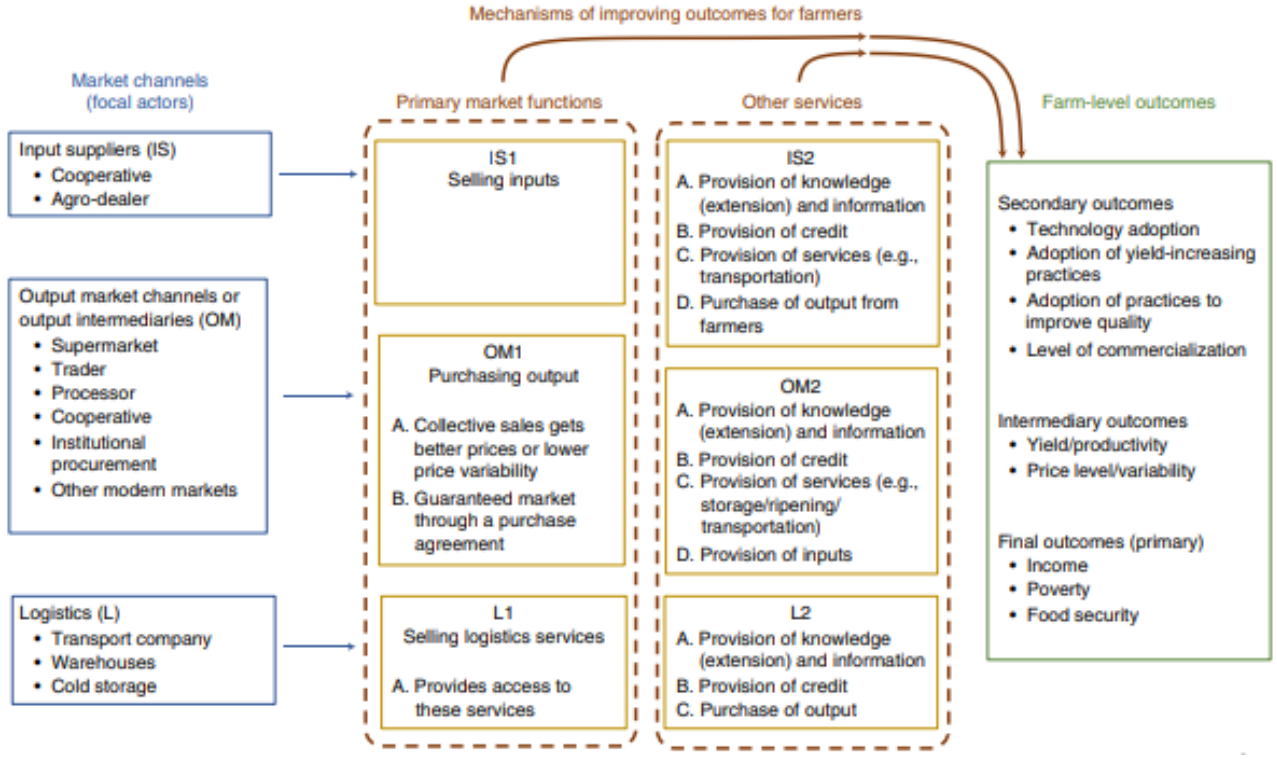

Figure 6: Mechanisms for improving outcomes for farmers

(Source: Saweda et al. 2020:800)

Saweda et al. (2020) presented knowledge and information provision as among 'other services' to smallholder farmers in the farming value chain to improve farmers' outcomes, as seen in Figure 6. The present study investigated EBI access and use by smallholder farmers through the lens of EBIP for improved postharvest handling practices. Therefore, the information presented in Figure 6, specifically the concept of provision of information, was helpful in focusing this study. This structure helped the researcher to understand how evidence is considered in the smallholder value chain. Access to and use of EBI contribute to positive changes in smallholders' mindsets towards maize postharvest handling by creating awareness and empowering them to improve their practices. In turn, this can help to reduce maize loss and eventually improve family incomes and food security. Figure 6 helped the researcher to confirm that in Uganda, there is an established framework that recognises the importance and contribution of knowledge and information to addressing problems in maize postharvest handling.

2.7 Chapter Summary

This chapter discussed the theoretical and conceptual framework applied in this study. It presented the structural framework that showed the connection of the independent, intervening and dependent variables. Furthermore, concepts drawn from the theory of practice, EBP theory and the framework for access to and use of information and their relationships in this study were discussed. The chapter explained how the four concepts of practice theory (action, saying, goal and social values) related to the other concepts examined in this study. EBIP (action) influenced the independent variable (i.e. maize postharvest handling value chain practices) and led to the dependent variable (goal), which was the access to and use of scientific information (saying). This empowered farmers with a changed mindset, improved postharvest handling technologies, reduced maize loss, and increased household incomes and food security in the social context (farmer values).

This chapter also described how EBIP concepts originated in health sciences, EBP and information practice. It explained the term ‘evidence’ and how it is hierarchically ranked by quality and source. In addition, this chapter explained the 6As of EBIP (ask, acquire, appraise, aggregate, apply and assess) that were employed in this study. The concept of access to and use of EBI was explained using the laws of librarianship (Ranganathan 1931), whereby information is for use, and must be accessed in relation to the specific need and on time.

The concept of maize postharvest handling was also described, including the rural smallholder value chain in Uganda. The Ugandan legal and policy frameworks for access to and use of information relevant to this study were also discussed, which were the Constitution of the Republic of Uganda 1995, the Information Access Act 2005 and the Agricultural Extension Services Policy. These frameworks were explained in detail in terms of how they related to the study objectives and outcomes. In Uganda, these frameworks were agreed upon by government legislative bodies to govern information practice in all sectors; all Ugandans, irrespective of their location, have the right to access information.

CHAPTER 3

LITERATURE REVIEW

3. 1 Introduction

This chapter discusses the literature review conducted for this study. It provides a review introduction, body and conclusions based on the review findings. The review introduction covers the significance of the review and the chosen approach, the general research question that guided the literature search, the inclusion and exclusion criteria, chosen procedures for analysis of the selected studies, procedure for presenting the findings and a summary of key aspects that were found in the review. The body of the review covers the findings and discussion, which are presented thematically based on the keywords that were derived inductively and deductively to reflect the nature and objective of this study. The keywords included: EBIP, rural smallholder farmers, maize postharvest handling EBI needs, rural smallholder farmers' and extension workers' sources of maize-postharvest handling EBI and difficulties smallholder farmers experienced when accessing and using maize postharvest handling EBI.

To ensure this study was sufficiently transparent, various empirical studies from both published and unpublished sources were gathered systematically through database searches and using a snowballing approach (Wohlin, Kalinowski, Felizardo & Mendes 2022). A database search is a systematic approach to retrieving documents from a well-structured set of records (i.e. database) (Bramer, de Jonge, Rethlefsen, Mast & Kleijnen 2018). The present researcher combined search terms or keywords drawn from the review question and objectives, along with Boolean operators (AND, OR), synonyms and alternative spellings, and searched multiple databases (5). The snowballing approach is the process of identifying a relevant journal article or empirical paper and using the reference list to obtain additional relevant papers or articles (Wohlin 2014). In this study, snowballing was used to complement the systematic search for empirical studies across various databases. Elements of a systematic literature review, such as the Population, Intervention, Comparative, Outcome and Time (PICOT) framework (Petticrew & Roberts 2006) were adopted to formulate the review question and search terms. The Preferred Reporting Items for Systematic and Meta-Analysis framework (PRISMA) statement was used to guide the reporting of the findings (Page et al. 2020). Relevant knowledge was identified, such as the study domain, research gaps and areas for further research. Empirical studies are those that are scientific, derive conclusions from an acceptable research procedure and in which the evidence can be verified (Bouchrika 2022).

3.2 Literature review mind map

A mind map for a literature review is an organised visual representation of the ideas, concepts and themes accrued from the literature. It is a method that helps to show the flow of ideas and their relationships (Heinrich 2001). The mind map also explains the reporting of the literature review using an established format, such as the introduction, findings, discussion and gaps that were identified in the literature in relation to the study topic. The literature mind map for this study is presented in Figure 7.

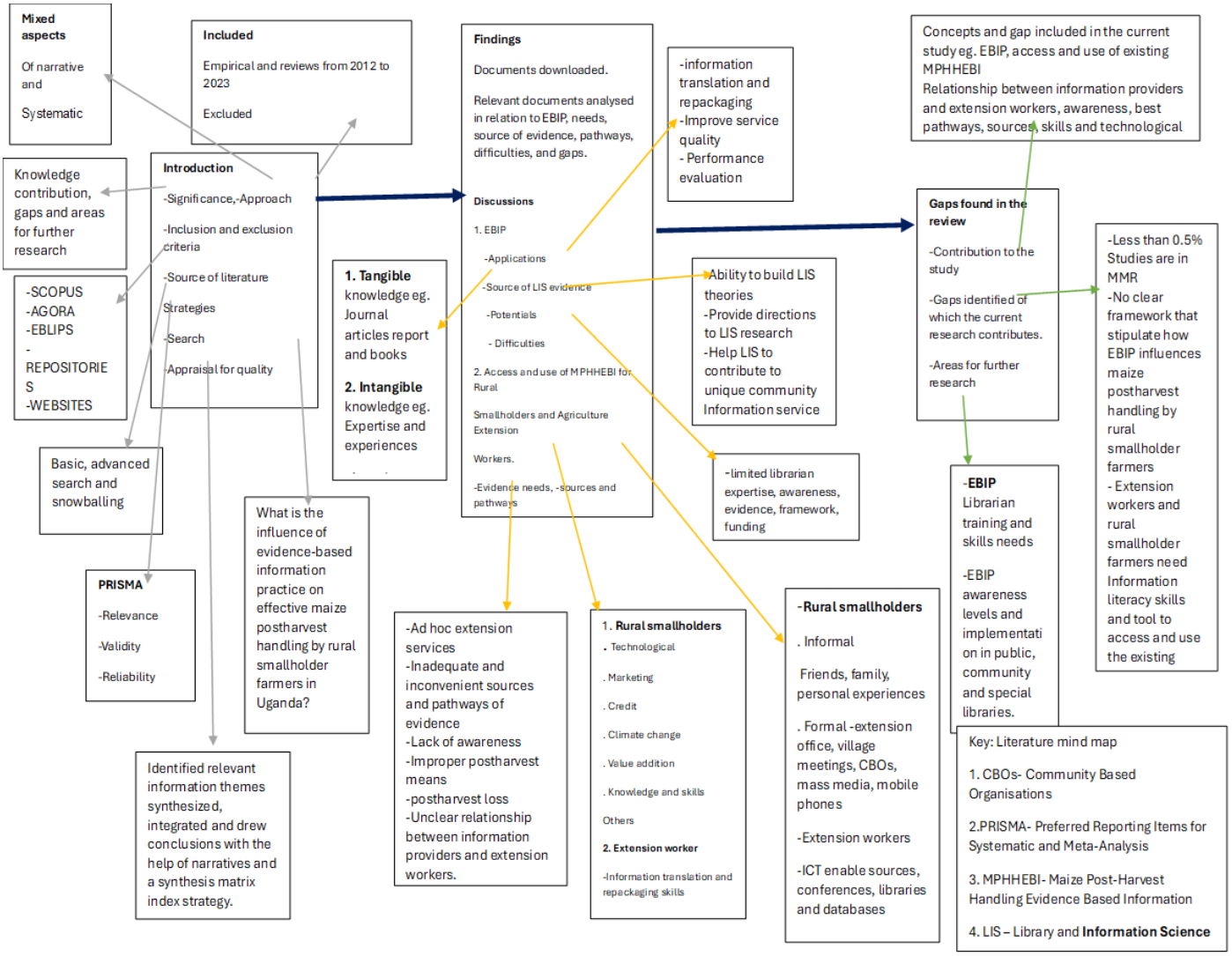

Figure 7: Literature mind map

(Source: Researcher developed 2024)

3.3 Significance of the literature review

A literature review is a 'thorough and critical analysis of relevant empirical and conceptual information on the topic under investigation' (Cronin, Ryan & Coughlan 2020:3). Furthermore, Paré, Trudel, Jaana and Kitsiou (2015) and Ramdhani, Ramdhani and Amin (2014) argued that a good literature review should be sufficiently comprehensive through the collection of information from various sources, such as journals, books and reports, that are relevant to build evidence, explain concepts or theories and provide an overview of what has been covered in the study. In contextualising this definition of a literature review and its significance, the present researcher critically analysed and discussed previously documented information relevant to the study topic and determined the contribution of this study to extant knowledge. The ideas discovered from previous studies therefore became the cornerstone of the present research. In the remainder of this chapter, the researcher presents the differences, consensus and approaches from various scholars concerning the studied topic. This helped to clarify the knowledge gap that this study covered and highlight areas for further research. The literature review also helped to define the conceptual framework used to guide this study, as presented in the previous chapter.

3.4 Approaches to a literature review

There is some controversy among scholars about the different types of literature review (Baumeister 2013; Cronin, Ryan & Coughlan 2020). The common position is that literature reviews can be narrative reviews, systematic reviews, systematised reviews and meta-analyses. Baumeister (2013) explained that a meta-analysis, as a type of literature review, uses statistical methods to summarise the selected literature. A narrative review provides a qualitative description of empirical studies by summarising and critiquing the literature, and drawing conclusions on the subject area (Baumeister 2013). Narrative reviews aim to help the researcher identify gaps and properly define the research questions.

Booth, Sutton and Papaioannou (2016) argued a review should include an aspect of a 'systematic' literature review to ensure it is comprehensive, clearer, efficient and less biased, depending on the available time and resources. In this context, systematic means that a transparent step-by-step procedure or process was followed in conducting the search, analysis and presentation of the findings in the review. The present researcher adopted a narrative approach to explain the themes and concepts relevant to this study as they emerged from the review, research objectives, questions and problems.

A systematic review is a less common type of literature review that combines qualitative and quantitative approaches to summarise and analyse empirical studies (Old Dominion University Library 2022) and draw conclusions from a clearly defined research question (Siddaway, Wood & Hedges 2019). A fully systematic review is rigorous, and requires a team of experts and sufficient time to conduct. An alternative approach is a rapid systematic or systematised literature review, which is conducted systematically but is less rigorous and has a limited time and scope (e.g. year or country) and one reviewer (Petticrew & Roberts 2006). Baumeister (2013) argued that researchers should adopt the sceptical mindset of a judge and jury to evaluate literature to derive fair conclusions.

This study adopted some aspects of a systematic review, such as formulating the general review question using the PICOT framework (Petticrew & Roberts 2006) and adopting the PRISMA statement (Haddaway, Page, Pritchard & McGuinness 2022) to guide the screening, inclusion and exclusion criteria, data appraisal and synthesis and presentation of the findings. This helped the researcher to identify the relationships in the arguments, and draw out new knowledge, policy implications, practical directions and areas for further research (Petticrew & Roberts 2006). Petticrew and Roberts (2006) argued that most social science systematic reviews focused on questions that looked at effectiveness, although this approach was also used to examine risk factors, characteristics and relationships relevant to the studied phenomenon.

A literature review can be organised thematically, theoretically, historically or methodically (Saunders, Lewis & Thornhill 2019; Torraco 2016). In a thematically or conceptually organised review, the researcher builds themes from the research topic, problem, purposes and objectives. The knowledge (data) in the literature is summarised and analysed according to these themes. In reviews organised theoretically, theories are defined and explained in relation to their application in the examined empirical studies and their relationships with the researcher's study. In a historically organised review, the literature is reviewed chronologically based on various developments in the topic and changes over time/years. Finally, in methodical reviews, the researcher examines the literature according to various methods in relation to the findings of the included studies that are relevant to their research.

This study organised the literature review thematically. The findings were discussed as they were discovered from the literature and in relation to the research topic, general review question, and study purpose and objectives. This study was anchored on a pragmatic or pluralist paradigm, which believes that research should not be limited to one view or methodology but include a variety of credible evidence (Hall 2013; Leavy 2017; Saunders, Lewis & Thornhill

2019). The present researcher used both inductive and deductive approaches to derive the themes discussed in this review.

3.5 The literature review general question

The present researcher developed the general study question while applying the PICOT question formulation framework as suggested by Petticrew and Roberts (2006:38-42), Crumley and Koufogiannakis (2002) and Booth (2006). This is presented and described below.

Intervention question: What is the influence of EBIP on access to and use of information for effective maize postharvest handling by rural smallholder farmers in Uganda?

P: Population (rural smallholder maize farmers in Uganda, agriculture extension workers, agriculture information officers/librarians)

I: Intervention (EBIP)

C: Comparison intervention (maize postharvest handling information needs/agriculture extension information services)

O: Outcome (access to and use of EBI by rural smallholder farmers for effective maize postharvest handling in Uganda).

T: Timeframe of included empirical studies (2012–2023)

3.6 Inclusion and exclusion criteria for selection of empirical studies

After the review question was formulated, boundaries were set for the studies to be included in the review. The inclusion and exclusion criteria used to set boundaries for the empirical studies to be reviewed encompassed search themes, publishing time frame, language and type of articles or papers, as described below.

a) **Inclusion criteria**

i. Empirical studies related to EBIP and maize postharvest handling. Rural smallholder farmers' information access and use.
ii. Time frame: 2012–2023.
iii. Empirical studies that were primary or review articles; research that presented the study's purpose or objective, population, methodology, findings, conclusions and recommendations.
iv. Studies published in the English language.
v. Studies accessible to the researcher in full-text.

b) **Exclusion criteria**

i. Empirical studies and reviews conducted before 2012 and that were anecdotal or based on people's views.
ii. Theories and conceptual frameworks, which were presented in Chapter 2 of this thesis.
iii. Studies not published in the English language.
iv. Studies not accessible to the researcher in full-text.

3.7 Selected literature sources

There are many sources of literature to consider when conducting a review, in both electronic and print collections. Electronic databases are easy to reach, and conducting basic and advanced searches to obtain relevant literature offers a good starting point (Petticrew & Roberts 2006). However, some studies in electronic databases prove to be inaccessible for various reasons, such as copyright restrictions, cost and irrelevance to the study. Therefore, scholars advise using multiple sources when reviewing the literature, including grey literature or unpublished studies, websites, a general Internet search, Google Scholar, repositories, consulting experts and hand-searching bibliographies (Petticrew & Roberts 2006). Furthermore, for academic work, Saunders, Lewis and Thornhill (2019) stated that it is important to use online databases that indexed and produced full-text abstracts and indices with peer-reviewed content, including high-impact journals, books, book chapters, conference papers, reports and theses.

This study used primary and secondary sources (review articles) from online sources that archived high-impact research related to the study topic. These sources included: SCOPUS; AGORA; evidence-based library and information practice; websites such as the FAO, World Bank, MAAIF and NARO; Google Scholar; Wiley Online; EBSCO; and the Makerere University and Kampala International University repositories.

This review also included empirical studies from the grey literature, as suggested by Hopewell, Clarke and Mallett (2005) and Paez (2017) to broaden the reviewed studies and prevent bias. The Kampala International University and Makerere University repositories were chosen for the grey literature search because they archive the largest amount of grey literature in Uganda. Primary sources are those that reported the first occurrence of a piece of work (Saunders, Lewis & Thornhill 2019) and that have original information from research (e.g. theses and dissertations, book chapters and journal articles), whether officially published or not. Secondary sources are the products of the primary sources, such as systematic and literature reviews. The

reference lists of some articles obtained from the databases were searched, and additional relevant literature was manually selected as deemed relevant to this study.

3.8 Search strategy

A search strategy is a systematic procedure whereby key terms or words are used to retrieve documents from a database. These key concepts are selected from the research question. The concepts can be keywords with their synonyms, major subjects and phrases (Komba & Lwoga 2020). This study used basic and advanced searches of electronic databases to retrieve relevant literature using keywords, subject headings, controlled vocabularies, synonyms and Boolean operators such as 'AND' 'OR' and 'NOT'. The snowballing method was also used to retrieve additional documents, as reference lists were manually searched and examined to identify further literature relevant to this study based on the research question keywords, as explained below.

i. Target population search terms

"Rural maize small scale farmers", "maize smallholder*", "smallholder cereal agricultural producer*", peasant, "maize rural farmers", "corn farming" "Small enterprises", "rural subsistence farmers", backyard, "small scale", women, gender, "the poor", Uganda, "developing countries", "developed countries".

ii. Intervention search terms

"Evidence-based information practices", "maize postharvest handling", "maize postharvest handling information sources and pathways", "Rural smallholder farmers information needs", "Information access and use by rural smallholder farmers", "Library and information services for rural smallholder farmers", "extension information services for maize farmers", "maize scientific and technological information", "Evidence-based library and information practices", "Agricultural scientific information access and use", "Agricultural knowledge access and use".

3.9 Strategy for appraisal of the quality of the reviewed studies

Empirical studies that were consistent with the study objectives and the review question and considered valid, reliable and applicable in relation to the inclusion and exclusion criteria were screened and selected, as guided by the PRISMA flow diagram and checklist (University of North Carolina 2022). The researcher examined scientific studies that clearly stated the purpose or objectives, methodology, findings and recommendations. The studies could be published or unpublished, but had to be available to the public within the study time frame (2012–2023) and authoritative (i.e. having the author with credentials indicated).

Relevance: The researcher considered how the empirical studies directly related to EBIP for maize postharvest handling by rural smallholder farmers from 2012 to 2023.

Validity: The methodology of the empirical studies were assessed in relation to the study's purpose, objectives and findings.

Reliability: The study methods helped to assess whether the study findings answered the research questions and objectives.

Applicability: The findings in these studies had to be applicable to the present study. They contributed ideas for research tools and objectives, facilitated discussion and overall recommendations or encouraged further research on the topic.

3.10 Strategy for the analysis, synthesis and presentation of review findings

After the literature was retrieved and screened, it was broken down thematically into general relevant concepts and themes. Important information was identified, synthesised and integrated, and possible conclusions were drawn. The information was classified and grouped using narratives and a synthesis matrix. A synthesis matrix is a table for sorting and grouping ideas presented in a literature source (University of Arizona Writing Center 2023:1). In this study, the synthesis matrix indicated the source of literature (title, author/s, date of publication), study purpose or objective, methodology, population, major findings, main ideas or themes extracted from the findings and recommendations. Vertically, the matrix presents the sources, with the main ideas or topic indicated on top of the matrix and the purpose or objective, methodology, population, findings, and recommendations labelled horizontally.

The necessary critical evaluation of each information source was performed with the help of the PRISMA framework and checklist (Page et al. 2020). A description of these findings is presented in Figure 8.

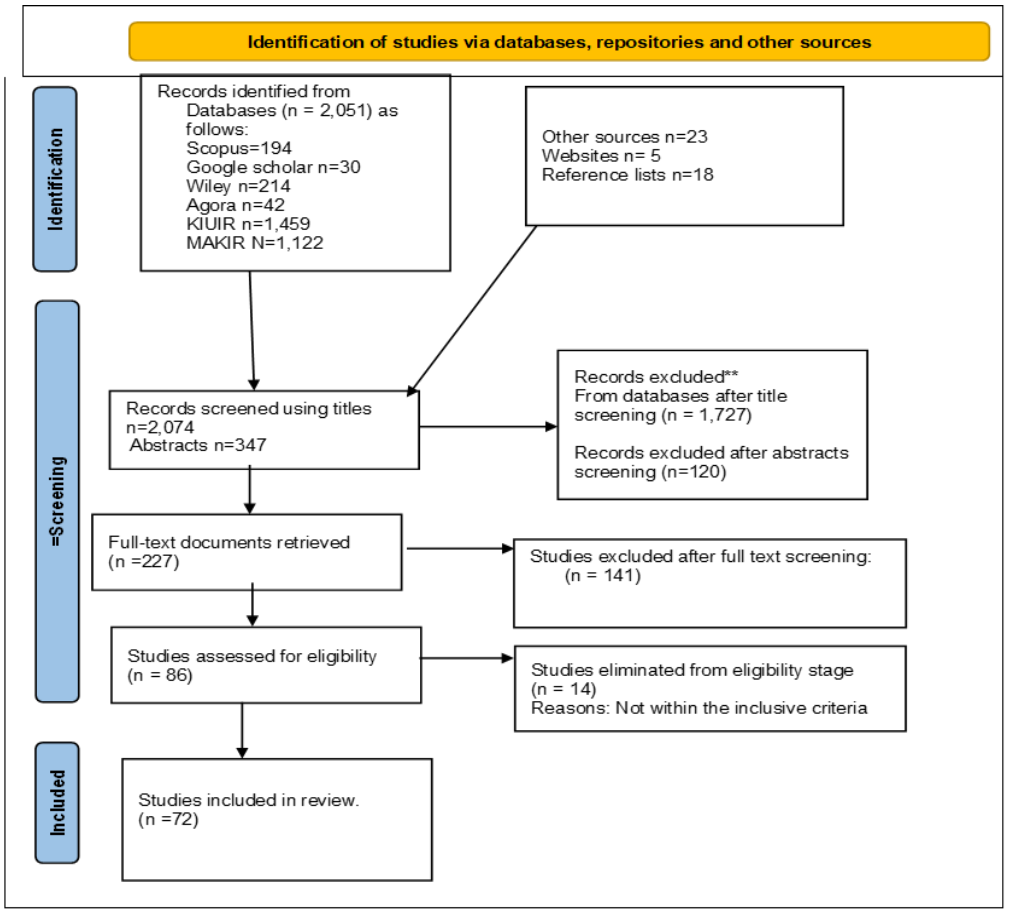

Figure 8: PRISMA framework

(Source: Page et al. 2020)

3.11 Body of the literature review

The review findings and discussion are presented topically according to the main ideas and keywords derived inductively and deductively in accordance with the nature of this study. The keywords included: EBIP, sources and pathways of maize postharvest handling EBI, difficulties smallholder farmers experienced when accessing and using maize postharvest handling EBI, rural smallholder farmers' and agricultural extension workers' maize postharvest EBI needs, information access and use by rural smallholder farmers, and maize scientific and technological information.

3.11.1 Literature Review Findings

Below are the findings from the included studies. These findings were extracted from various sources (e.g. published and grey literature) and analysed using a synthesis matrix presented in

Appendix 25 and Appendix 26. Table 3 summarises the reviewed studies by topic and research type.

Table 3. Main topic by type of the empirical studies reviewed

Methodology	EBIP	MPHH	Number	%
Quantitative	5	27	32	44.4
Qualitative	14	7	21	29.2
Mixed methods	2	3	5	7.0
Reviews	9	5	14	19.4
Total	30	42	72	100

EBIP: evidence-based information practice; MPHH: maize postharvest handling.

In total, 72 of the 227 empirical studies retrieved from the databases and other sources were considered relevant to this study. Of these, the majority (42 studies) focused on access to and use of maize postharvest handling EBI for rural smallholder farmers, and the remaining 30 studies addressed the implementation of EBIP in library and information science. Of the 72 studies reviewed, 58 (80%) were primary research and 14 (20%) were reviews. The 58 primary studies comprised 32 quantitative studies, 21 qualitative studies and five mixed methods studies. The mixed methods studies all mentioned that they used mixed methods, but did not specify the approach used (i.e. whether they were convergent concurrent/parallel, explanatory sequential, exploratory sequential, transformative, embedded or multiphase parallel). Table 4 shows the studies focused on EBIP by region and field.

Table 4. Studies focused on evidence-based information practice by region and discipline

Discipline	Uganda	Developing countries	Developed countries	Number	%
Library and information science	0	3	9	12	40
Health Sciences	1	2	9	12	40
Agriculture	0	2	1	3	10
Others	2	1	0	3	10
Total	3	6	19	30	100

Of the EBIP-focused studies that were included in this review, three were from Uganda, five were from other developing countries and 19 were from developed countries. Furthermore, the findings of the reviewed studies showed that EBIP was applied in various ways in library and information science, including information translation and repackaging, improved patron service, collection development, information literacy, library management and administration, and improved quality library practice and information-seeking behaviour. The distribution of studies focused on maize postharvest handling by value chain component is shown in Table 5.

Table 5. Distribution of studies on maize postharvest handling by study focus areas

Focus areas	Uganda	Developing countries	Developed countries	Number*	%
Technology	8	15	0	23	45.1
Marketing	2	6	0	8	15.7
Credit	1	1	0	2	3.9
Climate	1	1	0	2	3.9
Value addition	4	1	0	5	9.8
Training and skills	4	0	1	5	9.8
Extension workers	2	3	1	6	11.8
Total	22	27	2	51	100

*Some studies mentioned more than one attribute of the maize postharvest value chain

Only studies that considered access to and use of information for maize postharvest handling were eligible for inclusion in this review. Of the 51 studies examining maize postharvest handling value chain, 22 were from Uganda, 27 were conducted in other developing countries and two were from developed countries.

Furthermore, studies that examined EBI needs revealed that rural smallholder maize farmers and agricultural extension workers needed maize postharvest value chain EBI on: maize value addition five studies (9.8%); technology for maize storage, drying and processing 23 studies (45.1%); and knowledge, training and skills on how to handle maize postharvest handling five studies (9.8%). Two studies (3.9%) reported a need for climatic information, one each from Uganda and other developing countries. Six studies (11.8%) considered information and retooling needs for extension workers.

The reviewed studies also revealed that rural smallholder maize farmers depended on informal sources of information, such as personal experience, friends, family members and cultural

knowledge more than on formal sources. The major recommendations in the reviewed studies included embracing collaboration and partnership among stakeholders to address the gap in access to and use of EBI among rural smallholder maize farmers. For example, maize farmers, researchers, extension workers, manufacturers of maize postharvest technologies and buyers of maize products should work together. A detailed discussion of the above findings is presented thematically below.

3.11.2 Discussion of the findings from the literature

The findings from the review were broken down into themes based on the data extracted from the included studies and the research question. This reflected the approach for literature reviews set out by Popenoe, Langius-Eklof, Stenwall and Jervaeus (2021) and Torraco (2016), whereby the themes extracted from the data and research question were used to guide the analysis and presentation of the results.

EBIP in library and information science

Several of the reviewed studies focused on EBIP in library and information science (Aynalem, Yazew & Gebrie 2021; De Brun 2015; Diekema, Hopkins, Patterson and Schvaneveldt 2019; Dongardive 2013; Eldredge 2016; Esmaeilzad, Gavgani, Zarei & Familrouhany 2023; Etomaru, Bisaso & Nakayiwa-Mayega 2021; Franzen & Bannon 2016; Koufogiannakis 2013; Luo 2018; McGowan 2019; Ochoa & Pinto 2020; Oyadonghan, Eke & Fyneman 2016; Parmar 2018; Ruchon 2018; Thorpe & Howlett 2020;). Of the 30 studies concerning EBIP, the majority (n= 14, 48.3%) were qualitative and two (7%) used mixed methods. This suggested that qualitative methodology was the preferred approach in research on EBIP. Furthermore, EBIP studies were more often related to health science librarianship (40%) compared with other fields. The identified application of EBIP in library and information science, challenges, and sources of evidence are discussed below. Parmar (2018) noted that the concept of EBIP was more applicable to specific problems in various library and information science areas, such as improved patron service, collection development, information literacy, library management and administration, improved quality library practice and information-seeking behaviour.

a) Translation and repackaging of evidence

Information translation and repackaging refers to a process that begins with identifying a specific user information need. The next steps are to ‘collect information from various sources, process the information and make it more effective and attractive package of information and disseminate or serve according to demand’ (Dongardive 2013:209). This

repackaged information can be consolidated in an appropriate form that suits the library user, and may be in different formats such as electronic (e.g. video, audio, PowerPoint presentation) or print (e.g. leaflets, magazines, calendar, brochure). Oyadonghan, Eke and Fyneman (2016) argued that repackaging was not a new concept in libraries because it was for user satisfaction, but the source of the repackaged information could be scientific databases, indigenous knowledge, government publications or research bodies.

An empirical study on knowledge translation in universities conducted by Etomaru, Bisaso and Nakayiwa-Mayega (2021) reported that research funding tended to cover the research process and leave out knowledge translation and repackaging. This affected the communication of the research findings to users, meaning those research findings could not influence practices. Repackaging information gives librarians an easy way to provide relevant, reliable, convenient and efficient information services to clients (Dongardive 2013). Information repackaging also offers a way of improving library services, particularly in the current era of electronic information. Librarians who translate and repackage information contribute more effectively to the ever-increasing information needs of their community. Research seeks to generate information, and the information generated must be translated into practice to cover identified gaps. Genoni, Haddow and Ritchie (2004) and referred to this as a communication gap between research and practice. Those authors observed that librarians did not use research findings for professional decisions and other library practices but often used a colleague's opinion, which was a 'risky' venture without proper evidence. This observation has also been made across other disciplines where knowledge generated through the research process is not being used because it is not easily translated to an easy way for use and practice (Law & MacDermid 2024). Lack of time, quality information and expertise are difficulties librarians and other professions experience when trying to undertake research and use research information for professional decisions and practice (Law & MacDermid 2024; Luo 2018). However, library and information science scholars (Dongardive 2013; Genoni, Haddow & Ritchie 2004; Oyadonghan, Eke & Fyneman 2016) posited that librarians have best practices in information quality, search, organisation, documentation, dissemination and retrieval, which are good enough for EBP. Using familiar practices can enable librarians to apply the available locally generated and archived evidence in their library practices and effectively contribute to meeting community information needs.

In discussing information translation and repackaging, the present researcher understood that for research to influence professional decisions and practices, the adoption of EBIP in library and information science will contribute to the application of research information to

practice through the process of asking, acquiring, appraising, aggregating, applying and assessing. Librarians are conversant with managing and disseminating information, but tend to be unfamiliar with what happens after information has been disseminated. Through partnership with experts in other fields and information users, librarians can exploit the value of a team approach to become effective in translating and repackaging information. If librarians can improve their focus on the information service itself, what happens to the information once it has left their custody and whether it is used, they become effective in information translation. The relationship between information generators (researchers), information providers (librarians) and information users (farmers, students, researchers) is information translation. This study proposed a framework for knowledge translation and repackaging that highlights how researchers should have a close relationship with knowledge users.

b) Improving service quality to stakeholders

A qualitative study by Luo (2018) highlighted the benefits and challenges for academic librarians in relation to EBIP. That study noted that librarians had the opportunity to use evidence in decision-making, improve the quality of services and direct library practice towards being more research-based, all of which were important in the development of the profession. The benefits of EBIP can be realised when librarians can set time, organise available evidence and prioritise mentorship and training in this area. This highlighted that EBIP is an important concept that can spur the growth of concepts and innovations, and enable librarians to be more effective and efficient in service delivery. However, there must be deliberate efforts from library schools and library professionals to seek the potential that EBIP offers.

Koufogiannakis (2013) tested the EBIP framework (ask, acquire, appraise, aggregate, apply, assess) on academic librarians' decision-making in Canada. That study focused on both individual librarian and collective decision-making in libraries, and modified the framework to 'articulate, assemble, agree and adapt', which they believed was more applicable to librarians' decision-making. However, this did not address the issues of improving practice and asking users' needs. That study recommended that the EBIP framework should be tested in other problem-solving contexts for development in library and information science (Koufogiannakis 2013).

(Thorpe & Howlett, 2020)Their findings revealed that librarians' understanding and experiences of evidence-based library practices differed by the level of library awareness and

librarians' personal understanding of evidence. They explained that EBIP was an ad hoc activity in some libraries, whereas in others, it was used for justifying some administrative queries or certain actions; that is, the evidence was generated as a project emerged, or used by others for transforming their mode of practice. Those authors proposed a five-level model of experiencing EBIP: ad hoc or sporadic, justification, emergence, experiments and transformation. That study concluded that library professionals could use this model to improve their EBP in decision-making, provision of satisfactory library services and demonstrating their value to various stakeholders. Furthermore, the study suggested that librarians should build a culture of quality services relevant to the specific needs of their stakeholders through applying EBIP tools across five levels of growth: start, re-do, define, manage and keep on doing it until it is perfected and established. This highlighted the various ways that EBIP can be implemented in libraries and other institutions. However, those authors raised the issue of training and professional expertise, because lack of expertise leads to failure in using EBIP in the profession. Although that study did not address the implementation of EBIP in other community problems (e.g. access to and use of evidence by rural smallholder farmers), it did establish the importance of the contribution of EBIP to quality services as either ad hoc or continuous practice.

c) Library and information science performance evaluation

Ochoa and Pinto (2020) focused on gathering evidence for the SDGs. Their alignment perspective contended that EBIP can be useful in library and information science performance evaluation, including transaction confirmation. That study aimed to develop a framework for evaluating library and information science sustainability, competence and impact on the SDGs. Those authors proposed a four-step model: pre-planning, planning, implementing and using evidence to advocate for libraries. They demonstrated that EBIP was relevant in a multidisciplinary environment and provided a conclusive contribution. Ochoa and Pinto used EBIP to create framework that can help to incorporate evidence in library and information science practice on specific SDG issues based on an evaluation of the literature. Therefore, that study was relevant to the present study where EBIP was applied in specific issues of maize postharvest handling by smallholder farmers. This highlighted that EBIP can be relevant in different disciplines and provide a conclusive contribution.

Despite the need for evidence in library and information science for performance evaluation, Thorpe and Howlett (2020) noted that EBP was individually motivated, and there was no documented evidence of efforts being initiated at the institutional level.

d) Enhancement of information literacy training and skills

Four of the reviewed studies (Aynalem, Yazew & Gebrie 2021; Azami, Sharifi & Alvandpur 2020; Franzen & Bannon 2020; McGowan 2019) evaluated the application of EBP in information literacy by nurses. These scholars concluded that there was a close relationship between EBIP and information literacy practices, whereby EBIP enhanced nursing information literacy training and decision-making and helped them avoid making mistakes (Azami et al. 2020). A mixed methods study by De Brun (2015) reported that information literacy skills and tools facilitated access to and use of existing EBI. This suggested that EBIP should be incorporated in information literacy curricula to maximise its potential. Library schools that had incorporated EBIP in their curricula reported increased confidence levels among librarians in implementing EBP (McGowan 2019).

These findings revealed that information literacy skills around EBIP were useful for librarians in the course of their services. Such skills are also useful for evidence users, such as rural smallholder maize farmers. Farmers and agriculture extension workers need information literacy skills to be able to establish their specific maize postharvest handling evidence needs, know where to find the relevant evidence, and how to appraise, assess and put it into use. There is a particular need for stakeholders in developing countries to be sensitised on the benefits of EBIP so that they set aside time, train and develop EBIP frameworks to improve access to and use of EBI for problem-solving, quality services and proper decision making and practices.

e) Problem-solving

Luo (2018) conducted focus group discussions among academic librarians in the US (California) and revealed that 84% of participants said evidence was primarily used for solving specific problems. Participating librarians indicated they engaged in users' problem solving on a daily basis; therefore, having credible evidence at their fingertips enabled them to make the right decisions at the right time to solve users' problems. These findings were consistent with a descriptive study by Diekema, Hopkins, Patterson and Schvaneveldt (2019) that examined nurses' information literacy skills required for EBP in the US (Utah). That study noted that identifying specific information literacy skills needs was the starting point for nurses to be able to provide the best clinical service and solve specific patient problems in their daily practice.

These findings were considered relevant to the present study in the sense that rural smallholder maize farmers have specific EBI needs to solve specific maize postharvest

handling problems. Therefore, being able to access and use such evidence will enable them to take the right actions at the right time as a specific postharvest handling problem emerges.

f) Enhances critical thinking abilities for librarians

Esmaeilzad, Gavgani, Zarei and Familrouhany (2023) examined the effect of EBIP on critical thinking among health librarians and reported a positive relationship between librarians' exposure to EBIP and critical thinking. Those researchers suggested that EBIP should be included in library schools to develop critical thinking among librarians.

3.11.3 Sources of evidence in library and information science

Luo (2018) highlighted that the sources of evidence used in library and information science included hard and soft evidence, tangible research findings and publications, intangible human knowledge and anecdotes. These findings were consistent with Kumar (2017), who found that evidence was tangible scientific knowledge in the form of journal articles, books and textbooks. Another study (Koufogiannakis 2013) highlighted the different kinds of evidence used in libraries, which included special issues, statistics, experts' knowledge, reports of transactions, empirical studies and peoples' experiences.

3.11.4 Barriers and facilitators of EBIP in library and information science

Booth (2011) examined evidence-based library and information practice and highlighted several barriers and facilitators to the implementation of EBIP in this context. Among those mentioned were awareness, attitude, time, availability of evidence, financial and resource support, infrastructure, organisational support, education, knowledge, training and skills. These factors were also highlighted in EBIP for health sciences as reported by Ayoubian, Nasiripour, Tabibi and Bahadori, (2020) and Nkeiruka, Noreen and Iroro (2024). They were also summarised in a framework by Shafaghat, Imani, BahramiKavosi, Roozrokh, Rahimi and Bastani (2021) (Figure 9).

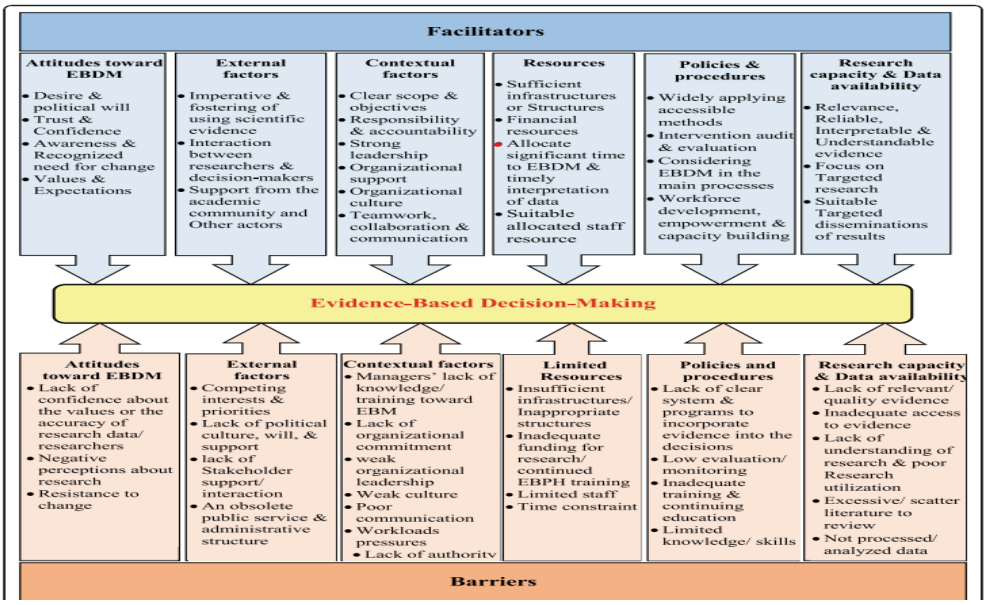

Figure 9: Barriers to and facilitators of evidence-based information practice

(Source: Shafaghat et al. 2021:14)

As shown in Figure 9, implementation of EBIP in library and information science, health science and other fields has various barriers and facilitators. Implementers of EBIP should consider the facilitators and seek to minimise the barriers that affect decisions and practices. For example, it is necessary to be aware that EBIP implementation can be influenced by positive or negative attitudes, along with available resources, skills and policies.

3.11.5 EBIP gaps identified in the literature review

The present review only identified two studies (De Brun 2015; Hayman & Smith 2020) focused on EBIP that used mixed methods research. However, these studies reported different data collection methods rather than specifying that they used a specific mixed methods design. The remaining studies were quantitative or qualitative. Hayman and Smith (2020) conducted a systematic review to evaluate methodological trends in evidence-based library and information science, specifically on mixed methods research from 2008–2018. Their results revealed that mixed methods studies comprised a small proportion (less than 0.5%) of the EBIP research. That study highlighted the opportunity for more mixed methods studies to be conducted in the library and information science field, which was explored by the present study. Hayman and Smith (2020) recommended that library and information science professionals should build capacity in EBIP, systematic, and meta-analysis approaches as a research methodology.

Through EBIP, library and information scientists can evaluate literature and bring out important conclusions that can guide research and build specific theories in this discipline.

Furthermore, using the EBIP model in research remains minimal, as only 12 studies (40%) identified EBIP in library and information science (Table 3). These findings were consistent with those of Aynalem, Yazew and Gebrie (2021), Thorpe and Howlett (2020) and Koufogiannakis (2013), which also highlighted the paucity of EBIP studies. This means there is an opportunity for more research to test EBIP models. The maturity of the EBIP model has been tested in academic libraries but not in other special, public, national and community libraries. Furthermore, it has not been tested in other fields besides library and information science, such as agriculture, nutrition, engineering and other disciplines.

The study did not find any research from Uganda and the East African region on EBIP in library and information science apart from general EBP in health sciences. A study on the challenges of adopting EBP among lecturers at the College of Health Science at Makerere University in Uganda reports that EBP is relatively new and not well adopted because of a lack of resources and training. This study recommended funding and inclusion of EBP in the curriculum (Nalweyiso et al. 2024). In Malawi, a study about attitude and knowledge of EBP among nurses and midwives in Central hospitals in Malawi revealed a lack of EBP knowledge and skills among the nurses and midwives, though they recognised its importance (Kaseka & Mbakaya 2022). Two studies were identified from other developing countries. Parmar (2018) and Eldredge (2016) also noted that few EBIP studies had been conducted in developing countries. They identified a lack of time, commitment and availability of scientific evidence and expertise as major challenges. Therefore, this research will make a timely contribution to the knowledge gap concerning EBIP in Uganda and developing countries.

3.12 Access to and use of maize postharvest handling EBI

Access to and use of maize postharvest handling EBI is the ability to ‘identify, obtain and make use of database or information effectively for one’s development’ (Svärd 2021:78) and apply that information. This means that the need for evidence helps to identify the source, and the way the evidence can be obtained is an important factor that affects access to and use of information. This review only included studies that combined maize postharvest handling and information or knowledge as an intervention.

Rural smallholder farmers and agricultural extension workers have various categories of EBI needs that they would like to access and use to improve their maize postharvest handling

practices. This evidence covers various topics such as technological, knowledge and skills, prices, contacts and transport facilities, and encompasses different postharvest value chain stages (e.g. harvesting, drying, storage, transport, marketing, credit and climatic evidence) (Essougong, Fouepe & Degrande 2018).

a) Technological EBI

The majority of the reviewed empirical studies related to rural smallholder farmers in developing countries covered technological information needs 23 (45.1%) (see Table 5) (Abodoulaye et al. 2016; Affognon, & Mutungi, Sanginga & Borgemeister 2015; Baributsa, Bakoye, Ibrahim & Murdock 2020; Darfour & Rosentrater 2020; Kadjo et al. 2018; Mondal et al. 2020; Manandhar, Milindi & Shah 2018; Mutambuki & Likhayo 2021; Mutiga, Mushongi & Kangethe 2019; Sam, Osei, Dzandu & Atengble 2017; Walker, Wolfe & Davies 2017; Viola 2017; Uganda Ministry of Agriculture, Animal Industry and Fisheries n.d.). These studies showed that rural smallholder farmers had exploited traditional technologies such as sisal bags, metal silos, plastic tanks, sunshine, fireplaces and tarpaulins to support maize postharvest handling value chain activities. These technologies were effective, although vulnerable to human weakness, climate change and insects, all of which affected the quality and quantity of maize. However, research had been conducted and better technologies developed over the years (Campenhout 2021). The invention of scientific means was considered important to mitigate maize postharvest loss (Kumar & Kalita 2017). However, without awareness of the availability, use and profitability related to this scientific information, most rural smallholder farmers had not adopted or benefited from such means. Although several studies had been conducted on technological use and its contribution to reducing maize loss, few studies had examined the contribution of access to and use of technological information in creating awareness and influencing rural smallholder farmers to use these scientifically-evidenced technologies. A good flow of scientific information to rural smallholder farmers will help to create awareness, facilitate training and influence mindset changes concerning their adoption and use.

Figure 10: Comparison of unimproved and improved maize post-handling technologies

(Source: Darfour & Rosentrater 2020:3)

Figure 10 shows types of information available in the literature about improved versus unimproved maize postharvest technologies. Darfour and Rosentrater (2020) examined grain postharvest technologies in Ghana and argued that the costs for improved methods were relatively high, but compared with the postharvest loss incurred, it was worthwhile for farmers to form groups and acquire technologies, and also lobby the government to invest in these technologies to secure food and household incomes. The use of maize storage facilities among smallholder farmers in Uganda was reported to depend on how easily they were accessed, costs and cultural understanding (Tibaingana, Kele & Makombe 2018). Several studies recommended smallholders in developing countries should use improved means such as solar driers, threshers, hermetic bags, metal silos, harvesters and chemical protectants to minimise loss and improve household incomes (Abodoulaye et al. 2016; Affognon, Mutungi, Sanginga & Borgemeister 2015; Baributsa, Ibrahim & Murdock 2020; Balungi 2016; Darfour & Rosentrater 2020; Kadjo et al. 2018; Manandhar, Milindi & Shah 2018; Mondal et al. 2020; Mutambuki & Likhayo 2021; Mutiga, Mushongi & Kangethe 2019; Walker, Wolfe & Davies 2017; Viola 2017). However, before investing in new methods, evidence about the suitability of the technology must

be sought, and the technology tested and evaluated (Omotilewa, Ricker-Gilbert & Ainembabazi, 2019). Table 6 presents a summary of the recommended scientific evidenced-based technologies for smallholder farmers in developing countries.

Table 6. Examples of maize postharvest handling technological information

No	Evidence-based technology	Source of information	Cost USD $	Supplier and contact
1. Hermetic bags				
a	Super Grain bag	(Manandhar, Milindi and Shah 2018:9)	-	GrainPro, India
b	AgroZ®	https://www.azpfl.com/index.php/en/brands/agroz/agroz-bag-and-bag-plus	$2	A to Z in Arusha, Tanzania
c	Elite	Mutambuki and Likhayo (2021:3)	-	Elite Innovations in Eldoret, Kenya
d	EVAL-bags	Mutambuki and Likhayo (2021:3)	-	Kuraray Co. Ltd. (Osaka, Japan)
y	ZeroFly®	Mutambuki and Likhayo (2021:3)	$2	Vestergaard Frandsen Ltd. Nairobi, Kenya
f	PICS bags	Mutambuki and Likhayo (2021:3)	$2	Bell Industries Ltd. Nairobi, Kenya
g	PP Bags	Mutambuki and Likhayo (2021:3)	$2	Agrovet, Mfangano St., Nairobi, Kenya
2. Dryers				
a	Mixed flow dryer	Mondal et al. (2020:468)	-	-

b	Computational fluid dynamic	Roman et al. (2019:1442)	-	-
c	Easy dry m500	Walker, Wolfe and Davies (2017:8) www.acdivoca.org/aflastop-publications	$1,100	Aflastop Kenya
3. Silos				
a	Metal silos	Viola (2017:20)	$29 small and $243 1.5 tonnes	-
b	Plastic silos	Viola (2017:32)	-	Crestanks Ltd. and Smile Plast Ltd. Uganda

Table 6 shows the evidenced-based techniques for drying and storing maize suitable for smallholder farmers in Uganda and other developing countries as recommended in previous studies (Manandhar, Milindi & Shah 2018; Mondal et al. 2020; Mutambuki & Likhayo 2021; Mutiga, Mushongi & Kangethe 2019; Roman et al. 2019; Viola 2017; Walker, Wolfe & Davies 2017).

The World Food Programme (WFP) and other donors distribute hermetic bags in Uganda and other developing countries; however, these efforts are inadequate because of costs, incompatibility with local needs and lack of awareness (Kato & Musoke 2021; Viola 2017). Affognon, Mutungi, Sanginga and Borgemeister (2015) concurred that the evidence was not extended to end-users, with reasons cited being the end-user mindset, inadequate innovation support mechanisms, innovation to suitable to specific user needs and lack of budget. Those authors suggested new areas of research that included innovation dissemination to end-users, the application of the innovation, pathways to user needs and technology interaction and mindset change. One study included in this review examined the linkage between small and medium farming in developing countries (Liverpool-Tasie et al. 2020). That study suggested that clear mechanisms should be implemented to connect smallholder farmers with medium- and

large-scale farmers so they could exchange expertise and information to improve smallholders' practices and enable them to adopt technology.

Balungi (2016) investigated the way post-harvest handling technologies related to maize farmers' incomes in mid-west Uganda (Masindi and Kiryandongo districts), and found that the use of technologies depended on their availability, cost and adoption levels. That study also found moderate levels of awareness among maize smallholder farmers of these evidence-based technologies. This raised the question of how evidence-based technological information could be packaged and made available to smallholder farmers in Uganda. Importantly, there is a major gap concerning the availability of scientific/technological EBI to smallholder farmers in terms of convenience and adequacy, which this study aimed to address.

The reviewed studies suggested new areas of research, including information dissemination to maize smallholders to create awareness, practical sources of information on how to apply the available technology, establishing pathways for addressing smallholder farmers' information needs that are convenient and adequate and training smallholder farmers to promote mindset change. Jiang, Yang and June (2013) explored online services, and reported that convenience could encompass distance, decision, access and transactions and benefit the end-user in terms of time and effort. This means that EBI should be easily accessible to smallholder farmers, able to influence the farmers' decisions and transactions and be beneficial for users' satisfaction. The present study considered convenience in terms of time, place and effort a smallholder farmer used to access EBI to influence decision-making and transactions.

b) Marketing EBI

For maize postharvest handling to be performed well, there is a need for marketing information to be available to rural smallholder farmers. Eight of the 42 studies that investigated access to and use of maize postharvest handling information considered marketing as an important aspect of maize postharvest handling. Mbagwu, Benson and Onuoha (2018) noted that without sufficient information on market locations and prices, farmers failed to sell maize at good prices and ended up getting paid less and realising little profit. Access to timely and EBI about market prices, locations and contacts was reported to improve maize postharvest handling and allow farmers to profit from their efforts (Muhanguzi & Ngubiri 2022). Rural farmers need timely EBI on market location, prices, market demands and mobile service technology or online services that can connect them to buyers (Villar, Kozakiewicz, Bachina, Young & Shisler 2023). Through access to market information, rural smallholder farmers will understand where to get farm

machinery and where to sell agricultural products. If provided with market information, farmers will be able to make the right decisions, thereby contributing to agricultural development. This study examined the availability of one stopover where rural maize smallholder farmers could access and use marketing information when they need to sell their maize.

c) Credit EBI

The two studies that investigated credit information (Table 5) concluded that rural smallholder maize farmers were not aware of where they could access finances to support postharvest handling. For example, Mbagwu, Benson and Onuoha (2018) emphasised the need for credit-related EBI among rural smallholder farmers. Access to credit facilities from financial institutions will enhance maize postharvest facilities, such as supporting the acquisition of better drying and storage materials. Financial institutions provide credit to small, medium and large enterprises with collateral. This raised the following questions. 1) Could smallholder farmers access credit if they did not have collateral? 2) Is there a source of information where this category of farmer can be made aware of the various credit options available to them?

d) **Climate change EBI**

Given past and future climate change, farmers need EBI related to climate factors that is reliable to remain updated on these changes (Atube et al. 2021). Two of the reviewed studies covered climate information and maize postharvest handling (Atube et al. 2021 & Abdoulaye et al. 2016). Abdoulaye et al. (2016) revealed that maize often rotted because of too much rain or was dry too early because of little rain. Loss is often registered because of harsh weather and lack of timely climate information. Climate change is being experienced worldwide, including by rural smallholder maize farmers in Uganda. Timely climate information will help farmers to manage the maize postharvest process more effectively and avoid unnecessary loss because of drought, maize rotting because of excessive rains and failure to store maize in dry environments.

e) **Value addition EBI**

Five of the studies (Atube et al 2021; Darfour and Rosentrater 2020; Kato & Musoke 2021; Muhanguzi & Ngubiri 2022; FAO & Nuwagaba 2019) of the reviewed studies on maize postharvest handling considered value addition information. These studies suggested smallholder farmers often harvested maize when it was half ready for roasting and eating while on the cob. They also sold their maize cheaply without any value addition; their buyers then added value and sold more expensively, meaning smallholder farmers did not receive much benefit (Kato & Musoke 2021; FAO & Nuwagaba 2019). Value addition EBI will empower

farmers to add value to their maize and gain more income, which will eventually lead to a better way of life.

f) Training, knowledge and skills EBI

Five of the reviewed studies focused on maize postharvest handling examined the training, knowledge and skills that were important to improve practice among rural smallholder farmers. Continuous education and training for rural smallholder farmers will impart knowledge and skills related to maize postharvest handling (Ainembabazi & Mugisha 2014). Ainembabazi and Mugisha (2014) reported that farmers' practical experience and retraining impacted their adoption and use of technology. Furthermore, making demonstration and training centres available to equip rural farmers with knowledge and skills in various areas of the maize postharvest value chain was recommended by Shee et al. (2019). These studies showed that farmers' awareness of scientific knowledge, access to and use of this knowledge, along with skills-based EBI centres where they can practice and receive retraining were important. The convenience and adequacy of the EBI concerning knowledge and skills was therefore a useful factor to examine.

3.11.6 Agricultural extension workers' EBI needs

Six empirical studies were relevant to the information needs of agricultural extension workers (Sobalaje 2020; Sam, Osei, Dzandu & Atengble 2017; Elueze 2016). Elueze (2016) focused on information translation in agriculture and highlighted that research information or EBI that was disseminated and used influenced the generation of knowledge and also decision-making and practice. That study found that agriculture scientists and extension officers were using ICTs to disseminate information to farmers. Only one study mentioned libraries as involved in agricultural information translation. Focusing on information translation and repackaging is important to highlight the best ways to communicate research information to specific users. This will help to ensure that the information is made available in a format that can easily be accessed and used. The reviewed studies provided the framework for information transfer that extension workers can implement.

Sobalaje (2020) studied the role of the library for agricultural extension workers in Osun State, Nigeria, and reported that extension workers needed knowledge and skills in various maize postharvest value chain factors so that they could advise rural smallholder farmers efficiently and effectively. Sam, Osei, Dzandu and Atengble (2017) used a field survey to explore the information needs of agricultural extension agents in Ghana, and found that they needed

technological information to equip themselves to be able to provide adequate advice to farmers. To translate and repackage EBI for rural smallholder farmers, they required effective communication skills, which they could apply to effectively disseminate EBI to farmers. They also needed information evaluation knowledge and skills, information search and retrieval skills and general EBIP skills.

The gap observed in literature regarding agricultural extension workers' EBIP was concerning in that there was no clear formal linkage reported in the empirical studies between information service providers or librarians that had best practices in information repackaging, information literacy and dissemination with agricultural extension workers and agricultural scientists. Each of these fields was working individually; therefore, there is a need to create formal linkages to ensure better services for rural smallholder farmers.

3.11.7 Sources and pathways of scientific and technological information

Sources of information are the 'containers' that rural smallholder farmers and agricultural extension officers use to obtain specific maize postharvest EBI. Kumar (2017) noted that information was an important component of agricultural growth, and blending indigenous and scientific knowledge sources was crucial for sustainability. EBI sources include journals, textbooks, databases, blogs, websites and newspapers. People tend to prefer sources of information that they are aware of, feel they can trust to provide relevant information, are easy to access and use and available. For example, 85% of farmers in Spain relied on personal experience as the source of information, about 70% had low levels of education and agriculture training, and information service seeking was considered a private rather than public affair (Cruz, Albisub, Zamoranoa & Sayadi 2021). Therefore, accessing and using information depends on the users' level of education, information literacy levels (Kumar 2017) and exposure to sources of information. It is also important to note that the providers of the information must ensure it is evidence-based in that it is of sufficient quality and relevance to improve the practices of rural smallholder farmers. In other words, the condition of the information users and providers, the available evidence and methods of access dictate what and how maize postharvest EBI sources are accessed and used. Convenient and adequate information sources will contribute to the access to and use of such evidence (Essougong, Fouepe & Degrande 2018).

Pathways

Understanding information sources is not complete without examining EBI dissemination pathways for rural maize farmers. Maize postharvest handling EBI pathways are the media or

channels through which information passes to reach the smallholder user. These pathways can be informal or formal. Formal pathways can be via agricultural extension workers, farmers' group meetings, village meetings, community-based organisations, libraries, radio and newspapers, along with ICTs-enabled channels such as mobile phones (Mwantima 2018), the Internet and social media platforms (Essougong, Fouepe & Degrande 2018; Deichmann, Goyal & Mishra, 2016). Informal pathways can be word of mouth from friends and family members and personal experiences.

Several empirical studies included in this review covered information sources and pathways used by rural smallholder farmers and agricultural extension officers (Phiri, Chipeta & Chawinga 2019; Essougong, Fouepe & Degrande 2018; Mwantima 2018; Sam, Osei, Dzandu & Atengble 2017). The findings demonstrated that rural smallholder farmers in developing countries used more informal sources and pathways compared with formal means. When rural smallholder farmers had problems and needed information, they tended to ask family members, friends and other close sources. Conversely, agricultural extension officers preferred ICTs-enabled sources, libraries and databases.

Essougong, Fouepe and Degrande (2018) conducted a qualitative study to examine whether community-based organisations in Cameroon could deliver adequate agricultural information to farmers. That study found that rural resource centres, as a community-based organisation, were the second preferred source of information for farmers and agricultural extension workers after farmers themselves, whereas the Internet was among the least-used sources of information. That study recommended these resource centres be strengthened to acquire, package, train and disseminate agricultural EBI to rural communities.

Sam, Osei, Dzandu and Atengble (2017) conducted a field survey on the information needs of agricultural extension agents in Ghana. They found that extension workers used books, reports and pictures as sources of information. That study also identified an issue with inadequate information infrastructure and training, and recommended improving information infrastructure (e.g. libraries, information centres and databases). Phiri, Chipeta and Chawinga (2019) investigated the information behaviour of rural smallholder farmers in selected developing countries and found that the majority of farmers relied on personal experience, friends and family members as sources of information. That study also noted that print and electronic mass media tools had an important role in ensuring access to and use of information for rural smallholder farmers. Local means of communication such as rural radio and television stations, meetings and drama were also increasingly contributing to the flow of farming information.

ICTs and emerging trends

ICTs are a combination of network infrastructure, hardware and software that facilitates the generation, storage and transfer of information (Sangbuapuan & Guha 2016). Through ICTs, the world has been connected and become a 'global village', which means information can easily be generated, stored and communicated from one part of the world to another via the Internet. Therefore, a society that can exploit ICT capabilities can access and use EBI more easily today than it could 20 or 30 years ago when ICTs, including the Internet, were not available. Today, mobile phone technology (Mwantima 2018) and television have taken root in rural areas in developing countries, including Uganda. The Uganda Bureau of Statistics (2021) reported that 74% of the Uganda population owned a mobile phone, and 86% of phone owners used it to access Internet and social media services. Achora (2020) studied ICTs and agriculture information access and ascertained that ICTs had the potential to influence access to information for managing agriculture production. Abate, Bernard, Makhija and Spielman (2023) and Mwantima (2018) indicated that ICTs were a necessary technology to be enhanced and used to promote effective access to and use of agricultural knowledge. This means that ICTs including the artificial intelligence capabilites can enhance farmers' access to and use of maize postharvest handling EBI. Furthermore, a pilot study on the use of information kiosks to improve rice farming in Thailand found that the kiosks were effective in supporting access to and use of online and offline rice farming knowledge and skills by farmers (Sangbuapuan & Guha 2016). That study suggested that the same method could help to support other crop farming in rural communities.

Access to and use of various sources of EBI, knowledge and skills by rural smallholder farmers for improving practices is possible through farmers themselves, extension services, researchers and community information providers. A close relationship was found between access to/use of evidence and maize postharvest loss (Awuor & Rambim 2022). Rural smallholder farmers who accessed and used maize postharvest EBI were aware of existing technological knowledge (e.g. on maize drying and storage facilities that protected maize from weevils). This knowledge improved farmers' mindset towards using better maize postharvest handling practices and therefore reduced maize loss associated with weevils. Rural resource centres, libraries and farmer groups can be equipped with a variety of sources of print or electronic information. Scientific journals and book chapters are the most commonly used channels to disseminate scientific information. These sources, as noted by the reviewed studies, can be used by

information centres to study, equip, repackage, train, demonstrate and disseminate EBI to agricultural extension workers and rural smallholder farmers.

Development partners such as the FAO, UNESCO and the World Health Organization (2002) have supported access to scientific and technological information for developing countries through Research4life resources in five collections: HINARI, AGORA, OARE, Research for Development and Innovation and Research for Global Justice (Research4life 2023). This support has improved access to and use of scientific research, especially in academic and research institutions located in these parts of the world (Malapela & Jager 2017). However, the use of EBI by rural smallholder farmers to influence practice remains unknown. The present study will contribute knowledge in this area.

AGORA archives scientifically researched information published by reputable researchers for maize postharvest handling. Community, academic and research libraries have free or low-cost access to disseminate these resources to their users. However, it is unclear whether maize smallholder farmers access and use AGORA collections as a source of EBI. Furthermore, it is unclear whether agriculture extension workers use AGORA to equip themselves with scientific and technological information to transfer to rural smallholder farmers for improved maize postharvest handling. Malapela and Jager (2017) reported that library infrastructure that supports access to and use of scientific and technological information in developing countries was at the formation stage, and library budgets could not fully support these initiatives.

ICT enabled Trends

Artificial intelligence (AI) is one of the emerging trends in the information communication field; it can be understood as computer-enabled systems that perform tasks that require human intelligence and reasoning, like problem-solving and decision-making (Russell & Norvig, 2022). AI is significantly reshaping information dissemination not only in urban but also in rural areas (Goel & Rani 2024; Hussain et al. 2022; Kansal et al. 2023; Liu et al. 2022; Ngulube & Mosha 2024; Raj et al. 2024; Siau & Wang 2020; TuYizere et al. 2024; Xifeng & Han 2022; Zhang et al. 2024). The AI offers EBIP opportunities that should be harnessed and challenges to be overcome. Innovations in AI, combined with technologies like blockchain, chatbot and AI-generated content (AIGC) (Maginga et al. 2024; TuYizere et al. 2024; Zhang et al. 2024), enhance EBI communication, improve access to EBI resources, and foster socio-economic development in rural communities worldwide. One notable advancement is integrating blockchain technology with AI, particularly in rural live broadcasting, which has significantly

boosted information dissemination (Hussain et al., 2022; Liu et al., 2022; Raj et al., 2024). AI-generated content is transforming how multimedia information is shared by exploiting algorithms for specific information needs, enhancing user engagement, and providing timelier and relevant farming and other information (Cao et al., 2024; Zhang et al., 2024; Zhao et al., 2024). If harnessed properly, these technologies will reduce the barrier to accessing maize postharvest handling EBI for rural farming communities. AI and related ICT technologies hold immense potential to revolutionise information dissemination in rural areas, enhance access to EBI resources, empower communities, and support postharvest handling and overall agricultural development. Chatbots empowered by artificial intelligence and natural language capabilities can search, appraise, and aggregate EBI maize postharvest information for rural smallholder farmers. These technologies can understand farmers' information needs, translate the needs and provide localised feedback.

Furthermore, in the farming sector, AI research on rural development, particularly in machine learning and digital agriculture, has increased (Zhang et al., 2024). International collaborations between China, the U.S., and India are forming to leverage AI for rural empowerment, highlighting the global interest in using AI to address rural challenges (Zhang et al., 2024). AI-enabled systems like intelligent agricultural information systems (Agr-IS) are crucial in improving decision-making. These systems, which integrate ICT and e-government frameworks, help bridge the gap between farmers and governmental agencies, providing timely and accurate information that empowers farmers to manage farming practices (Ahmad & Sarwar 2008; Mulwa 2021) For instance, in rural India, AI-driven devices are helping individuals with limited literacy skills access important information and other services (María 2024). In Tanzania, Platforms like MkulimaGPT are also offering real-time farming advice via chatbots, helping overcome language barriers and ensuring farmers have timely access to critical information (Maginga et al. 2024).

AI applications are increasingly designed with inclusivity, ensuring that marginalized groups in rural areas have equitable access to information and resources (Maginga et al., 2024). Despite these advancements, several challenges persist. Infrastructural limitations, socio-cultural barriers, and policy constraints continue to hinder the full potential of AI and ICT technologies in rural areas. Digital illiteracy and inadequate infrastructure must be addressed to ensure that rural communities can fully benefit from these innovations. However, overcoming challenges related to infrastructure, socio-economic barriers, and ethical considerations is crucial to unlock their full potential. Addressing these issues will ensure that AI and ICT can be leveraged equitably, within the African norms, culture, ethics and sustainably, benefiting all rural

populations and contributing to long-term rural development (Borenstein & Howard, 2021; Gikunda, 2023; Ngulube & Vincent Mosha, 2024; Siau & Wang, 2020).

3.11.8 Barriers to maize postharvest handling information access and use

Rural smallholder farmers grow maize for food and income. Maize is an important food crop for Africa and many other parts of the world and cannot be ignored regarding food security (Akumu et al. 2021; Manandhar, Milindi & Shah 2018; Mondal et al. 2020). Maize is a priority food crop grown by 55% of households in Uganda (Uganda Bureau of Statistics 2019). Rural smallholder farmers experience maize postharvest loss associated with pests (e.g. weevils) and improper maize postharvest handling practices. In addition, maize prices are low just after the harvesting season, but prices rise after a short period and households without money go hungry (Abdoulaye et al. 2016; Atube et al. 2021). Scholars have attributed food shortage, aflatoxins and loss of income in developing countries to improper postharvest handling and lack of adequate information, knowledge/skills and credit support (Akumu et al. 2020; Atube et al. 2021; FAO, WFP & IFAD 2019; Kato & Musoke 2021; Mutiga, Mushongi & Kangéthe 2019; Omondi 2021). Viola (2017) and Abdoulaye et al. (2016) suggested postharvest loss accounted for 30%–45% of general farm produce. The process of drying maize on the soil and beating it contributes to reducing the quality and quantity of maize by breaking it down and introducing dirt (Abdoulaye et al. 2016; Mutiga, Mushongi & Kangéthe 2019). Furthermore, aflatoxins affect maize quality and reduce farmers' income in Uganda and the rest of East Africa because of improper maize drying, transportation and storage methods (Abdoulaye et al. 2016; Akumu et al. 2020; Omondi 2021). Maize is harvested in the cob, de-husked and transported to the homestead using a head load or bicycle. It is then sun-dried on the ground or using tarpaulin. Maize is removed from the cobs by beating it in sacks or using hand-operated machines (Mutiga, Mushongi & Kangéthe 2019). Winnowing is performed using the hands to remove dirt, which is generally inadequate. The maize is then stored at the homestead in granaries, which serve for a short period before weevils and other pastes start destroying the maize.

Atube et al. (2021) confirmed various difficulties smallholder farmers experienced with maize postharvest handling, especially challenges related to lack of climate change training and information. Changes in weather negatively impact maize postharvest handling. Moisture that remains in maize because of insufficient drying causes moulds and rot, which eventually makes the maize toxic. In addition to being produced, food must be delivered to the ultimate consumer

in an acceptable form (Abdoulaye et al. 2016). Many farmers are not sure of the exact time to plant, meaning that harvesting is unpredictable. It also varies from year to year because of changes in the climate. These studies suggested that the ability of smallholders to properly handle maize post-harvest depends on their ability to access and use relevant information. This means that smallholders who are educated and have access to and can use information are better able to manage post-harvest handling difficulties than those who are uneducated or without information (Atube et al. 2021). Furthermore, if uneducated farmers could be trained and given a mechanism that is suitable to their environment, they can also access EBI and continuous training, which in the long term will contribute to making informed decisions that reduce loss associated with postharvest handling difficulties.

Tibagonzeka et al. (2018) found that farmers were aware of post-harvest handling best practices for drying maize using tarpaulins and raised places, although only 20% confirmed they used these practices. Farmers had received postharvest handling information from non-government organisations (NGOs) (54%), peer farmers (16.5%) and radio (4.1%), but none had received information from government extension offices. Tibagonzeka et al. (2018) recommended that the different groups involved in disseminating postharvest handling information worked together so that the farmers could benefit more. Arias, Hallam, Krivonos and Morrison (2013) advised that evidence-based policies should be implemented to support the flow of EBI to rural smallholder farmers, of whom the majority farm maize as a source of food and income. Rural smallholder farmers and agriculture extension workers (Sam, Osei, Dzandu & Atengble 2017) should be able to access and use EBI effectively; this will create awareness and promote the use of better maize postharvest handling practices along the maize value chain.

A mixed methods study by Phiri, Chipeta and Chiwenga (2019) focused on information needs among smallholder farmers in Malawi found that 76.6% (147/192) of respondents reported information sources were inconvenient and inaccessible. They cited distance and lack of means for movement as difficulties they experienced in accessing and using information. That study also recommended collaboration among stakeholders as a solution to providing access and ensuring the use of EBI among rural smallholder farmers.

The reviewed studies highlighted that rural smallholder maize farmers have specific maize postharvest evidence needs along the postharvest value chain. Furthermore, the sources of information and associated pathways were both favourable and unfavourable. Most rural smallholder maize farmers were unaware of the available evidenced-based technological information to support improved postharvest handling. They lacked information literacy skills

and tools that could facilitate their access to the available EBI in agricultural databases (e.g. AGORA). However, no study examined how rural maize farmers accessed and used EBI that is commonly communicated through journal articles, textbooks, conferences and other research dissemination avenues such as blogs, websites, reports and digital collections. An important concern is that most of the evidence disseminated in these sources is published in English, which is not a common local language for rural smallholder maize farmers. This gave rise to the following question. If any evidence is accessed by the rural population, how is it used when it is not communicated in local languages.

In the literature covering maize postharvest handling EBI translation and repackaging for rural farmers or agriculture extension workers, it was unclear how this was done and who was doing it in Uganda. EBIP was not perceived in the literature as an intervention for improved maize postharvest handling; instead, it was seen as 'other services' that can be considered necessary. The growth and availability of ICTs have improved access to and use of EBI in many parts of the world. However, rural smallholder farmers in developing countries still face difficulties accessing and using EBI.

EBI access and use starts when an individual is consciously or unconsciously aware or made aware that there is a need to seek information to solve the problem at hand. After creating awareness, need or desire, the user decides to pursue evidence from an information source or system. When the system or source is prompted, the relevant evidence is found and used. An EBI user, in this case, a rural smallholder maize farmer, may be affected by personal and environmental factors when accessing and using information. Many studies highlighted that lack of awareness, inadequate evidence sources, socioeconomic factors (e.g. culture and finances), lack of ICT infrastructure (Ogundeji, Danso-Abbeam & Jooste 2022; Sam, Osei, Dzandu & Atengble 2017), inconvenient locations and lack of information literacy skills hindered rural smallholder farmers from effectively accessing and using evidence (Antwin-Agyei, Dougill & Abaidoo 2021; Phiri, Chipeta & Chawinga 2019). A clear framework or mechanism that describes how to create awareness and prompt rural maize farmers to seek, access and use maize postharvest handling EBI is therefore important.

The literature documented that governments in developing countries provided extension information services, although the success was unclear (Campenhout 2021). The government of Uganda, through projects such as the National Agricultural Advisory Services (NAADS), private sector and NGOs, in collaboration with local government administrators, has implemented extension services to smallholders in Uganda. This includes services such as on-

farm support training, mobilisation and study tours. These services seek to empower farmers with agricultural advice to improve production and value addition. The Uganda MAAIF also prepares manuals that are used to train extension workers, who then disseminate information to maize farmers. However, Löwe and Sanyu (2017) and Uganda Bureau of Statistics (2020) revealed that extension services to smallholder farmers in Uganda were minimal and did not encourage youth to engage in agriculture. Nampijja and Birevu (2016) gave a ratio of one extension worker to 25,000 farmers. Consequently, extension services are limited in Uganda and in other Sub-Saharan African countries. Kadjo et al. (2018) indicated that post-harvest interventions were a project activity and often supported by donors (development partners); once the project was complete, there was no continuity.

A Ugandan governmental newspaper, the ‘New Vision’, innovated a farmers’ information pathway via the ‘Harvest Money Expo guide’. This is a weekly newspaper pullout aiming at bridging the gap between farmers, and farm produces input dealers. This guide has provided helpful information about seeds, farm mechanisation and postharvest handling techniques since 2016 (Harvest Money Expo 2021). Despite this positive innovation, Atube et al. (2021) reported that the information reached a few farmers who had the means, but the majority still lacked access to the knowledge. Action research by Breckons (2014) reported that cultural factors contributed to the failure to access and use EBI services. Mbagwu, Benson, and Onuoha (2018) contended that inadequate awareness of the need for farming information among rural smallholder farmers and stakeholders contributed to the failure to ensure that the right mechanism for access to and use of such information is made available.

Muhanguzi and Ngubiri (2022) conducted a convergent parallel mixed method study on smallholder farmers' challenges in extracting value agricultural information in Uganda. They reported that poor quality of information, lack of training, costs and poor pathways were major challenges for farmers. Costs were a challenge because of the inconvenient sources of information. For example, community libraries and agricultural extension offices that were known to be sources of information were urban-oriented and, therefore, located far from where rural smallholder farmers resided. Farmers found it costly to move or travel to far places to access and use information. Cruz, Albisub, Zamoranoa and Sayadi (2021) reported that farmers in Spain needed quality information, which could be realised through collaboration between farmers, researchers, extension advisors and manufacturers. Another study focused on extension workers (Sobalaje 2020) reported that libraries with agriculture information were irrelevant and inadequate to the specific needs of the maize farmers, such as the use of

postharvest technologies. If EBI about its existence and use is not widely accessible and disseminated to farmers, it will not be easy for them to use technology despite that technology being profitable (Campenhout 2021).

ICT infrastructure in rural areas in most developing countries remains poor, costly or non-existent (Abate, Bernard, Makhija & Spielman 2023; Achora 2018). Muhanguzi and Ngubiri (2022) recommended that ICTs needed be improved for farmers in rural areas to be able to access research information. Illiteracy, especially among women, lack of ICT skills, costs of access to quality information and lack of awareness were some identified difficulties rural smallholder farmers experienced (Awuor & Rambim 2022).

Although studies on access to and use of information/knowledge for improved agriculture and general farming practices that covered some components of postharvest handling have been documented and reviewed, no study was found that specifically looked at EBIP for maize postharvest handling. Generally, EBI is researched information that has been peer-reviewed and verified as scientifically viable to contribute to improving practices. Most such information is communicated through academic journals, academic conferences and textbooks, and stored in scientific databases, which cannot easily reach rural people (University of Florida Libraries 2023). Furthermore, much of the research information or EBI is communicated using scientific terms that are easily interpreted by professionals but not in language rural smallholder farmers can understand. Therefore, it is difficult for them to directly use the information without it being repackaged and communicated easily to them. Extension workers have the responsibility of translating and repackaging EBI and disseminating it to rural smallholder farmers. However, Sam, Osei, Dzandu and Atengble (2017) found that the information infrastructure in Ghana was adequate and extension workers lacked sufficient training. This was confirmed by Muhanguzi and Ngubiri (2022), who reported that most agricultural extension workers in developing countries lacked knowledge and skills for information repackaging and translation. Furthermore, a recent survey reported that Uganda lacked effective extension services, and lacked reliable postharvest handling knowledge and skills (FAO, WFP & IFAD 2019).

3.12 Review summary and conclusions, research gap and areas for further research

The reviewed empirical studies indicated the magnitude of the maize postharvest loss difficulties, along with the breadth of smallholder farmers' postharvest value chain information needs, technologies related to storage and other areas of grain postharvest handling. It highlighted numerous areas for further research, including rural smallholders' information

dissemination, continuous practices, training, technology and behaviour change. The sources of evidence for scientific research do not easily reach the majority of rural smallholder farmers in Uganda, and there is a need for further research on EBI translation and re-packaging. The literature clarified that maize postharvest handling activity tended to be ad hoc in the form of projects and lacked continuity. Therefore, there is a need for a framework to support continuous extension information flows to rural smallholder farmers.

Furthermore, this review highlighted the importance of EBIP in library and information sciences and other disciplines. It discussed the way EBIP was implemented in library and information science practices, the EBI needs and sources for rural maize smallholder farmers and agricultural extension workers, along with relevant pathways. The review identified a gap in the knowledge whereby no clear study had been conducted on how EBIP influenced access to and use of EBI by rural smallholder maize farmers in Uganda. This confirmed the need for mixed-methods empirical research on the influence of EBIP on maize postharvest handling by smallholder farmers in Uganda; agricultural extension workers' involvement in information/knowledge translation and repackaging for rural smallholder farmers; and the connection between libraries, rural smallholder farmers and agriculture extension workers in terms of access to and use of maize postharvest handling EBI. There is also a need to test the EBIP model in Africa in general and Uganda in particular. This study sought to address these gaps.

The review also highlighted the need for further research on EBIP technologies, knowledge and skills needs for librarians, and the engagement of academic and special libraries in information translation and repackaging, including challenges and opportunities. Testing the evidence-based library and information practice model in an academic library in a developing country, which has unique needs compared with developed countries, will add value to its maturity.

CHAPTER 4

RESEARCH METHODOLOGY

4.0 Introduction

Research methodology is the step-by-step criteria by which research is conducted (Hall 2020; Hyatt & Roberts 2024; Creswell 2023). This chapter discusses the way this study was performed, the researcher's underlying assumptions, the procedures that were followed to understand the research problem and conduct the study to derive conclusions and recommendations. It presents a general summary of common approaches in research and their underpinning philosophical assumptions. It also outlines the type of the mixed methods research design employed, population, sample and sampling procedures, data collection instruments, limitations and strategies used to mitigate them, validation and analysis procedures.

4.1 Philosophical assumptions/paradigms

The philosophical underpinnings of social research are important for the researcher to understand and execute as a foundation for their research (Ngulube 2019). These philosophies reflect the 'researcher's beliefs and values' (Creswell & Poth 2023:17). They direct the patterns the researcher follows to collect valid data and interpret these data to develop and contribute knowledge (Creswell & Poth 2023). The terms 'philosophical assumptions' and 'paradigms' are often used interchangeably (Saunders, Lewis & Thornhill 2019). However, Creswell and Poth (2023) and Saunders, Lewis and Thornhill (2019) explained that 'research philosophy' is a term generally used to describe the researcher's assumptions or worldviews and beliefs about the development and nature of knowledge in research, whereas a paradigm is a philosophy or way of thinking that is used to explain the researcher's stance in gaining meaning or knowledge from data. Previous studies (Hall 2020; Leavy 2017; Ngulube 2015; Saunders, Lewis & Thornhill 2019) stated that knowledge has an origin (i.e. epistemology), exists in a certain social reality (i.e. ontology), follows a certain pattern (i.e. methodology) and is generated in an ethical manner (i.e. axiology). The researcher chose an approach that was consistent with the underpinning philosophical assumptions and paradigm.

4.1.1 Epistemology, ontology, axiology and methodology

The following sections discuss various research paradigms, the four elements (epistemology, ontology, axiology and methodology) underpinning each paradigm, the three major types of

research methodology and the associated research designs or strategies. Table 7 presents a summary of this information.

Table 7. Research paradigms and their four elements

Paradigm	Epistemology	Ontology	Axiology	Methodology
Positivism	• Realism • Scientism • Theory testing • Hypothesis • Mathematical measurement • Generalisations • Facts	• Objectivity • Deductive • One reality	• Quality • Validity • Integrity • Free from value	1. Quantitative 2. Designs/strategies • Experiments and surveys 3. Data collection techniques • Closed-ended questionnaire • Observation • Pre-determined techniques 4. Data type: • Numerical • Specimen 5. Study cases • Respondents
Interpretivism	• Explorative • Interpretation • Perceptions • Opinions • From specific to general	• Subjectivity • Constructivism • Inductive • Multiple reality	• Quality, validity, integrity • Not free from value	1. Qualitative 2. Designs/strategies • Phenomenology • Grounded theory • Ethnographies • Case study • Narrative design • Exploratory • Participatory observation 3. Data collection techniques • Open-ended questions • Interviews, observations, discussions 4. Data type: Narratives, pictures, explanations 5. Study cases: Participants/informants
Pragmatism	• Mixed methods research practices take precedence • All elements are applicable • Scientism • Explorative • Empiricism • Construction • Measurement	• Pluralism • Deductive and inductive are applicable • Objectivity and subjectivity • Complex reality • Flexibility	• Quality, validity, integrity • Both free from value and not free from value	1. Mixed methods research 2. Designs/strategies • Convergent concurrent/parallel • Explanatory sequential • Exploratory sequential 3. Data collection techniques • Open- and closed-ended questions • Predetermined and emerging techniques 4. Mixing and integrating 5. Data type: both quantitative and qualitative data 6. Study cases: both respondents and participants/informants

Source: Creswell (2009); Creswell (2023); Creswell and Poth (2023); Hall (2020); Leavy (2017); Morgan (2014); Ngulube (2015); Saunders, Lewis and Thornhill (2019).

As shown in Table 7, all research methodologies generally agree that the researcher's integrity, ethics, truthfulness, fairness and openness throughout the research process, including the relationship with participants/respondents and data, influences the research quality. This is called axiology (Creswell & Poth 2023; Leavy 2017; Ngulube 2019). The researcher should respect people's rights, norms and ethics during a research study, irrespective of the philosophical assumptions adopted (Saunders, Lewis & Thornhill 2019). If research is conducted in a social setting on social realities and using social constructs in a society where humans exist, then there are cultural factors, rights, values and ethical issues in that society that must be considered. Issues concerning privacy, data accuracy and participation are ethical (Creswell & Poth 2023; Ngulube 2020). African society, specifically Uganda where this study was conducted, and South Africa where this study was initiated, has ethics, cultural norms and human rights that the researcher embraced when conducting this study. The researcher considered the ethical issues of fidelity and values that the participants and data brought into the research. This study underwent ethical evaluation by the UNISA and Uganda ethical committees, and a certificate of registration was issued to ensure it was conducted ethically.

Table 7 also summarises different paradigms and the way they are employed in research. There is a foundational relationship between the philosophical assumption, methodology or research design, data collection methods and analysis (Creswell 2023). Commonly used research methodologies are quantitative, qualitative and mixed methods (Creswell 2023; Hyatt & Roberts 2024; Ngulube 2019). These research methodologies reflect the strategic principles, processes, procedures and techniques used to obtain answers to an identified research problem (Hyatt & Roberts 2024; Mukherjee 2020). The research methodology is chosen based on the researcher's philosophical beliefs or assumptions, applicability to the research problem, research use and experience (Saunders, Lewis & Thornhill 2019). After considering different philosophical assumptions, including interpretivism and positivism (as outlined in Table 7), this study was guided by pragmatism, which was deemed the most suitable.

4.1.2 Pragmatism

The discrepancies between the positivist and interpretivism philosophies led to the development of pragmatism (Creswell & Clark 2018; Creswell 2023; Hall 2020; Mavodza 2020; Ngulube 2019). Saunders, Lewis and Thornhill (2019) defined pragmatism as a 'philosophical stance that argues that concepts are only relevant where they support action'. This means that a study is conducted because there is a problem that needs a solution; therefore, the methodology employed in pragmatic research depends on the problem under study and the outcomes.

Ontologically, pragmatists embrace pluralism, based on the argument that acquiring knowledge in a single scientific methodology is impossible for a comprehensive study that produces balanced knowledge (Ngulube 2019; Creswell 2023). Therefore, pluralists advocate for mixed methods research or multiple ways of investigating and drawing conclusions on research problems. The pluralist term 'mixed methods' encompass the third methodological movement that aims to see things in everyday life in more than one way (Creswell & Clark 2018; Granikov et al. 2020; Morse & Linda 2016; Ngulube 2022; Nakasiba & Namujuzi 2022).

From a pluralist perspective, mixed methods research in social sciences is the procedure of integrating the strengths of qualitative and quantitative methodology rather than incorporating philosophical demands (Morgan 2014). This methodological approach focuses on acquiring balanced knowledge in research rather than making a philosophical claim. This study was anchored on the pluralist assumptions that some phenomena or research problems are complex and should be understood or studied using mixed methods patterns (Creswell & Clark 2018; Mavodza 2020). Combining elements of qualitative and quantitative approaches from arts and humanities with natural sciences assumptions provides flexibility and 'what works' (Morgan 2014:1041) for a balanced research study and knowledge generation. In the pragmatist or pluralist school of thought, this study's multi-faceted objectives sought to evaluate, describe and explain maize postharvest handling as a phenomenon through the lens of EBIP. Data were collected and analysed from multiple sources in a single study.

4.2 Mixed methods research

A mixed methods research approach integrates qualitative and quantitative components to deeply understand the problem under study and corroborate and strengthen the study's conclusions (Creswell & Clark 2018; Schoonenboom & Johnson 2017). The mixed methods researcher assumes that legitimate knowledge originates from multiple data sources, and therefore they use various methods of inquiry (Saunders, Lewis & Thornhill 2019). This combination of quantitative and qualitative elements complement each other and provide meaningful, legitimate, verifiable and trusted research knowledge (Granikov, Hong, Crist & Pluye 2020). Furthermore, this methodology uses deductive and inductive strategies to build theories and concepts in the sense that a theory or framework can be identified from the literature studied, and modified or confirmed during the study (Leavy 2017; Saunders, Lewis & Thornhill 2019).

Mixed methods research gained prominence as a social research approach in the 2000s when various scholars started writing about it as a 'third methodology' (Granikov et al. 2020; Morse &

Linda 2016; Nakaziba & Namujuzi 2022). This approach could address the complex nature of research problems for which qualitative or quantitative approaches could not satisfy the research questions (Creswell & Clark 2018; Leavy 2017). Love (2022) and Migiro and Magangi (2011) argued that mixed methods research is rigorous, challenging to execute, time-consuming and expensive. It needs appropriate planning and expertise to properly combine quantitative and qualitative methods (Morse & Linda 2016). Love (2022), Creamer (2018) and Creswell and Clark (2018) noted that although mixed methods research is challenging, it offers an approach that can be exploited to understand social issues to inform practice and produce richer results. It is also worth noting that no research method is perfect (Ngulube 2015) or distinctive, but they are dependent on each other (Creamer 2018).

4.3 Justification for using a mixed methods approach

Adopting a mixed methods approach in this study enabled the researcher to gather evidence on the complex research questions that could not be satisfactorily addressed by qualitative or quantitative methods alone (Morse & Linda 2016). Based on the assumptions of pluralism, the present researcher needed to use a methodology that worked for this study and could produce rich results. The researcher benefited from the strength that the combination of quantitative and qualitative approaches complemented each other (Love 2022). The choice of this methodology was guided by the researcher's assumption and belief that legitimate, verifiable and trusted knowledge originated from multiple data sources that required various methods of inquiry (Saunders, Lewis & Thornhill, 2019). Consequently, combining quantitative and quantitative elements provided meaningful knowledge via research that was free from bias and where participants' voices were recognised (Dawadi, Shrestha & Giri 2021; O'Cathain, Murphy & Nicholl 2006). The integration of deductive and inductive components of quantitative and qualitative research, respectively, helped to develop, test and confirm concepts within the same study (Granikov, Hong, Crist & Pluye 2020; Leavy 2017; Morse & Linda 2016; Ngulube 2022; Saunders, Lewis & Thornhill 2019). The use of multiple groups of participants (i.e. smallholder farmers, extension workers and extension/community librarians) and multiple concepts (maize postharvest handling, EBIP, smallholder farming, extension agriculture information practices) introduced the elements of expansion of the study, corroboration and complementarity (Dawadi, Shrestha & Giri 2021; Morse & Linda 2016).

4.4 Convergent parallel mixed methods design

In this study, a convergent parallel design was chosen to reflect the data collection timeline, balance the findings and save finances (Dawadi, Shrestha & Giri 2021; Granikov et al. 2020).

Previous studies (Bash, Smith & Trantham 2021; Creswell 2014; Creswell & Clark 2018; Demir & Pismek 2018) agreed that in a convergent parallel/simultaneous/concurrent mixed-methods design, quantitative and qualitative data are gathered simultaneously (although individually), analysed independently and integrated at the time of interpretation and drawing conclusions (Figure 11).

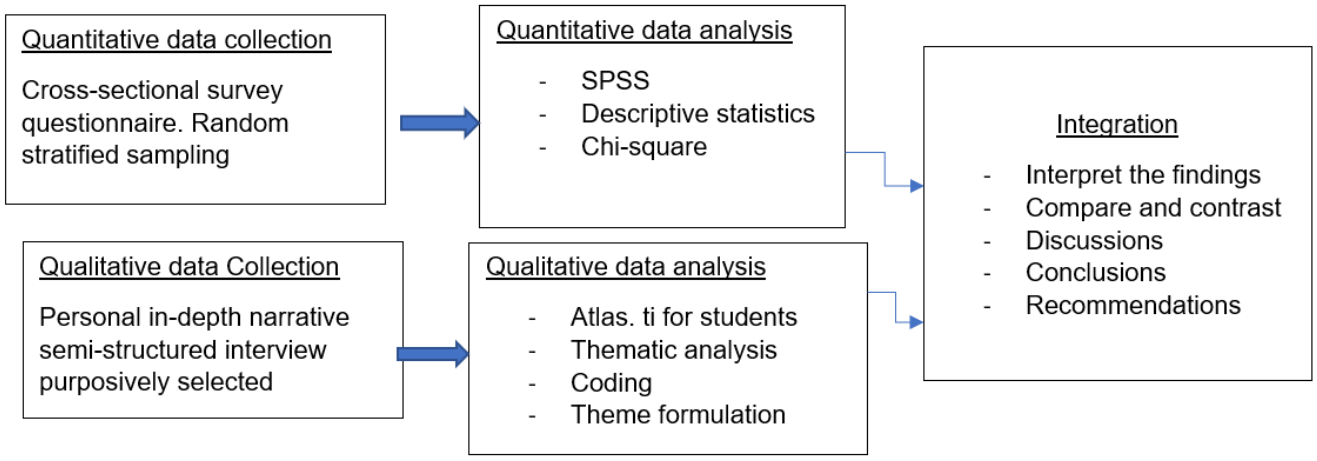

Figure 11: Convergent parallel mixed methods design

(Source: Creswell & Clark 2018)

As seen in Figure 11, quantitative and quantitative data are collected in parallel and analysed independently in a convergent parallel mixed methods design. The convergence or integration occurs during the interpretation, discussion and conclusions. Creamer (2018) and Hands (2022) posited that the integral component of a mixed-methods study was important, and should be performed consistently and meaningfully. Ngulube (2020) further explained that the integration can be performed when formulating the research question and during data collection. Akerblad, Seppanen-Jarvela and Haapakoski (2021) noted that integration in mixed methods research was a 'relationship in research praxis'. This means that the researcher relates the qualitative and quantitative datasets (Leavy 2017), the findings, the meanings and the conclusions. Fàbregues, Pare and Meneses (2019) and Ngulube (2020) explained that a convergent design helps a researcher to answer exploratory, explanatory and confirmatory questions. The two types of data are collected in parallel for validation and comparison before conclusions are drawn (Ngulube 2020; Ngulube & Ngulube 2022). In this study, the primary quantitative and qualitative data were collected simultaneously, the research questions were integrated and the data were interpreted together and compared for similarities and differences.

4.5 Research population

The research population refers to the whole group included in a study (Stockemer 2019). This convergent parallel mixed study targeted a population of 1,930,019 people, comprising three categories: a) maize smallholder farmers (n=1,926,034) (Atube et al 2021); b) agriculture extension officers (n=3,854); and c) extension librarians/information scientists (n=131) (Uganda Ministry of Finance, Economic Planning and Development 2019). In other words, this study had three population groups, with multilevel relationships. Ngulube (2020) confirmed a multilevel relationship was applicable in a scenario where two or more populations are considered for a study. The smallholder maize farmer population in Uganda was determined using the 2008/2009 national agriculture census. This census reported the number of maize agriculture householders at 1,743,016, with 85% (1,481,564) of these households being smallholder farmers (Atube et al. 2021) and 261,457 being medium- and large-scale farmers. The population estimates suggested Uganda was growing at a rate of 3% (0.03) per year, meaning maize smallholder farmers were increasing at a rate of 44,445 per year. When the year estimates were multiplied by 10 years (0.3) the estimate was 444,450 maize smallholder farmer households. Therefore, the number of maize smallholder farmers was estimated to be 1,926,034 as of December 2020. The Uganda smallholder maize farmers were distributed across four regions: Eastern, Western, Central and Northern. Table 8 presents the distribution of smallholder households (UBOS, 2010).

Table 8. Distribution of Uganda smallholder maize farmers

No.	Region	Maize agriculture households/farmers 2010	Estimates for December 2020	Maize smallholder farmers (85%) of total maize agriculture households	Estimates for December 2020
1	Eastern	578,363	751,872	491,609	639,092
2	Western	457,798	595,137	389,128	505,866
3	Central	410,332	533,432	348,782	453,417
4	Northern	296,523	385,480	252,045	327,659
	Total	1,743,016	2,265,921	1,481,564	1,926,034

Source: UBOS (2010); Atube et al. (2021).

The population of extension workers and information officers for this study is shown in Table 9.

Table 9. Population distribution of extension workers and information officers

Population category	Districts	Estimates
Agriculture extension officers	128	3,854 (30 per district)
Information officers (librarians)	128	131 (1 per district, plus 3 at the head office)
	Total	3,985

Source: Uganda Ministry of Finance, Economic Planning and Development (2019).

4.6 Sampling procedures

Stockemer (2019) explained a sample as a subset of the study population that had the same characteristics. This study recruited three meaningful samples from the three population groups (smallholder farmers, agriculture extension officers and information officers). This study involved multilevel relationships in the sense that the three samples were from different populations and included in the same study (Headley & Clark 2020; Onwuegbuzie & Collins 2007). The three groups recruited for the quantitative (smallholder farmers) and qualitative (extension workers and extension/community librarians) arms of this study facilitated the extraction of comprehensive findings to inform meaningful conclusions and recommendations (Headley & Clark 2020; Ngulube 2022; Onwuegbuzie & Collins 2007).

Sampling is the process of determining the study participants or respondents from the entire study population (Leavy 2017). A study uses a sample because it is not always possible to collect data from the entire population (Saunders, Lewis & Thornhill 2019). Sampling is an essential process that contributes to the quality of the inferences made from the data and the overall validity and trustworthiness of the study (Clark & Ivankova 2016). In mixed methods research, both probability and non-probability sampling strategies can be employed (Leavy 2017). In this study, stratified and purposive sampling procedures were used to select the relevant sample across multilevel relationships whereby samples were selected from various participant groups (strata) (Ngulube 2022; Onwuegbuzie & Collins 2007). Stratified simple random sampling was used to identify respondents for the quantitative arm of this study and quota purposive sampling was used to recruit participants for the qualitative arm.

Stratified simple random sampling is a probability sampling technique in which the population is partitioned into two or more strata, and simple or systematic random sampling is used to select

a sample from each stratum (Creswell & Clark 2018; Saunders, Lewis & Thornhill 2019). Purposive quota sampling is a non-probability sampling technique that aids the selection of a sample to collect qualitative data (Creswell & Clark 2018; Stockemer 2019). In the present study, the researcher critically and purposively judged the population to select cases to make up a sample that could provide rich information on the studied phenomenon (Saunders, Lewis & Thornhill 2019). The choice of these two methods (stratified random and quota purposive sampling) was directed by the mixed methods nature of this study, which required both quantitative and qualitative data (Ngulube 2022). Stratified random sampling was used to ensure all the cases of the population were represented in the quantitative arm of the study to avoid bias. Purposive quota sampling enabled the researcher to choose key informants for the qualitative arm of this study from the population strata.

4.7 Sample size

A sample size is the estimated number of cases required for the sample (Leavy 2017). A good sample should be able to represent the population in relation to the study objectives, goals and purpose (Saunders, Lewis & Thornhill 2019; Onwuegbuzie & Collins 2007). The required sample size for the quantitative arm of this study was determined using statistical methods, whereas the smaller qualitative sample was purposively selected.

4.7.1 Sample size of smallholder farmers

There are four ways to determine a survey sample size from a large population: name census, statistical tables, statistical computer programmes and statistical formulae (Katz 2012). Several statistical formulae have been proposed and used for generating sample sizes, including those described by Cochran (1961), Yamale (1967), Krejcie and Morgan (1970) and Slovin (1960) (Glen 2023; Katz 2012). A census sample size method is implemented when the entire study population is researched (Saunders, Lewis & Thornhill 2019), whereas statistical tables, software and formulae generate samples from the population by systematically calculating a meaningful or representative sample. Irrespective of the method chosen, sample accuracy and tolerable error levels must be considered (Creswell & Clark 2018; Migiro & Magangi 2011; Ngulube 2022).

Ngulube (2005) explained that although it is not always easy to determine the right sample size, the larger the survey sample, the more accurate the study will be. It is also worth noting that no survey is free from errors; the accuracy is determined by the confidence levels (e.g. 90%, 95% or 99%) or margin of error (10%, 5% or 1%), with the standard acceptable statistical error being 5% or a 95% level of confidence (Leavy 2017). Adam (2020) and Israel (1992) argued that

statisticians had generated statistical tables that indicate the acceptable sample for various populations, which researchers may employ depending on the size of their study population. For this study, the formula proposed by Slovin (1960) and Yamale (1967) as adjusted by Adam and Israel, was considered relevant because it was easy to explain and use, and provided the standard acceptable sample of 5% error and 95% confidence level. Furthermore, it reflected the researcher's consideration of costs and time, and the precision of the sample (Adam 2020; Migiro & Magangi 2011). The formula used was as follows.

$$N = \frac{N}{1 + N\,(e)^2}$$

Where 'n' is the sample size, 'N' is the target population and 'e' is the level of significance, which is equal to the 0.05 (5%) accepted error in research.

$$\text{Therefore } n = \frac{1{,}926{,}034}{1 + 1{,}926{,}034\,(0.05)^2} = \frac{1{,}926{,}034}{1 + 1{,}926{,}034\,(0.0025)} = 399.91 \approx 400$$

Therefore, the total required sample for this study from all three population categories was 448 people. This comprised smallholder farmers (n=400) as calculated using the Slovin formula, along with 38 extension workers and 10 information officers that were purposively sampled. The smallholder farmers comprised 99.7% of the sample, followed by extension workers (0.2%) and information workers (0.007%) (Table 10).

Table 10. Sample strata

No.	Strata	Estimates	Multilevel distribution (%)	Sample (N)
1	Smallholder farmers	1,926,034	99.70	400 (Slovin formula)
2	Extension workers	3,854	0.2	38 (Purposive)
3	Information officers	131	0.007	10 (Purposive)
	Total	1,930,019	100.0	448

Smallholder farmers were selected from the four districts representing the major producers of maize in each of the four regions (Iganga, Mubende, Adjumani and Kabarole). The smallholder farmers were first enumerated and then potential participants were identified using randomly generated smallholder lists. This technique was chosen to identify relevant research

respondents and avoid bias. Table 11 shows the distribution of the sample for smallholder farmers from the four districts.

Table 11. Sample details for the smallholder farmers in this study

No.	District	Estimated no. of smallholder maize farmers	Number	%
1	Iganga	639,092	133	33.25
2	Kabarole	505,866	105	26.25
3	Mubende	453,417	94	23.50
4	Adjumani	327,659	68	17.00
	Total	1,926,034	400	100.00

The district strata were subdivided by sub-counties to ensure that all areas of the districts were represented in this study, as presented in Table 12. This table shows the number of respondents from each sub-counties represented in this study.

Table 12. Sample size for smallholder farmers by sub-counties

Iganga	n	Adjumani	n	Mubende	n	Kabarole	n
1. Bulamagi	17	1. Adropi	8	1. Kitenga	8	1. Kasenda	15
2. Nabitende	17	2. Pachara	8	2. Kalonga	8	2. Ruteete	15
3. Nakalama	17	3. Ciforo	8	3. Kayebe	8	3. Mugusu	15
4. Nakigo	17	4. Ukusijoni	8	4. Madudu	7	4. Busoro	15
5. Nambale	17	5. Pakele	8	5. Kiyuni	7	5. Kabende	15
6. Namungalwe	16	6. Dzaipi	7	6. Butoloogo	7	6. Kicwamba	15
7. Nawandala	16	7. Arinyapi	7	7. Kiruuma	7	7. Karangura	15
8. Nawaningi	16	8. Ofua	7	8. Kasambya	7		
		9. Itirikwa	7	9. Kigando	7		
				10. Nabingoola	7		
				11. Lubimbiri	7		
				12. Kibalinga	7		
				13. Bagezza	7		
Total	**133**		**68**		**94**		**105**

4.7.2 Sample of extension workers and information officers

Creswell and Clark (2018) and Stockemer (2019) argued that purposive sampling helped researchers to use cases that were relevant to their study for qualitative data collection. This study employed quota purposive sampling to select qualitative participants. Quota sampling is a non-probability sampling technique that uses available participants to represent a quota of the population (Iliyasu & Etican 2021; Pace 2021). In quota sampling, the researcher divides the population into strata, and the sample units are recruited randomly from these strata until the desired quota is achieved. In this study, the researcher employed quota purposive sampling to select 48 key informants, who were extension librarians from the MAAIF department head office (n=3), district extension officers (n=35), and district extension service libraries (n=10) from the major maize producing districts (Adjumani, Iganga, Kabarole and Mubende). This sample represented the four regions of Uganda and the head office, which formed five strata (Table 13).

Table 13: Sample size for extension officers and information officers

No.	Region/District	Extension officers	Sample (n)	Information officers	Sample (n)
1	Eastern	966	9	32	2
2	Western	960	9	32	2
3	Central	978	8	32	2
4	Northern	940	8	32	2
5	Head Office	12	4	3	2
	Total	3854	38	131	10

4.8 Research instruments

Research instruments are the methods that researchers use to obtain the required data for their study (Culcut University 2017). This study used a survey questionnaire, observations and interviews/focus groups to collect primary data, and document analysis to obtain secondary data.

4.8.1 Closed-ended questionnaire

A closed-ended questionnaire is a survey instrument that provides various options from which respondents choose in response to the questions asked (Stockemer 2019). This study used a closed-ended questionnaire as the instrument to gather quantitative data. The questionnaire comprised two sections: respondents' sociodemographic characteristics and the evaluation section. The questionnaire (Appendix 1) was translated to four local languages (Luganda, Lusoga, Madi and Rutooro) as shown in Appendices 2–5, and then administered to rural smallholder farmers.

A five-point Likert scale was used to rate the questionnaire items and determine the extent of relationships in the quantitative data (Gracyalny 2017; Mohn 2023). The five response options indicated the level of agreement or disagreement: 1=strongly disagree, 2=disagree, 3=neither agree nor disagree (neutral), 4=agree and 5=strongly agree (Gracyalny 2017; Mohn 2023; Leavy 2017; Stockemer 2019).

4.8.2 Interviews

Interviews are used to collect and record qualitative data during a study. Interviews can either be one-on-one or use a focus group format in which multiple participants are interviewed in a group (Ngulube 2015). Interviews can be designed in various ways, including in-depth, unstructured, semi-structured, an oral history or life history, biographic minimalist and focus groups (Leavy 2017). This study used a semi-structured interviews (see Appendices 8 and 9 for the interview guide) to collect data from agriculture extension officers and information officers. The researcher first interviewed the key informants using a focus group discussion format, with in-depth individual or one-on-one interviews then conducted to verify and confirm the data, and gain a deeper understanding of the studied phenomena.

4.8.3 Focus group discussions

Focus group discussions are interviews that aim to explore people's perceptions and experiences regarding a phenomenon in a group setting where a broad topic is discussed (Flick 2014; Kumar 2019). In focus groups, the researcher gets to learn as people deliberate (Khan & Abedin 2022). Focus group discussions can be conducted face-to-face or online using a computer-enabled facility. Online focus group discussions are convenient, flexible and inexpensive (Aurini, Heath & Howells 2022; Marley et al. 2023), although not suitable for remote areas without proper Internet connectivity and participants that are not computer literate.

Physical discussions are more costly and may it be difficult to reach the population, although they can create stronger rapport, are convenient for rural/uneducated/non-computer literate participants and are easily noted (Aurini, Heath & Howells 2022; Flick 2022). Previous research suggested components and step-by-step procedures that a researcher should consider to conduct an effective focus group discussion, including the number of participants, the purpose and objectives, a discussion guide and the topic to be discussed (Aurini, Heath & Howells 2022; Flick 2014, 2022; Kumar 2019; Khan & Abedin 2022; Moniques 2014). The purpose of the study and the topic to be discussed dictate the number of participants for a focus group (Aurini, Heath & Howells 2022; Flick 2014; Kumar 2019; Khan & Abedin 2022; Moniques 2014). Other important factors to consider are the moderator, note taker, meeting location, recording of the discussions, and data transcription, analysis and reporting (Aurini, Heath & Howells 2022; Flick 2014, 2022; Kumar 2019; Khan & Abedin 2022; Monique 2014).

In this study, two focus group discussions were held, with a guide (Appendix 6) used to discuss broad research topics for integration in the larger research. For convenience, one group discussion was held physically, and the second was held online using the Zoom platform. The online group had 10 participants, and combined extension officers and information officers to discuss the EBIP framework. The second group comprised nine smallholder farmers, and discussed access to and use of EBI for maize postharvest handling. The aim of these discussions was to gain further understanding of peoples' actual thoughts, feelings and perceptions concerning the topic under study.

4.8.4 Qualitative observation

Qualitative observation is a process in which the researcher participates in the data collection activity at the research site through observing participants' behaviour and recording the information (Creswell 2014). This study employed an observation checklist (Appendix 7) to verify participants' answers and examine the physical facilities that were available as evidence of the existing services being evaluated, described and examined among smallholder farmers. For example, the researcher observed when smallholder farmers were seeking evidence in the library.

4.8.5 Document analysis

Document analysis is a secondary data collection method whereby various public and private documents are studied to obtain relevant data for a study (Creswell 2014). Bowen (2009) and Kutsyuruba (2023) explained that document analysis is a systematic evaluation and reviewing

procedure that examines and interprets documents to gain meanings and understanding of empirical research. Saunders, Lewis and Thornhill (2019) highlighted examples of secondary data that researchers can consider valid for their research question, including data collected through surveys (e.g. a government census), organisation reports, books and journal articles. This study examined the government of Uganda's Information Access Act 2005, Uganda National Household Survey 2019/2020 report, National Agricultural Extension Strategy 2016/17–2020/21, Extension Guidelines and Standards 2016, The Constitution of the Republic of Uganda 1995, The Budget Monitoring and Accountability Unit (BMAU) briefing paper 25/19, 2019, and The Maize Training Manual for Extension workers in Uganda to supplement the qualitative primary data. Electronic and print documents were reviewed and evaluated to gather the information that helped draw conceptual boundaries for this study and gain an understanding of the research phenomena. These data were combined with the primary data to draw meaningful conclusions. Document analysis is also used in mixed-methods studies as a technique for triangulating research methods in a study to facilitate convergence and corroboration (Bowen 2009).

4.8.6 Administering the research instruments and data collection

The present researcher worked with local research assistants and agricultural extension officers/production officers to access rural smallholder farmers. Two training sessions were held to equip the research assistants with the necessary skills to recruit participants ethically, interpret and administer the research tool and ensure the intended responses were collected. The respondents were first enumerated and counted. Next, a strategic simple random number table was used to select respondents for the quantitative part this study, as explained by Saunders, Lewis and Thornhill (2019). A convenience-based purposive quota was employed to recruit participants for the qualitative part of this study.

4.9 Validity and reliability of the methodology in the research process

Although research can have flaws, there are many possible ways that research can validate their study and ensure its quality and trustworthiness. The issue of study quality in mixed methods research is of concern among researchers, and has been debated by several scholars (Fàbregues, Pare & Meneses 2019; Perez, Smith, Babchuk & Lynch-O'Brien 2023). These debates have been noted in library and information science studies where the rigour of mixed methods research has been reported as not clear and openly shared (Ngulube & Ukwoma 2021).

Over the years, mixed methods researchers have attempted to share various ways novice researchers can show rigour in their mixed methods studies. However, these methods are not easy for a novice researcher to follow (Hirose & Creswell 2023). Suggested strategies include being sufficiently transparent (Ngulube & Ukwoma 2021), using frameworks (O'Cathain, Murphy & Nicholl 2008; Harrison, Reilly & Creswell 2020), using guidelines (Creswell & Creswell 2018), using established criteria (Hirose & Creswell 2023:15) and continuous validity (Jameson-Charles 2015; Leech & Onwuegbuzie 2010; Onwuegbuzie & Sutton 2006).

The present researcher observed that most of these scholars had common ideas, which were transparency, choosing a specific mixed methods design, providing clear justification or rationale for using mixed methods, incorporating mixed methods throughout the study, including the research questions, and showing the integration and how conclusions were drawn. Creswell and Poth (2023:286) reported that 'writers have searched for and found qualitative equivalents that parallel traditional quantitative approaches to validation'. Those authors validated their statement by providing a summary table of the terms used in both qualitative and quantitative approaches from 1982 to 2011, such as internal and external validity, credibility, triangulation, ethical validation, fair representation and transparency. This statement suggested that there is no difference in validating qualitative and quantitative studies. Therefore, this mixed methods study combined validation approaches as described for both qualitative and quantitative studies.

Ngulube and Ukwoma (2021) argued that the more mixed methods researchers in library and information science are transparent about the research process by documenting the whole process, including challenges, limitations and strengths, the better the research rigour. In this study, the entire process was documented to ensure transparency In addition to being transparent, this study considered the framework established by O'Cathain, Murphy and Nicholl (2008); namely, the Good Reporting of a Mixed Methods Study (GRAMMS) for health sciences. This framework has also been implemented by other mixed methods researchers in other disciplines (e.g. business and education) (Cameron, Dwyer, Richardson, Ahmed & Sukumaran 2013). The O'Cathain, Murphy and Nicholl (2008) framework recommends observing and reporting six elements: (i) the study should justify the need for mixed methods in the research; (ii) the mixed methods research design should be specified; (iii) the sampling technique for data collection and analysis in each method should be explained; (iv) there should be clear integration of methods, including when, where and how this occurred; (v) the limitations should be discussed; and (vi) the new understanding or ideas acquired in the process of integrating the methods should be clarified (Granivok et al. 2020; Nakasiba & Namujuzi 2020). The present

researcher believed the framework was also applicable for library and information science and was therefore relevant for this study, which was situated in the social science disciplines.

To further explain the application of GRAMMS in this study, the researcher provided justification for using mixed methods research (Section 4.3). The design chosen was convergent parallel mixed methods research (Section 4.4). The sampling technique adopted in this study for each dataset, data collection and analysis were clearly explained (Sections 4.6 and 4.10). Validity was confirmed in all stages of this study, including forming the questions, sampling, data collection, analysis, integration and conclusions (Clark & Ivankova 2016). Creswell (2014) highlighted the areas where validity in convergent parallel design studies should be observed, which included sample size equality in the qualitative dataset and integrating the findings from the quantitative and qualitative datasets. This study ensured there was equal representation in the quantitative and qualitative samples, with each stratum represented. A clear integration strategy is shown in Figure 11, which was based on the suggestion by Hirose and Creswell (2023) that the integration should be in the form of a drawing.

Fàbregues, Pare and Meneses (2019) examined mixed methods research in four disciplines reported that quality should be observed from all the phases of research. This includes planning, where the problem, purpose, research question and clear mixed methods design are stipulated, and when conducting the study where the quantitative and qualitative components are adhered to, including the integration process. In this study, interpretations and inferences drawn from the data were consistent with the findings, and any anomalies were transparently reported (Section 4.12). The findings have been reported openly, including the mixed methods literature cited and new insights discovered.

In this study, the validity and reliability of mixed methods research were transparently handled as a continuous process, as proposed by Onwuegbuzie and Johnson (2006), who introduced a ‘legitimation typology’ for assessing quality in mixed methods research. Legitimation typology assumes that mixed methods study quality assessment is a continuous process that is performed from identifying the research problem, planning, data gathering, presentation and interpretation of the findings to drawing conclusions (Creswell & Poth 2023; Perez, 2019; Perez, Smith, Babchuk & Lynch-O’Brien 2023). The legitimation typology process is not unique to qualitative and quantitative studies, which follow the same criteria of setting out a proposal or clear plan for the research, and ensuring consistency in the data collection, interpretation and conclusions. Transparency is also emphasised in all research paradigms.

Therefore, the researcher must handle issues of validity or quality (external and internal threats) continuously as they surface throughout the research process using the legitimation typology strategy of keeping within the pluralism assumptions, establishing a clear research plan and transparently stipulating the research problem, purpose, questions, design, sampling and integration, and using more than one data collection method (Jameson-Charles 2015). Furthermore, research integration must occur throughout the study. In the present study, integration was performed throughout the data collection, presentation of findings, interpretation, discussion, conclusions and recommendations (Perez, Michelle, Smith, Babchuk, Louise & Lynch-O'Brien 2023; Younas et al. 2020).

4.9.1 Application of pluralism and a large sample

Multiple (quantitative and qualitative) datasets, use of more than one data collection method, multiple validities, integration and the use of a large sample with a high confidence level enhanced the credibility of the present findings (Leavy 2017; Schoonenboom & Johnson 2017). This study included a large sample for the quantitative arm (N=400) with a 95% confidence level or 0.5% accepted error to ensure its validity. Furthermore, a structured questionnaire was used for the quantitative dataset, with personal interviews, observations, focus group discussions and document analysis used to collect qualitative data and validate the findings. Use of multiple techniques to collect data ensured the verification of the data, and aim and objective of pluralism, and therefore established the validity (Creswell & Poth 2023; Leavy 2017).

4.9.2 Establishing a clear research plan

A research proposal or plan that stipulated the research problem, purpose, questions and design was developed for this study. These aspects have been described in detail in Chapter 1. The proposal or plan was approved and then followed when conducting this study. The researcher was transparent and comprehensive in the research process, from the plan to the conclusion, including in sampling, data collection and interpretation, which makes the findings understandable and trustworthy (Leavy 2017).

4.9.3 Multiple validation of mixed methods

Reliability is the process of ensuring the methods used in the research process are accurate, consistent, replicable and reliable in terms of yielding the desired results (Leavy 2017). This process is achieved through a pretest. Pretesting is when research instruments are tried out on the target population to establish their reliability and validity before the actual study is conducted (Hu 2014). A pretest helps the researcher identify any inconsistencies and errors in the

instruments and correct them before the main study. In this study, a pretest was performed in Kasenda and Nambale, which are sub-counties of Iganga and Kabarole districts, respectively. The results indicated that some questions were misunderstood; therefore, they would generate unreliable responses. The researcher evaluated this feedback and corrected the instruments accordingly. This process was guided by the legitimation typology strategies, which means the tests were performed many times to ensure consistency.

4.9.4 Content validity and reliability

Yusoff (2019) defined content validity as the level to which a research instrument is relevant and representative of the purpose of the assessment construct. Content validity in this study was ascertained by subjecting the research instruments to research experts on the topic for peer review. Using more than one method to collect data from various sources on the same issue with the aim of verifying the data is known as data triangulation and contributes to content validity (Dawadi, Shrestha & Giri 2021; Leavy 2017). For example, as the rural smallholder farmers completed the questionnaire or the key informants answered the interview questions, the researcher was simultaneously using an observation checklist to verify the physical facilities that were asked to prove their existence. For the qualitative data, the researcher reported inconsistent data or information that was discovered to be contrary to data accuracy. Furthermore, the researcher involved peers as external auditors to review the evidence and give their opinions that the researcher had adhered to ensure accuracy and trustworthiness (Creswell & Clark 2018).

The use of SPSS version 29 and ATLAS.ti 24 data analysis software in this study was guided by expert administrators who knew the proper use of the software. The researcher also ensured that the selected theory constructs were used in the data collection instruments. This was achieved by going through the questionnaire and interview guides item-by-item and rating the validity of the questions. A content validity index formula (R/N) was used for each item to test their validity using a rating scale of 1–5 whereby scores of 4 and 5 indicated the items were valid and consistent with the study (1=very poor, 2=poor, 3=satisfactory, 4=good and 5=very good). Where R was the number of items declared valid and N was the total number of items tested (Surucu & Maslakci 2020; Yusoff 2019).

4.10 Data analysis

The qualitative and quantitative data were analysed separately, and then merged at the interpretation phase, as advised by the mixed methods research experts (Creswell & Clark 2018; Demir 2018; Leavy 2017; Perez, Smith, Babchuk & Lynch-O'Brien 2023).

Quantitative data analysis

Quantitative data analysis is the process of identifying meaning, relationships and trends from numerical data collected in a questionnaire (Clark & Ivankova 2015; Leavy 2017). For a quantitative dataset, Leavy (2017) advised the use of statistical software. In this study, SPSS version 29 was used for the quantitative data analysis to bring out meaning from the data. Descriptive statistics were used to present the results in the form of frequencies and percentages. Tables were used for univariate bivariate and cross-tabulation data analyses. Correlational data analyses for inferences were performed using Pearson's chi-square product moment correlation to analyse categorical data and establish the relationships between variables. A five-level mean range scale of 1–3.90 was used (strongly disagree, disagree, neutral, agree and strongly agree).

The relationships between variables were evaluated using levels of statistical significance. This statistical measure was chosen for this study to further analyse the quantitative data by testing the nominal and categorical variables to offer more meaningful conclusions or inferences showing how the variables affected each other. Chi-square tests were used to test the significance of relationships between variables at a 5% level of significance. Cross-tabulations were applied to further understand these relationships using likelihood ratio and linear-by-linear association analyses. Degrees of freedom (df) represented the number of independent pieces of information available to estimate a factor. In the context of chi-square tests, the df is related to the number of categories in the variables being compared. For Pearson's chi-square and likelihood ratio tests, the df was 4, indicating that four categories were being compared. For the linear-by-linear association test, the df was 1, indicating a comparison between two categories. 'Asymp. Sig. (2-sided)' provides the asymptotic significance (p-value) associated with each test statistic. It indicates the probability of observing the test statistic value or more extreme values under the null hypothesis (i.e. assuming there is no association between the variables). When the p-value is higher than the significance level (i.e. 0.05), the null hypothesis is not rejected as the findings did not provide sufficient evidence to conclude that there was a significant relationship between the variables being tested. Conversely, when the p-value is less than 0.05, the results show a level of significance or a relationship between the variables tested (Zai 2018).

Qualitative data analysis

Qualitative data analysis is the process of obtaining meaning from non-numeric data, and is often considered the most challenging phase of a qualitative inquiry (Braun & Clarke 2022; Grbich 2023; Lester, Cho & Lochmiller 2020; Mattimoe, Hayden, Murphy & Ballantine 2021). There are various methods used to analyse qualitative data; however, content analysis, thematic analysis, grounded theory analysis, discourse analysis and narrative analysis are commonly used (Braun & Clarke 2022; Burck 2005; Grbich 2013; Mattimoe, Hayden, Murphy & Ballantine 2021; Shava, Hleza, Tlou, Shonhiwa & Mathonsi 2021). In content analysis, the researcher concentrates on identifying the consistency of concepts to form patterns and conclusions (Grbich 2013). In narrative analysis, the researcher examines participants' stories to understand their meanings and perspectives (Burck 2005). In discourse analysis, the researcher examines the language of participants' social contexts to understand the data (Burck 2005). In thematic analysis, the researcher deductively or inductively reads through the data, identifies themes and explains the meanings within the themes (Braun & Clarke 2022; Burck 2005; Mattimoe, Hayden, Murphy & Ballantine 2021; Vaismoradi, Turunen & Bondas 2013). Grounded theory analysis involves the researcher developing a theory based on a single data case before moving on to additional cases. Each of these methods has weaknesses and strengths and may be selected because of the researcher's preference and the suitability for the study. The present researcher considered thematic analysis to be flexible and accommodative, and therefore most suitable for this study (Lester, Cho & Lochmiller 2020). The six-phase thematic analysis framework proposed by Braun and Clarke (2006) was used to analyse the qualitative data in this study. The six phases are: knowing the data, coding the data, forming code groups or themes, reviewing the themes, deciding on the important themes and reporting the results (Braun & Clarke 2006, 2022). This study used ATLAS.ti 24 (which is supported by UNISA) for the qualitative dataset to form codes, categorise codes in the form of themes (case-by-case), generate codes and quotations in visual figures, code frequency tables, word clouds, networks and memos, as deemed necessary, to observe meaningful comparatives, associations, and correlations (Akerblad, Seppanen-Jarvela & Haapakoski 2021; Leavy 2017).

The researcher uploaded the data to ATLAS.ti in the form of documents. The uploaded documents were grouped into five groups based on how the findings were realised (personal interviews, focus group discussions, quantitative open-ended questions, observations and document analysis). The researcher conducted 26 in-person interviews with agriculture extension workers and information officers, held two focus group discussions and conducted

four observations. The researcher read and re-read the documents one after another to become familiar with the data. The most relevant segments of the data were identified as the researcher was reading and re-reading the documents. Next, the first codes were generated by marking the relevant segments in the documents in the form of quotations and assigning codes using the open and quick codes. The codes were then grouped by their respective families or relevant overarching codes to help the researcher organise the findings and understand the relationships between concepts from the perspective of the research questions and objectives. Thereafter, themes were reviewed, re-grouped and some additions were made. They were then confirmed as suitable themes using common patterns, topics and connections as advised by Creswell and Poth (2023), whereby similar codes formed code groups and refined code groups formed themes. The present researcher developed a code book for the codes and code groups, as presented in Appendix 24.

4.11 Data interpretation and integration

Leavy (2017) posited that data interpretation in mixed methods research was not easy. However, it is made possible through various ways, such as one dataset confirming the other (corroboration), one dataset explaining the other (elaboration), one dataset introducing the other (initiation), both datasets complementing each other (complimentary) and both datasets contrasting each other. Mixed methods researchers should explain how they combined their quantitative and qualitative data (Creswell & Hirose 2019; Ngulube & Ukwoma 2021). Integrating data promotes methodological transparency (Ngulube & Ukwoma 2021) and provides a comprehensive understanding that can yield deeper explanations and more new insights than separate datasets (Creswell & Hirose, 2019). This study employed a convergent design and technique (Hands 2022), with data analysed simultaneously to identify convergence or divergence. The datasets were then integrated when evaluating, presenting, interpreting and discussing the findings and drawing conclusions. This was based on the process of comparing, confirming, explaining and contracting research questions objectively to draw inferences using descriptive statistics and content analysis procedures (Figure 11). A narrative weaving approach was used to explain the interpretation and report the findings. This weaving approach involved presenting the qualitative and quantitative findings on a theme-by-theme or concept-by-concept basis to show collaborations and relationships (Fetters, Curry & Creswell 2013; Skamagki, King, Carpenter & Wåhlin 2024).

4.12 Ethical considerations

Ethics govern the ways of conduct for individuals, professions, institutions and communities. Leavy (2017), Creswell and Clark (2018) and Ngulube (2020) noted that ethics in research are the values that a researcher cherishes in the research process, from the conception of the research topic to the study conclusion. The UNISA ethical values of accountability, originality, integrity and proper referencing were adhered to in all steps of this research (UNISA 2020). This study was also conducted in a manner that did not contravene the values of the Uganda research community. Permission to conduct this study was sought and granted (refer to the permission letters, Appendices 15–19). This study was also registered by the Uganda National Council of Science, and Technology (registration number SS1435ES) and the accredited local Research Evaluation Committee, known as The AIDS Support Organization (Appendix 20). The study was ethically evaluated and approved by the South African ethical clearance body at UNISA (Appendix 22).

Participation in this study was voluntary to respect participants' rights. The data collection instruments included a statement to assure respondents that the study aimed to generate new knowledge that will benefit society and will not harm anyone. To maintain respondents'/participants' confidentiality and anonymity, the researcher excluded names and any other clues that could identify them. Caution was exercised during data analysis, interpretation and storage to prevent potential identification of respondents/participants. The researcher adhered to the data validation strategy of participant checking audits when assessing the interpretations to avoid bias, as advised by Creswell and Poth (2023). The researcher also upheld academic integrity by properly citing and referencing sources, acknowledging the contributions of other authors and adhering to the appropriate referencing style throughout this thesis.

4.13 Evaluation of the research methodology

Evaluation is the systematic assessment of a process to establish its worth in terms of money, time and any other efforts, while highlighting limitations and strengths for further improvements (Wanzer 2021). This definition of evaluation was applied to evaluate the process of this study. A researcher's transparency helps further researchers to avoid repeating the same limitations or become more aware of the road they are going to be undertaking. This study adopted the pragmatist or pluralist paradigm, which gave the researcher freedom to draw on multiple methods, assumptions and worldviews to implement this research. The researcher integrated different perspectives, constructs and insights from relevant literature, theories and frameworks

(e.g. theory of practice, evidence-based library and information practice model, maize postharvest handling value chain, Uganda Information Access Act and the extension services framework) to address the research question, develop research instruments, refine the objectives and validate the findings. The choice of concurrent or parallel convergent design to collect both qualitative and quantitative data saved time and resources.

This study had various limitations and challenges. This study became broader than initially expected after the researcher realised it needed to cover four districts in Uganda. Having to include three different types of populations also made the study more demanding. Focusing on two aspects was challenging (i.e. access to and use of EBI and the agriculture extension services implementation of translation and packaging evidence using EBIP). Issues with unresponsive participants, the use of more multiple tools (questionnaire, interview guide and observation guide) meant the researcher needed a lot of time and resources. Furthermore, the unfavourable road network in the study areas made movement difficult. The focus group discussions were difficult to conduct online because of Internet connectivity challenges, but it became expensive for people to move from one place to another to attend a meeting. Through persistent follow-up, two focus group discussions were held, one online and another physically. The researcher used both Google Forms and physical printouts of the tools to collect the required data, which catered for those able to use online means and those without such means. Telephone calls and WhatsApp groups were used to contact the local research assistants and respondents/participants. The data collection process took 7 months (November 2023 to May 2024) despite being planned to take 3 months. A lot of time was also used to become familiar with ATLAS.ti 24, which was new to the researcher. A major challenge was that the software constantly logged the researcher out and asked to ascertain the license. These ATLAS.ti difficulties restricted the researcher to the basics; prior knowledge and greater stability of the software would have made the work easier.

However, the researcher's determination, involvement of local research assistants, consultations with a statistician and colleagues, their supervisors' commitment and assistance and peers' evaluations provided encouragement to push on to the end. The researcher, with support from their family, funded this study, which proved almost impossible. Despite these challenges and difficulties, this study was successful. The researcher agrees with scholars such as Creamer (2018), Creswell and Clark (2018), Love (2022), Morse and Linda (2016) and Ngulube (2015) that mixed methods research is meticulous and needs diligence, time and funds to execute. The novice mixed methods researcher needs to set time to learn it well and plan

effectively to be able to achieve the ‘mixing’ aspect of the two independent methodologies (quantitative and qualitative) in all phases of the study. This is because mixed methods research, when implemented well, is an approach that provides a clear understanding of complex problems and yields rich results.

4.14 Chapter Summary

This chapter presented the research procedure that was followed to conduct this study. It discussed the research paradigm, study approach, population, sampling procedures, sample size, and data collection methods and instruments. Furthermore, this chapter discussed the procedures followed in ensuring the study’s validity and reliability, managing the data processing and analysis and ethical considerations. It also provided an evaluation of the chosen research methodology.

Using more than one method of data collection was useful in cross-examining and validating the findings. Pre-testing and legitimation typology were instrumental in ensuring the consistency, reliability and credibility of the findings. Importantly, the registration of this study with the Uganda National Council of Science and Technology added value to the study, as it means it was needed and found important for the country. The next chapter presents the quantitative and qualitative findings.

CHAPTER 5

PRESENTATION OF THE STUDY FINDINGS

5.0 Introduction

This chapter describes the findings of this study, which are presented thematically and concurrently by the data source. In each section, the quantitative survey findings are presented first, followed by the personal interviews, focus group discussions, and observations. This presentation enabled the researcher to derive inferences, make comparisons and ensure comprehensiveness, complementarity and corroboration among variables.

This study embraced pluralism in the sense that the researcher believed in acquiring knowledge using various scientific methodologies to ensure a comprehensive, complementary, corroborative and balanced study (Clark & Ivankova 2015; Ngulube 2019; Creswell 2023). Therefore, the quantitative and qualitative data were collected concurrently using a survey questionnaire, personal interviews, observations, document analysis and focus group discussions. The quantitative and qualitative data analyses were performed separately. The data were then integrated during the presentation of the findings (Chapter 5), the interpretation and discussion (Chapter 6), and the summary, conclusions and recommendations (Chapter 7) as advised by mixed methods research experts (Creswell & Clark 2018; Demir 2018; Leavy 2017; Perez, Smith, Babchuk & Lynch-O'Brien 2023). The present study sought to answer the following research questions.

1. To what extent does EBIP influence access to and use of relevant scientific research information for maize postharvest handling practice by smallholder farmers in Uganda?
2. What are the specific maize postharvest handling EBI needs for rural smallholder farmers in Uganda?
3. How and where (sources) do rural smallholder farmers access maize postharvest handling EBI?
4. What difficulties do smallholder farmers and extension service providers experience with accessing maize postharvest handling EBIP?
5. What can be done to ensure EBIP is implemented within the extension services to contribute to access to maize postharvest handling EBI by rural smallholder farmers in Uganda? Why?

5.1 Response rate

The survey response rate was 80% or 320 of the 400 respondents sampled (Table 14). Adjumani district (Northern region) had a response of 100%, followed by Iganga (Eastern Region) with 94.7%, Mubende (Central Region) with 77.7% and Kabarole (Western Region) with the lowest response rate at 50.5%. The low response rate in Kabarole was attributed to the poor road terrain that made data collection and callbacks difficult compared with other districts. The responses were considered representative of the overall rural smallholder farmers derived from Uganda's four regions.

Table 14. The response rate for rural smallholder farmers

No.	District	Sample	Sample proportion (%)	Responses (n)	Response proportion (%)
1	Iganga	133	33.20	126	94.7
2	Kabarole	105	25.50	53	50.5
3	Mubende	94	23.50	73	77.7
4	Adjumani	68	17.00	68	100
	Total	400	100	320	80.00

5.2 Participation rate in the qualitative study

Table 15 shows the participation rate for the personal interviews conducted as part of the qualitative arm of this study. Personal interviews were conducted among participants from five workstations: the four selected districts (Adjumani, Iganga, Kabarole, Mubende) and the MAAIF Head Office, which is in Entebbe Municipality. These participants were given codes as described in Appendix 13. The codebook for the qualitative study (Appendix 24) sets out the codes and code groups.

Table 15. Response rate for personal interviews

Workstations	Sample	% of sample	Responses (n)	Response proportion (%)
Ministry Head Office (Entebbe)	6	12.50	2	33.3
Adjumani	11	22.91	7	63.6
Iganga	10	20.83	4	40.0
Kabarole	11	22.91	9	81.8
Mubende	10	20.83	4	40
TOTAL	48	100.0	26	54.15

The response rate for the personal interviews was higher in Kabarole (9, 81.8%) compared with the remaining districts. Participants were coded by number (P1–P26) and the initial representing their district (Appendix 23). Details of responses for the focus group discussions are presented in Table 16.

Table 16. The response rate for the focus group discussions

Focus group discussion	Codes	Sample	%	Responses (n)	%
Physical	FGD1 (09.02.2024)	11	50	9	81.81
Online (Zoom)	FGD2 (13.03.2024)	11	50	6	54.5
Overall Total		22	100	15	68.18

Two focus groups were conducted (Table 16) to deepen the researcher's understanding of people's true thoughts, feelings, and perceptions about the topic being studied. The focus groups were coded as FGD1 (held on 09.02.2024) and FGD2 (held on 13.3.2024). The physical focus group discussion had higher attendance (81.8%) than the online group (54.5%). The focus groups did not attract participants from the Adjumani and Mubende districts. The low attendance of the focus group discussions was attributed to poor connectivity and some officials being busy with other assignments at the scheduled time of the discussions.

This study also used observations as part of the data collection. These observations aimed to answer the third and fourth research questions concerning the sources of EBI and the difficulties rural smallholder farmers experienced when accessing EBI.

5.3 Document analysis

Several documents from the Government of Uganda were analysed to supplement the primary data. These were: i) Uganda National Household Survey 2019/2020 report (UNHS 2019); ii) National Agricultural Extension Strategy 2016/17–2020/21(NAES 2016); iii) Extension Guidelines and Standards 2016 (EGS 2016); iv) The Constitution of the Republic of Uganda 1995(CRU 1995); v) Uganda Information Access Act 2005 (UAA 2005); vi) the BMAU briefing paper 25/19, 2019 (BMAU 2019); and vii) The Maize Training Manual for Extension Workers in Uganda (MTEWU). The information generated from these documents is presented together with the other findings using the codes in the bracket.

5.4 Questionnaire respondents' demographic characteristics

The demographic or unique characteristics of the questionnaire respondents examined were: gender, literacy, age bracket and Savings and Credit Cooperative Organization (SACCO) membership.

Table 17. Demographics of questionnaire respondents

	Number	**%**
Gender		
Female	135	42.0
Male	182	57.0
Preferred not to declare gender	3	1.0
Total	320	100
Literacy levels		
I can read and write	227	70.9
I cannot read and write	81	25.3
No response	12	3.7
Total	320	100
Age bracket, years		
18–40	246	76.87
41–60	69	21.56
≥61	5	1.56
Total	320	100

SACCO		
Yes	160	50.00
No	154	48.12
No response	6	1.87
Total	320	100

Table 17 presents a summary of these characteristics. In total, 57.4% of the respondents were men, and 42.6% were women. This indicated that the majority of maize smallholder farmers were male. The majority of respondents (70.9%) were literate, 25.3% were illiterate and the remainder (nearly 4%) did not indicate their literacy status. The rate of literacy among respondents was close to the national literacy level average (80.6%) (UNHS 2019). Most respondents (76.9%) were aged 18–40 years, which was consistent with Uganda's largely youthful population composition (UNHS 2019). Only 23.1% of respondents were aged over 40 years, which suggested there were relatively few older farmers.

Nearly half of the respondents held SACCO membership, which was a critical aspect in terms of financial support for farming enterprises. This finding was thought to reflect the recent government drive to set up SACCO and Farmers Cooperatives to support smallholder farmers and small and medium enterprises in Uganda. This implied that smallholder farmers had access to credit facilities offered through SACCO across the country.

The qualitative data from personal interviews (P10-ADJ; P2-KAB) and observations (PIGA) supported the quantitative data that showed many rural smallholder farmers (81, 25.3%) could not read on their own, even in their local language. These farmers needed assistance to complete the questionnaire.

5.5 Qualitative participants' demographic characteristics

Table 18 presents the demographic information for those who participated in the personal interviews and focus group discussions.

Table 18. Demographics for the personal interviews

	Participants	%
Gender		
Female	8	30.7
Male	18	69.3
Total	26	100
Category of the participants		
Agriculture extension officers	20	77.0
Information service providers	6	23.0
Total	26	100
Age bracket		
18–40	18	69.3
41–60	8	30.7
Total	26	100
Qualifications		
Master of Library and Information Science	1	3.8
Master of Science in Agriculture Crop	2	7.6
Bachelor Science in Agriculture	17	65.8
Bachelor of Arts Mass Communication	1	3.8
Diploma in Agriculture	4	15.3
Diploma in Library and Information Science	1	3.8
Total	26	100

Table 18 shows the demographic details of the personal interview participants. Out of the 26 (100%) participants, 18 (69.3) were female, while eight (30.7%) were male. Two categories of participants were interviewed: the Agricultural extension officer (20, 77.0%) and Information service providers (6, 23.0%). Among those interviewed, there were three (11.4%) master's holders, 18 (69.3%) degree holders and five (19.2%) diploma holders in their respective qualifications. This means that the interviewees had training in what they were practising.

5.6 Influence of EBIP on access to and use of maize postharvest handling information

The findings regarding the status of the influence of EBIP on access to and use of information on maize postharvest handling are reported by themes, such as maize farming activity for rural smallholder farmers (i.e. farm size), harvest quantity, postharvest loss, access to and use of

EBI, EBIP, sources of EBI, the evidence itself, translation and repackaging of evidence, means of dissemination and stakeholders in information dissemination.

5.6.1 Maize farming activity and postharvest handling by rural smallholder farmers

Respondents were asked to declare their maize farming activity in the last season in terms of the land size they farmed, the quantity of maize harvested, and the postharvest loss experienced in terms of bags or kilograms. This was to enable understanding of the maize postharvest handling variable in this study. The findings are presented in Figures 12 and 13.

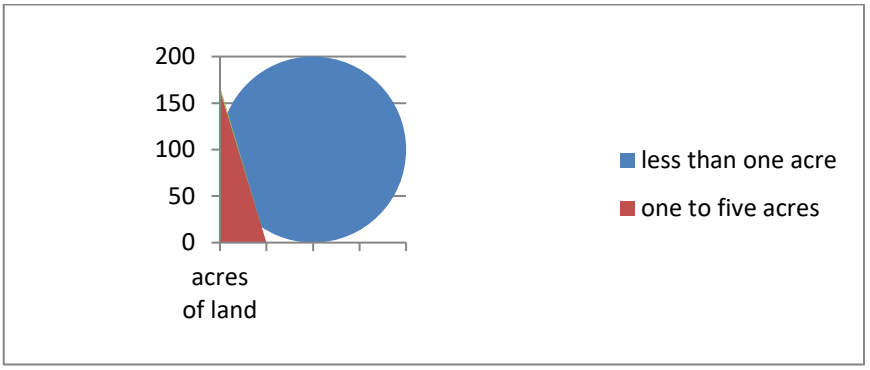

Figure 12: Acres of land farmed by rural smallholder farmers in Uganda

Figure 12 vertically shows the number of responses (N=320) and horizontally the amount of land owned in terms of acres. Figure 12 indicates that the majority of respondents (164, 51.2%) had farmed 1–5 acres in the last season, and the remainder farmed less than 1 acre (152, 47.5%). Four (1.25%) respondents did not answer this question.

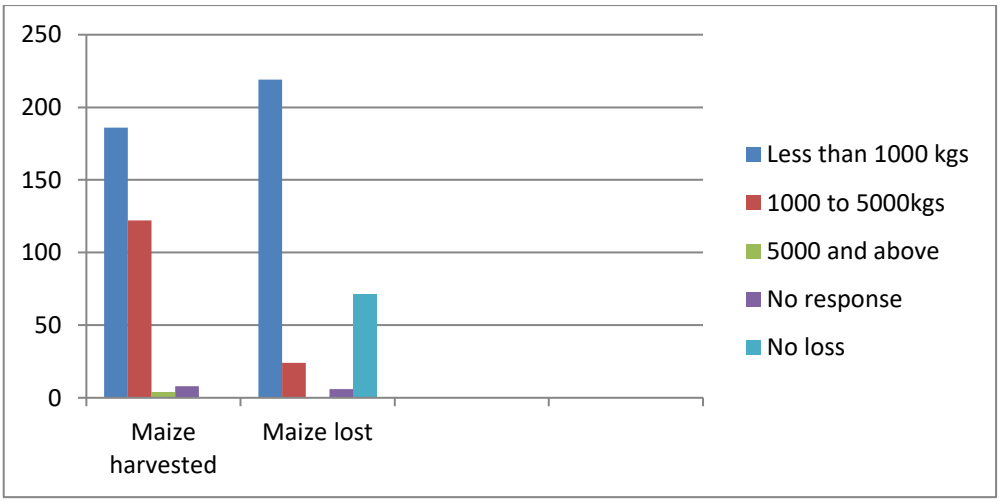

Figure 13: Quantity of maize harvested and lost

Concerning maize output, Figure 13 shows vertically that the majority of respondents (186, 58.1%) had harvested less than 1,000 kilograms of maize in the last season, and 124 (38.7%) had harvested 1,000–5,000 kilograms. These findings confirmed the subsistence nature of most smallholder farmers in Uganda, whose farming practices were non-mechanised and reliant on rudimental tools such as hand hoes, axes (pangas) and ox ploughs. Eight respondents (2.0%) did not answer this question. However, two respondents (1.2%) reported they had managed to harvest more than 5,000 kilograms from 5 acres of land.

The qualitative information collected from personal interviews with key informants confirmed that rural maize farmers grew maize on small farms using simple tools such as hand hoes and animals; few could afford tractors or other forms of mechanisation (P1-IGA; P3-KAB). In addition, the qualitative data suggested the maize harvest returned low yields because of poor soils, fake seeds, high fertiliser costs, and a lack of EBI on how to scientifically improve the soils for improved crop yields (FGD1 09.02.2024).

Figure 13 also shows the losses declared by respondents who had harvested maize in the last season. The registered losses were in varying proportions by the amount, district and farmers' exposure. Altogether, 240 (75%) of respondents had experienced postharvest loss, although 71(22.2%) of them said they had not registered any loss of maize, and nine respondents (2.8%) did not answer the question. The findings from FGD2 (13.03.2024) estimated post-harvest maize loss at 40% in Mubende District and 60% in Iganga District because of factors such as heavy rains, lack of dryers and insect pests (e.g. weevils).

5.6.2 Access to and use of maize post-harvest handling information

Respondents were asked to state the status of access to and use of maize postharvest handling information in their community using closed-ended questions (questionnaire items 9–17). These questions aimed to determine what and how information influenced their postharvest handling activities. Respondents were asked to rate their level of agreement with each of the statements concerning access to maize postharvest information. Responses were different for each of the major postharvest handling activities, as seen in Figure 14, the vertical axis represents the category of information accessed and the horizontal shows the number of responses out of the total N=320.

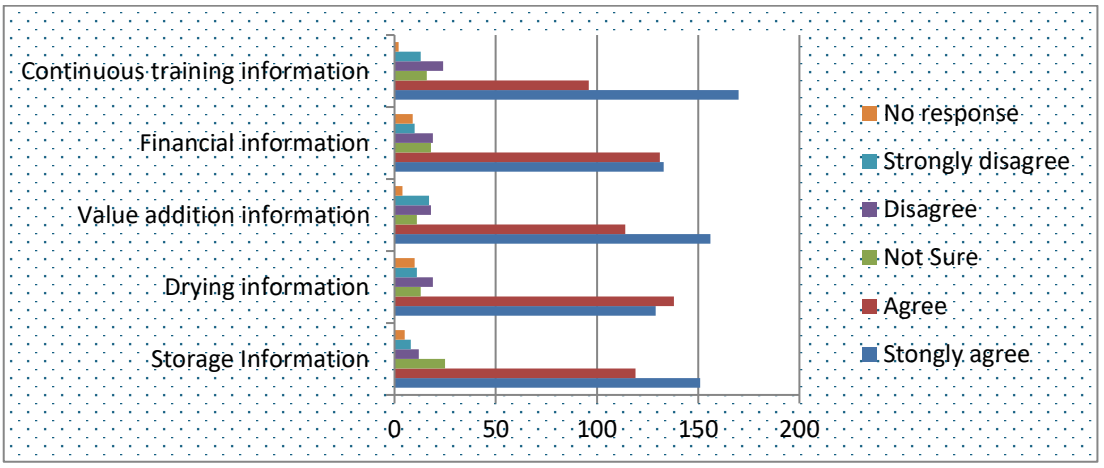

Figure 14: Access to maize postharvest information on various topics

Access to storage information

As shown in Figure 14, most respondents had accessed information about maize storage before they stored their maize (strongly agreed: 151, 47.2%; agreed: 119, 37.2%). The remainder were not sure or disagreed that they had accessed such information (not sure/disagreed: 50, 15.6%; strongly disagreed; 2.5%). When these findings were compared across districts, the percentages were proportional to the sample size from those districts; therefore, there was no significant variation among those who strongly agreed they had accessed information from Adjumani, Iganga, Kabarole and Mubende. The qualitative dataset showed that few rural smallholder farmers had accessed storage information checked for quality through extension services (P6-IGA; P7-KAB–P15-KAB; FGD1 09.02.2024; PIGA).

Access to drying information

Most respondents indicated that they had accessed information to influence their drying practices during maize postharvest handling information (strongly agreed: 138, 43.1%; agreed: 129, 40.3%). Conversely, 53 (16.6%) respondents disagreed that they had accessed information related to drying maize or were unsure about access.

Similarly, the qualitative findings showed that rural smallholder maize farmers lacked drying information. It was reported that last season, the maize had rotted in the gardens because of the rain. One participant said, '*The government forgot about drying maize mechanisation and concentrated more on production. Why produce maize expensively, and it gets rotten? Rural smallholder farmers need drying information and dryers. The evidence-based information about dryers should be widely disseminated to rural farmers*' (FGD2 13.03.2024).

Access to value addition information

This study sought to clarify smallholder farmers' access to information about value addition, which is considered a crucial part of the production chain. Respondents were asked whether, before selling maize, they had accessed value additional EBI to influence their farming practices. As shown in Figure 14, most (270, 84.4%) respondents agreed that they had accessed postharvest value addition information. The remaining 50 (15.6%) respondents disagreed, were unsure, or did not respond to the statement; this suggested that these respondents had not accessed postharvest value addition information.

Access to financial information

Respondents were asked whether they had accessed financial information to influence their farming decisions and practices. As farming is labour-intensive, it requires financial investment to acquire farm inputs, harvesting and value addition before marketing. The findings showed that most (264, 82.5%) respondents agreed that they had accessed financial information, although 56 (17.5%) either disagreed or were unsure of having accessed such information. The qualitative dataset reported that rural smallholder maize farmers lacked financial information about insurance and loans (P18-KAB; P26-EBB).

Access to continuous training information

Continuous training for smallholder farmers helps them understand and embrace modern farming practices during maize post-harvesting. This study examined whether participating farmers had accessed continuous training information before maize postharvest handling. As shown in Figure 14, more than half (170, 53%) of the respondents strongly agreed that they had access to information about training to gain knowledge and skills on implementing maize postharvest handling effectively. However, 54 (16.8%) respondents disagreed or were unsure if they had accessed information about such training. Overall, 83.1% agreed they had accessed information about continuous training. This suggested that if they participated in this training, they could help to transform smallholder farming practices across the country.

The personal interviews showed that training for rural smallholder maize farmers on postharvest handling was not continuous but seasonal or when funds allowed. Participants indicated that this training was ineffective; few farmers participated, and most lacked or never applied the knowledge they acquired. Rural smallholder farmers were also reported to have a negative

attitude towards training. Dissemination of available evidence used a top-to-bottom approach, meaning that farmers were not involved in directing their learning or expressing an interest in what kind of training they wanted (P1–P26; FGD2 13.03.2024). Figure 15 summarises information access based on government policies and regulations.

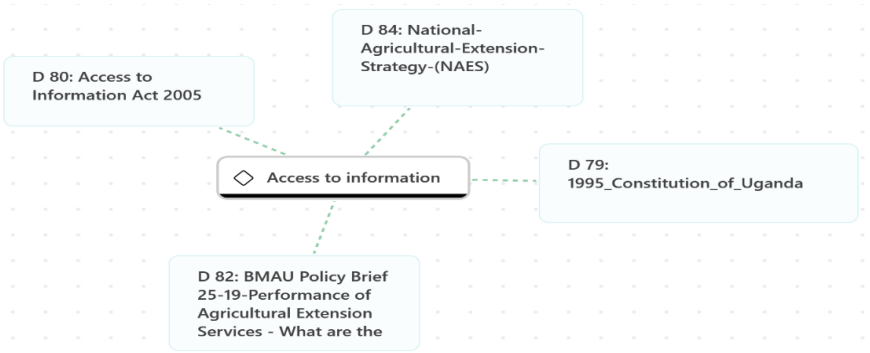

Figure 15: Information access according to government policies and regulations

Access to information is a fundamental right for all Ugandans, including rural smallholder farmers. This right is supported by government policies and regulations, as shown by the findings of the document analysis (Figure 15). Rural smallholder farmers are entitled to access information to support their daily decisions and practices.

Use or application of the accessed maize postharvest information

Importantly, accessing EBI and using the EBI accessed differ. Therefore, respondents who had accessed information were asked to indicate whether they had used the information they had accessed in the postharvest value chain to improve their mindset, decision-making and practices. These findings are presented in Table 19.

Table 19. Use of information accessed by smallholder farmers (N=320)

Type of information accessed	Strongly agree n (%)	Agree n (%)	Not sure n (%)	Disagree n (%)	Strongly disagree n (%)	No response n (%)	Total
Storage information	110 (40.7)	99 (36.6)	35 (12.9)	7 (2.5)	9 (3.3)	10 (3.7)	270
Drying information	101 (37.8)	69 (25.8)	32 (11.9)	38 (14.2)	25 (9.3)	2 (0.7)	267
Value addition information	115 (42.6)	86 (31.8)	24 (8.8)	17 (6.2)	15 (5.5)	13 (4.8)	270
Financial information	102 (38.6)	70 (26.5)	16 (6.1)	35 (13.2)	30 (11.3)	11 (4.1)	264
Continuous training information	125 (46.9)	66 (24.8)	36 (13.5)	24 (9)	13 (4.8)	2 (0.7)	266

The quantitative findings (Table 19) indicated that the majority (172, 65.2%) of respondents agreed that they had used the storage information they had accessed to influence their storage practices. The remainder (92, 34.8%) disagreed that they had used the information accessed or did not respond to the question. Conversely, the qualitative dataset showed that few farmers effectively used the EBI concerning storage they accessed to guide postharvest handling decisions and practices. As expected, most farmers were using granaries and other local facilities prone to weevils, termites and rodents (P1-IGA; P3-MUB; P4-KAB; FGD2 13.03.2024).

Furthermore, most respondents (170, 63.6%) agreed that they had used the drying information they accessed, and the remainder (97, 36.3%) disagreed, were not sure or did not answer the question. However, the qualitative findings suggested rural smallholder maize farmers had not used drying information in the last season, as the heavy rains meant the maize rotted in the gardens (FGD2 13.03.2024). One focus group participant said, '*Government has invested in machinery like tractors and grinding meals on 12 farmer groups in Iganga. However, it has forgotten threshing, drying and transportation*' (FGD2 13.03.2024).

The majority (201, 74.4%) of respondents agreed that they had applied value addition information, which influenced the sale price of their maize. Value addition is a critical component of improving the prices of maize and the generation of by-products in the maize value chain. Participants in FGD2 (13.03.2024) confirmed these findings and indicated that the government had equipped some rural maize farmers with grinding mills for value addition. Conversely, other qualitative participants noted that farmers were not adding value to their maize, had no markets and the maize was sold at 200/=, which was far below the expenses incurred to farm the maize (FDG1 09.02.2024; P20-KAB).

Most (222, 84.1%) respondents agreed that they had used financial information in their farming decisions, although 55 (17.1%) disagreed or were unsure. Financial information is likely to influence decisions such as the size of the area under cultivation and the application of fertilisers and insecticides to ensure high crop yields. The use of such information should also be reflected in financial literacy across the whole production and marketing chain.

Furthermore, the majority (191, 71.8%) agreed they had participated in continuous training, but others (74, 29.2%) disagreed, were unsure, or did not respond to the question. Participants in the personal interviews reported that training for rural smallholder maize farmers on postharvest handling was not continuous as it was seasonal or when funds allowed. They also noted that

training was ineffective as few farmers participated, most did not apply the knowledge they acquired, and many had negative attitudes towards training. Concerningly, dissemination of EBI used a top-to-bottom approach, whereby farmers were not involved in either directing their learning or expressing interest in the kind of training they wanted (P1–P26; FGD2 13.03.2024).

Comparing the results of the information accessed with the use of maize postharvest handling information from Table 19 showed that, generally, more farmers accessed information than those who used it (Figure 16). The vertical axis of Figure 16 represents the number of respondents (N=320), and the horizontal shows the information accessed and used.

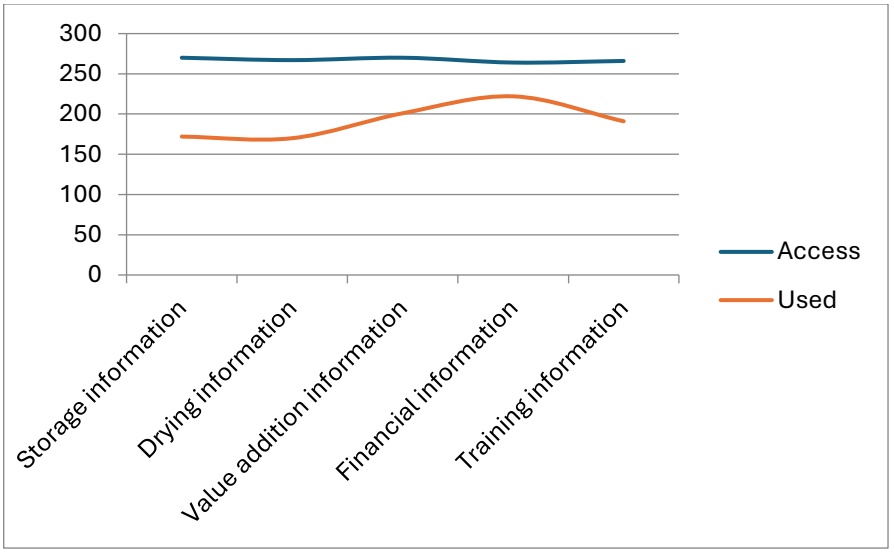

Figure 16: Comparison of information accessed and used by value chain category

Figure 17 summarises the proportions of those who accessed but did not use information for each value chain category.

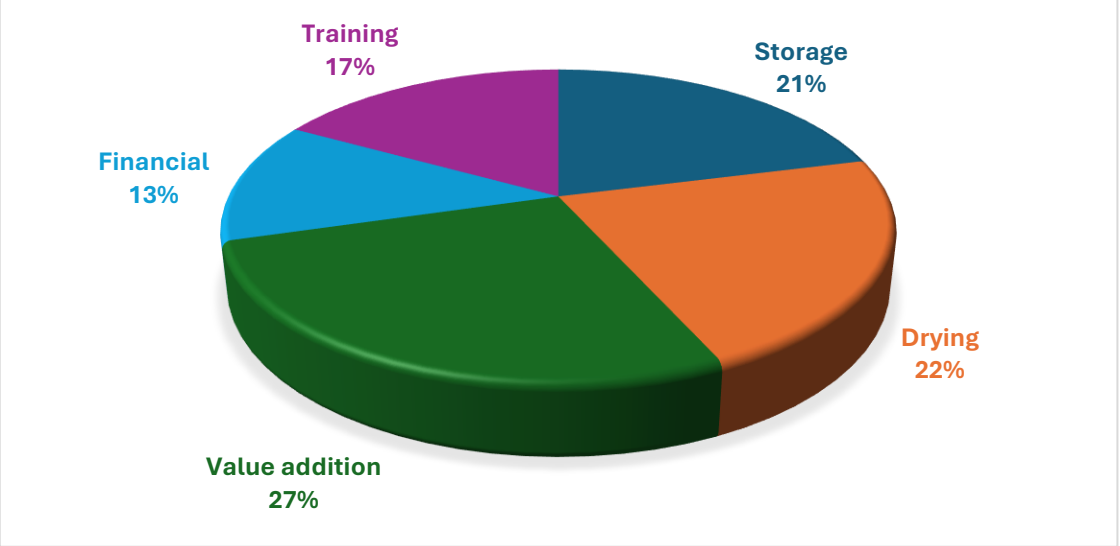

Figure 17: Information accessed but not used for postharvest handling

When looking critically at the data on information that was accessed but not used (Figure 17), value addition was the information type that was most accessed but not put into use to influence maize postharvest handling practices (119, 27%), followed by drying (97, 22%) and storage (92, 21%). Fewer respondents indicated they had not used the financial information they accessed, which suggested that they found it more valuable and practical than the other types of information. These findings were consistent with the qualitative findings that indicated not all the accessed information helped improve maize postharvest handling. For example, one participant said the information was '*Inadequate because little information is about the practices*'(P20-MUB).

The document analysis revealed that Uganda's extension service delivery system was established to provide access to and '*promote the application of appropriate information, knowledge and technological innovations for food security, and contribute to socioeconomic transformation and welfare of the population'* (EGS 2016).

Relationship between variables

This study examined the relationships between specific variables and access to maize postharvest handling EBI. This included testing relationships between demographic characteristics and both postharvest loss and quantity of maize. These findings are presented below by the variables tested.

First, the relationship between respondents' access to postharvest handling information and demographic characteristics (N=320) was examined. The chi-square test results and p-values are shown in Table 20.

Table 20. Relationship between access to postharvest handling information and respondents' demographics

Gender	**Number**	**%**	**Chi-square**	**P-value**
Female	135	42.02	4.180	0.382
Male	182	57.00	4.180	0.382
No response	3	0.93	4.180	0.382
Total	320	100		
Literacy levels				
I can read and write	227	70.93	3.945	0.413
I cannot read and write	81	25.31	3.945	0.413
No response	12	3.75	3.945	0.413
Total	320	100		
Age bracket, years				
18–40	246	76.87	18.642	0.098
41–60	69	21.56	18.642	0.098
≥61	5	1.56	18.642	0.098
Total	320	100		
SACCO				
Yes	160	50.00	5.678	0.225
No	154	48.12	5.678	0.225
No response	6	1.87	5.678	0.225
Total	320	100		

The results showed that none of the relationships tested were statistically significant. This means that the findings did not provide sufficient evidence to show significant relationships between any demographic variables and respondents' access to maize postharvest information. Table 20 shows the analysis of the relationship between maize harvest quantity and access to EBI.

Table 21. Quantity of maize harvested and access to evidence-based information

Chi-square tests			
Factors	**Value**	**df**	**Asymp. Sig. (2-sided)**
Pearson's chi-square	32.198	14	0.004
Likelihood ratio	30.371	14	0.007
Linear-by-linear association	6.686	1	0.010
Number of valid responses	310		

The p-values for the chi-square and likelihood ratio tests were less than 0.05 (p=0.004 and p=0.007, respectively), which showed that there was a significant relationship between the quantity of maize harvested in the last season and access to EBI that influenced maize postharvest handling practices. This finding implied that access to post-harvesting information had a strong influence on maize output.

Relationship between postharvest maize loss and access to information

The study investigated the relationship between postharvest maize loss and respondents' access to information using a chi-square test at a 0.05 level of significance. The results are presented in Table 22.

Table 22. Postharvest maize loss and access to information

Results	**Value**	**df**	**Asymp. Sig. (2-sided)**
Pearson's chi-square	28.569	16	0.027
Likelihood ratio	24.037	16	0.089
Linear-by-linear association	1.899	1	0.168
No. of valid cases	309		

Although the results of the chi-square test indicated a statistically significant relationship (p=0.027) between access to EBI and maize loss, the linear-by-linear association was negative.

This implied that there was no relationship between the loss of maize and access to EBI for effective postharvest practices.

SACCO membership and access to value addition information

This study examined the relationship between smallholder farmers' SACCO membership and their access to postharvest handling information concerning value addition. The results are presented in Table 23.

Table 23. SACCO membership and access to value addition information

Results	Value	df	Asymp. Sig. (2-sided)
Pearson's chi-square	14.947	8	0.060
Likelihood ratio	16.763	8	0.033
Linear-by-linear association	.167	1	0.682
No. of valid cases	313		

The chi-square test showed no relationship between respondents' SACCO membership and their access to value-added EBI to influence maize postharvest handling practices (p=0.060).

Relationship between continuous training and effective maize postharvest handling practices

This study sought to establish whether there was a relationship between continuous training and effective maize postharvest handling practices among rural smallholder farmers. The findings are shown in Table 24.

Table 24. Continuous training and effective maize postharvest handling practices

Results	Value	df	Asymp. Sig. (2-sided)
Pearson's chi-square	7.435	4	0.115
Likelihood ratio	8.064	4	0.089
Linear-by-linear association	3.051	1	0.081
No. of valid cases	312		

The results of the chi-square test revealed that there was no association/relationship between smallholder farmers' continuous training and access to EBI for effective maize postharvest handling practices (p=0.115).

5.6.3 Association between EBIP and maize postharvest handling information

To ensure the information accessed is good quality, the information undergoes a EBIP process, which includes the 6As: ask, acquire, appraise, aggregate, apply and assess. Therefore, respondents were asked to mention the EBIP that they were aware of that were implemented in their maize postharvest handling practices to access and use information. The results attracted multiple responses as presented in Table 25.

Table 25. Evidence-based information practice implementation and maize postharvest handling information (N=320)

Evidence-based information practice (6As)	**Number**	**%**
Asked about farmer's information on maize postharvest handling	260	84.1
Acquired maize postharvest information	146	45.62
Appraised maize postharvest handling information for credibility and quality	171	53.43
Aggregated maize postharvest handling information for easy access	95	29.68
Applied maize postharvest handling information for better practices	139	43.43
Assessed maize post-harvest handling information application	74	23.12
No evidence-based information practices known	66	20.62

The results (Table 25) showed that 'asked' was part of the EBIP process that was the most implemented (260, 84.1%), followed by appraising the evidence (171, 53.4%) and acquiring the information (146, 45.6%). Only 66 (20.6%) respondents said they were not aware of any

implementation of EBIP. Findings from the personal interviews revealed that the most implemented EBIP components were asking, acquiring and applying. The qualitative data source used A Sankey diagram to show the discussions on the relationship between EBIP and maize postharvest handling (Figure 18).

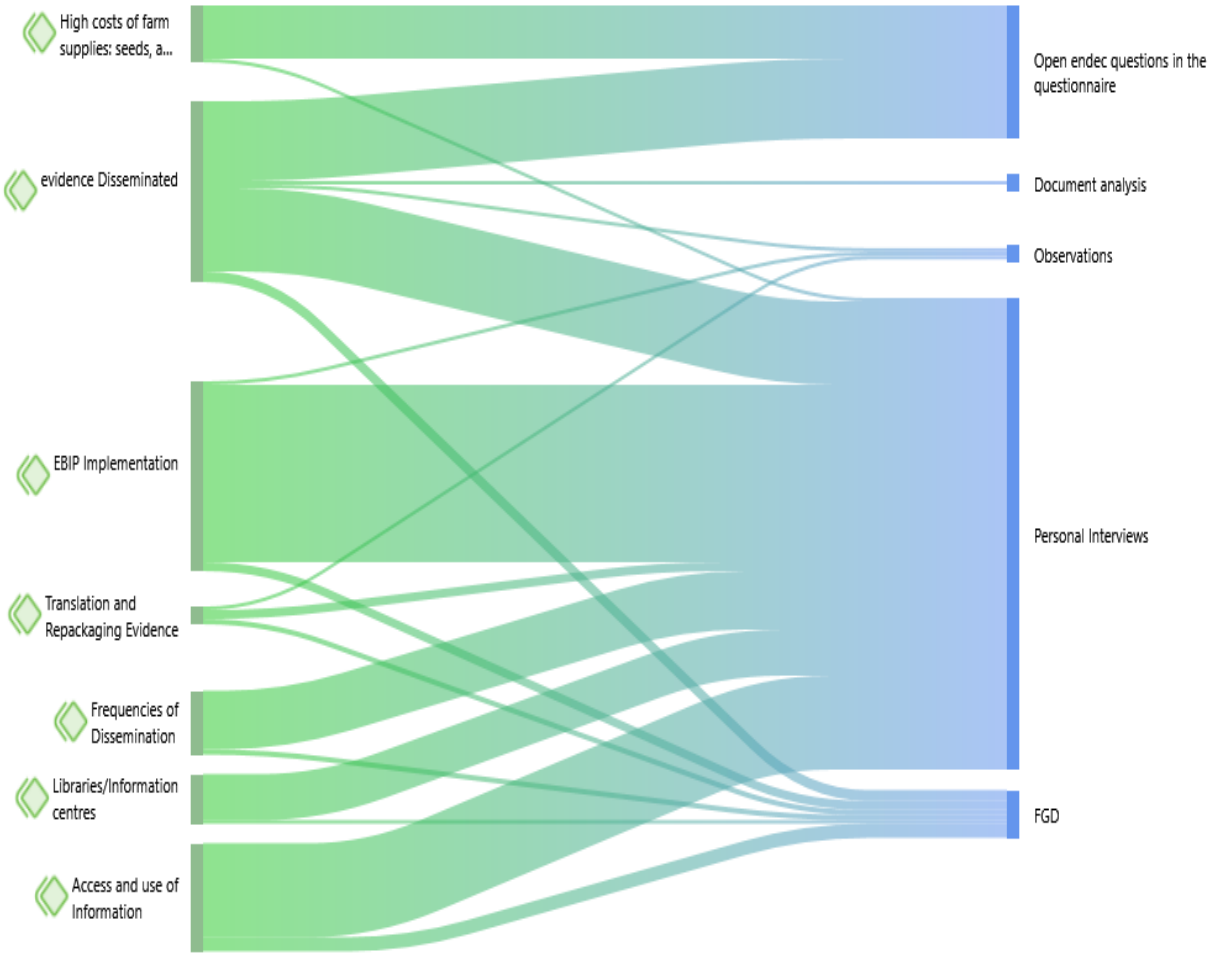

Figure 18: Relationship between evidence-based information practice themes by data source

EBIP for maize postharvest handling was widely highlighted in the qualitative arm of this study, including its practices, the evidence disseminated, the way EBI was accessed and used, the frequency of dissemination and the contribution from libraries and information centres (Figure 18). This Sankey diagram indicated the source of the findings that were drawn from the focus group discussions, personal interviews, observations, document analysis and open-ended questions in the survey. These findings showed that there was a mixture of sources for verification and validation purposes.

5.6.4 Influence of EBIP on farmers' routine maize postharvest handing decisions and practices

Respondents were asked whether they felt that EBIP influenced their access to and use of maize postharvest handling information in their daily practices. The results are presented in Figure 19.

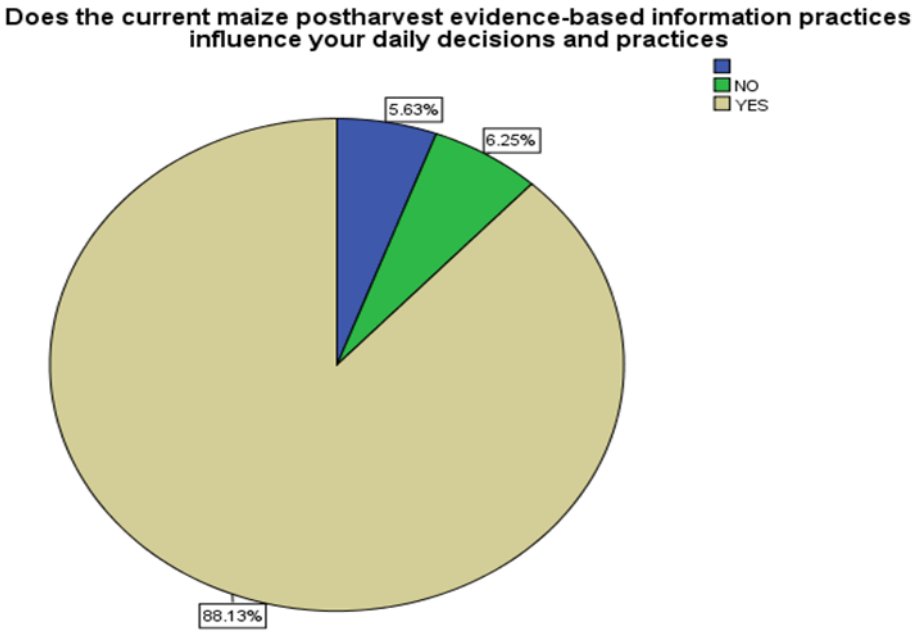

Figure 19: Influence of evidence-based information practice on access to and use of evidence-based maize postharvest handling information

According to Figure 19, most respondents (282, 88.1%) mentioned that the current EBIP had influenced their access to and use of maize postharvest handling information and their daily practices. In contrast, only 20 (6.3%) respondents felt that EBIP did not in any way influence their practices. These findings were supported by the qualitative data whereby participants confirmed that the information disseminated through official channels to smallholder farmers was evidence-based. However, information obtained through other channels, such as friends or family, could have been traditional or scientific but was difficult to verify. Importantly, these participants further revealed that EBIP was not fully implemented. They cited a lack of sufficient support from the line Ministry and a bottom-up approach for evidence that did not accommodate the beneficiaries. For example, EBI was only appraised by the Ministry and delivered to farmers to apply, and sometimes the evidence was not specific or irrelevant. Participants were not aware of any checklist that was used to appraise the information for quality or relevance (P1-IGA–P26 EBB; FGD2 13.03.2024).

Influence of EBIP on maize postharvest handling

The influence of EBIP on maize postharvest handling was examined using a word cloud to capture respondents' interactive responses to the subject matter of their practices. Figure 20 illustrates the word cloud used in the assessment.

Figure 20: Influence of evidence-based information practice on maize postharvest handling

The word cloud (Figure 20) was generated through ATLAS.ti and shows how EBIP influenced maize postharvest handling by rural smallholder farmers in Uganda. Participants mentioned commonly known EBIP components such as acquire, aggregate, apply and information, mixed with extension services and traditional means of postharvest handling. Furthermore, the personal interviews highlighted that the extension information dissemination involved a chain of processes performed by the line Ministry such as assessing farmers' information or technology needs, looking for the needed information, assessing the information for quality, repackaging it in training manuals for easy understanding by farmers, coordinating with stakeholders, disseminating the information through training and evaluating the implementation (P22-EBB).

An inferential analysis (chi-square test) was conducted to establish the relationship between EBIP implementation and access to relevant maize postharvest handling information (Table 26).

Table 26. Evidence-based information practice and access to postharvest handling information (N=320)

Evidence-based information practice (6As)	Number	%	P-value
Asking farmers' information needs	260	84.1	0.572
Acquisition of postharvest information	146	15.4	0.000
Appraising information	171	18.0	0.197
Aggregating information	95	10.0	0.273
Applying information	139	14.6	0.995
Assessing information	74	7.8	0.303

Below are the null hypotheses tested:

a. ***ASK: No significant relationship existed between asking about farmers' needs and access to EBIP*****.**

The findings indicated there was no significant relationship between asking farmers' information needs and access to relevant evidence (p=0.572). Therefore, this study failed to reject the null hypothesis and concluded that there was no significant relationship between asking farmers' needs and access to relevant evidence.

b. ***ACQUIRE: No significant relationship existed between the way the evidence was acquired and access to relevant evidence***.

The results indicated that the null hypothesis was rejected because there was a significant relationship between the acquisition of evidence and access to relevant evidence (p=0.000) as illustrated in Table 26.

c. ***APPRAISE: No significant relationship existed between appraising evidence and access to relevant evidence***.

The results showed that the null hypothesis was not rejected as there was no significant relationship between appraising evidence and access to relevant evidence (p=0.192).

d. ***AGGREGATE: No significant relationship existed between aggregating evidence and***

access to relevant evidence.

b) The results showed that the null hypothesis was not rejected because there was no significant relationship between aggregating evidence and access to relevant evidence (p=0.273).

5. APPLY: No relationship existed between applying evidence and access to relevant evidence.

The null hypothesis was not rejected as there was no significant relationship between applying evidence and access to relevant evidence (p=0.955).

6. ASSESS: No significant relationship existed between assessing evidence and access to relevant evidence.

Finally, this study failed to reject the null hypothesis as there was no significant relationship between assessing evidence and access to relevant evidence (p=0.303).

5.6.5 Translation and repackaging of evidence-based maize postharvest handing information

Participants in the qualitative arm of this study were asked to explain how EBI concerning maize postharvest handling was aggregated, with a specific focus on translation to local languages and repackaging for farmers' easy access and use. The findings are presented in Figure 21 using a word cloud.

Figure 21: Translation and repackaging of evidence-based maize postharvest handling information

The grounded words 'farmer' and 'information' showed that the focus was on repackaging evidence to farmers' needs. This repackaging was in visual forms such as videos, leaflets and

brochures. One interview participant said that repackaging was expensive and rarely done because of the lack of funds. That participant said, '*Information repackaging like translation is very expensive and challenging; rural farmers are like nursery children that need consistent training, like you say "a" until they come to understand. Consistent training is important but with no funding*'(P22-EBB).

5.6.6 Categories of evidence disseminated

The qualitative dataset showed that the EBI disseminated to rural smallholder farmers included traditional or local evidence and scientific evidence, in terms of both implicit or tacit and explicit knowledge. Agricultural officers (mostly extension officers and information officers) accessed explicit knowledge from the MAAIF Manual, databases (e.g. AGORA), textbooks, NARO and the Internet, as well as tacit knowledge from their experiences. This information was disseminated to farmers in the form of training, demonstrations and hands on-farm practices. Furthermore, materials such as PICS bags, hermetic bags and threshing equipment were made available to farmers through the WFP and the MAAIF.

5.6.7 Methods used to disseminate maize postharvest handling EBI to rural smallholder farmers

Participants in the qualitative study mentioned using several channels to disseminate evidence-based maize postharvest handling information to rural smallholder farmers. These channels included: farm demonstrations and trials, training, reference service in community libraries, radio and TV talk shows, WhatsApp, farmers' exploration and exhibitions.

5.6.8 Sources of maize postharvest handling information

Access to relevant information necessitated examining the sources of the maize postharvest handling information. The questionnaire respondents were asked to state how and where they accessed maize postharvest handling information (question 19). This question allowed multiple responses (Table 27).

Table 27. Sources of maize postharvest information (N=320)

Sources of information	Number	%
Village meetings/SACCO and church meetings	260	82.0
Agricultural Extension Office	255	80.4
Non-governmental organisations	220	69.4
Personal experience/learning offline or online means	112	35.3
District/village/sub-county information officers	135	42.6
Community libraries	35	11.0
Friends	272	85.8
Media (radio/TV/newspapers)	192	60.6
I do not know any source	4	1.3

The results in Table 27, indicated that 'friends' were the most dominant source of information for smallholder farmers (272, 85.8%), followed by village meetings (260, 82.0%) and the Agricultural Extension Office (255, 80.4%). Community libraries were the least commonly used information source (35, 11%), and 1.3% of respondents did not know any information source.

The personal interviews and document analysis revealed that farmers accessed EBI through farmers' groups, training, media and farm demonstrations. The sources of evidence for extension workers were the Internet, textbooks, AGORA, the MAAIF, workshops, partners and classroom knowledge, as seen in the word cloud presented in Figure 22. However, these participants felt they needed to widen and update their sources of evidence.

Furthermore, the qualitative findings revealed the same partners in disseminating EBI to rural smallholder farmers as reported in the quantitative study. Participants further explained that extension workers did not work with the community libraries, librarians or district information officers. They cited not being aware of their ability to disseminate technical evidence to farmers. Some participants recommended community libraries should be located nearer to rural smallholder farmers and actively introduce themselves to the farmers. In contrast, participants

from community libraries explained that they were disseminating information to rural smallholder farmers using Internet services via the community library reference services. One participant said, '*Every time farmers come to the library and the Internet is available, I help them, but if not, I cannot help*' (P21-IGA). Participants cited the lack of postharvest handling evidence, libraries and skills on how to help farmers (P23-IGA). They suggested that extension workers should work with community libraries by equipping them with already packaged evidence to disseminate to the farmers who visited their libraries. However, the National Agricultural Extension Services Strategy 2016/17–2020/21 did not specifically mention community libraries as partners in disseminating information to farmers.

Figure 22: Word cloud for sources of evidence

The qualitative arm of this study (Figure 22) revealed that extension workers used the Internet, MAAIF Manual and books as sources of EBI related to maize postharvest handling. They disseminated this information to rural smallholder farmers through training, farm demonstrations, radio talk shows, farm visits and various events.

5.6.9 Stakeholders in maize postharvest handling EBIP

This study considered that it was important to clarify the stakeholders who supported EBIP efforts related to maize postharvest handling in Uganda. The results are presented in Table 28.

Table 28. Stakeholders' support of maize postharvest handling evidence-based information practice (N=320)

Stakeholders	Number	%
National Agricultural Advisory Services (NAADS)	278	90.8
District extension officers	226	73.9
World Food Programme (WFP)	96	31.4
Food and Agricultural Organization (FAO)	121	39.5
National Agricultural Research Organisation (NARO)	166	54.2
Agriculture Cluster Development Project	103	33.7
Community librarians	15	4.7

In Table 28, NAADS was documented as the most known supportive stakeholder (278, 90.8%), followed by district extension officers (226, 73.9%) and NARO (166, 54.6%). However, community libraries were considered the least supportive stakeholders (15, 4.7%). The qualitative findings were consistent with the findings in Table 28. These participants further explained that extension workers did not work with community librarians or district information officers and cited being unaware of their ability to disseminate technical evidence to farmers. They recommended community libraries should be located nearer to rural smallholder farming areas and work to actively introduce themselves to farmers. Furthermore, community library participants indicated they disseminated information to rural smallholder farmers using Internet services via their reference services. However, they lacked postharvest handling evidence, the library and skills on how to help farmers (P23-IGA). They also suggested extension workers collaborate with community libraries by equipping them with pre-packaged evidence to disseminate to farmers.

5.7 Specific maize postharvest handling EBI needs for rural smallholder farmers

The second objective of this study was to establish smallholder farmers' specific needs for maize postharvest handling EBI. Questionnaire respondents were asked to express their EBI needs freely. The results are presented in Table 29.

Table 29. Specific maize postharvest handling information needs for farmers (N=320)

Evidence-based information needs	Number	%
Drying	296	94.3
Storage	305	97.1
Value addition	284	90.4
Credit support	240	76.4
Continuous training	228	72.6
High yielding seeds	26	8.12
Transportation	90	28.12

The most pressing EBI need for smallholder farmers was storage (305, 97.1%), followed by drying (296, 94.3%), value addition (284, 90.4%) and credit support (240, 76.4%). The qualitative findings from the personal interviews were consistent with these findings. For example, one participant said, '*Farmers are still in need of information regarding PHH (postharvest handling)'* (P17-MUB). Furthermore, participants mentioned other topics such as soil management, insurance for postharvest loss, marketable crops, reliable water for production and markets for maize, as additional information farmers needed.

5.8 Difficulties rural smallholder farmers experienced when accessing EBI

The third objective of this study was to examine the difficulties rural smallholder farmers experienced when accessing and using maize postharvest handling EBI. Questionnaire respondents were asked to mention the difficulties they faced when seeking to access EBI. Many respondents said the EBIP was inadequate and inconvenient, they lacked awareness of maize postharvest handling technologies, available training was occasional, and the maize postharvest handling EBI was unfavourable in presentation and content. The details of these findings are discussed below.

Inadequate EBI on maize postharvest handling

Most respondents (268, 83.8%) felt that the currently available EBI was inadequate for their needs and could not empower small farmers to overcome postharvest difficulties (agreed: 64, 20%; strongly agreed: 204, 63.8%) (Figure 23).

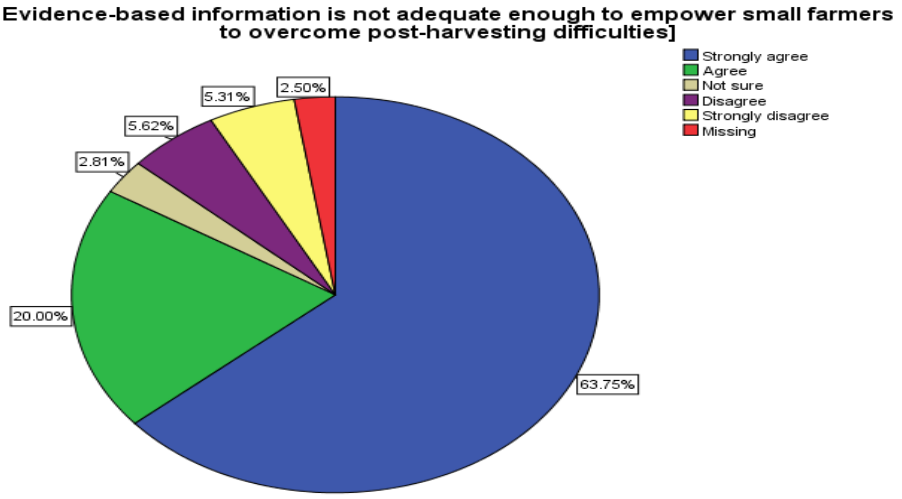

Figure 23: Inadequate evidence-based maze postharvest handling information

The qualitative dataset revealed that the current EBIP was inadequate in terms of the frequency of dissemination, the top-to-bottom approach to providing evidence, the evidence itself and the personnel mandated to disseminate the evidence. In terms of the personnel, participants reiterated that the ratio of farmers to extension workers was high and that agricultural extension workers had not reached the farmers. The evidence was mostly traditional and rarely scientific and was not available in some sources such as information centres or libraries. For example, one participant said, '*As a community librarian, I am looking for that knowledge so that I can disseminate it to farmers who come*' (P21-IGA).

Figure 24 presents a summary of the questionnaire responses to the open-ended questions in concerning difficulties that farmers experienced.

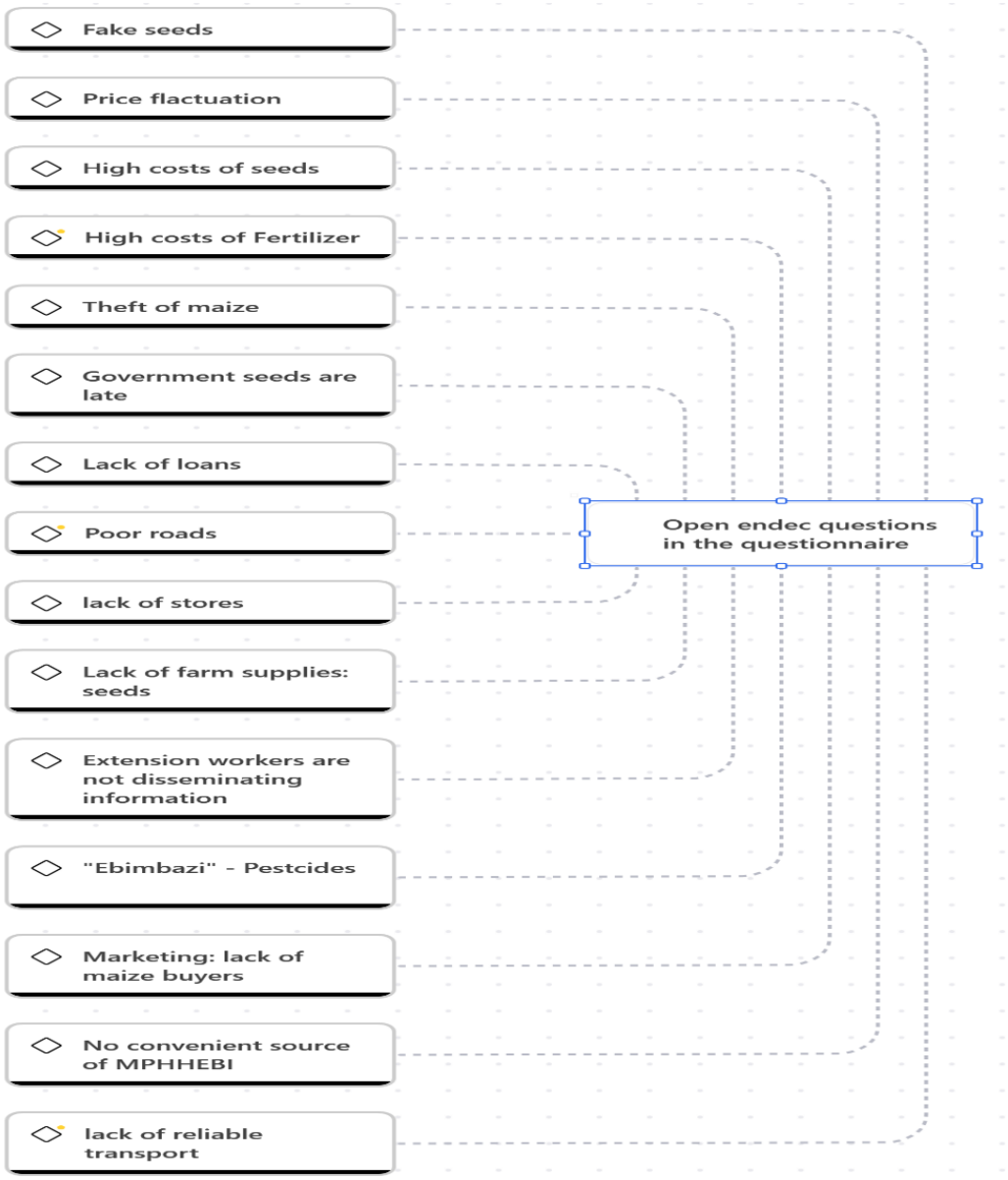

Figure 24: Summary of the difficulties described in the open-ended questions of the quantitative survey

Figure 24 highlights the difficulties identified by respondents through an open-ended question in the quantitative survey. These farmers highlighted that they lacked EBI on loans, farm marketing and reliable transport, and extension services were uncoordinated. Maize postharvest handling EBI was also not available from some sources such as information centres or community libraries in the studied districts. Furthermore, district information officers did not have evidence available for dissemination, and extension workers' knowledge and skills were limited. There was a need for updating and retooling these workers equip them with new technologies for improved services. Limited resources and inadequate funding also hindered efforts to disseminate information to rural smallholder farmers. These

challenges meant that the EBI disseminated was periodical and sometimes irregular. Figure 25 shows the participants that highlighted the limited funding and resources.

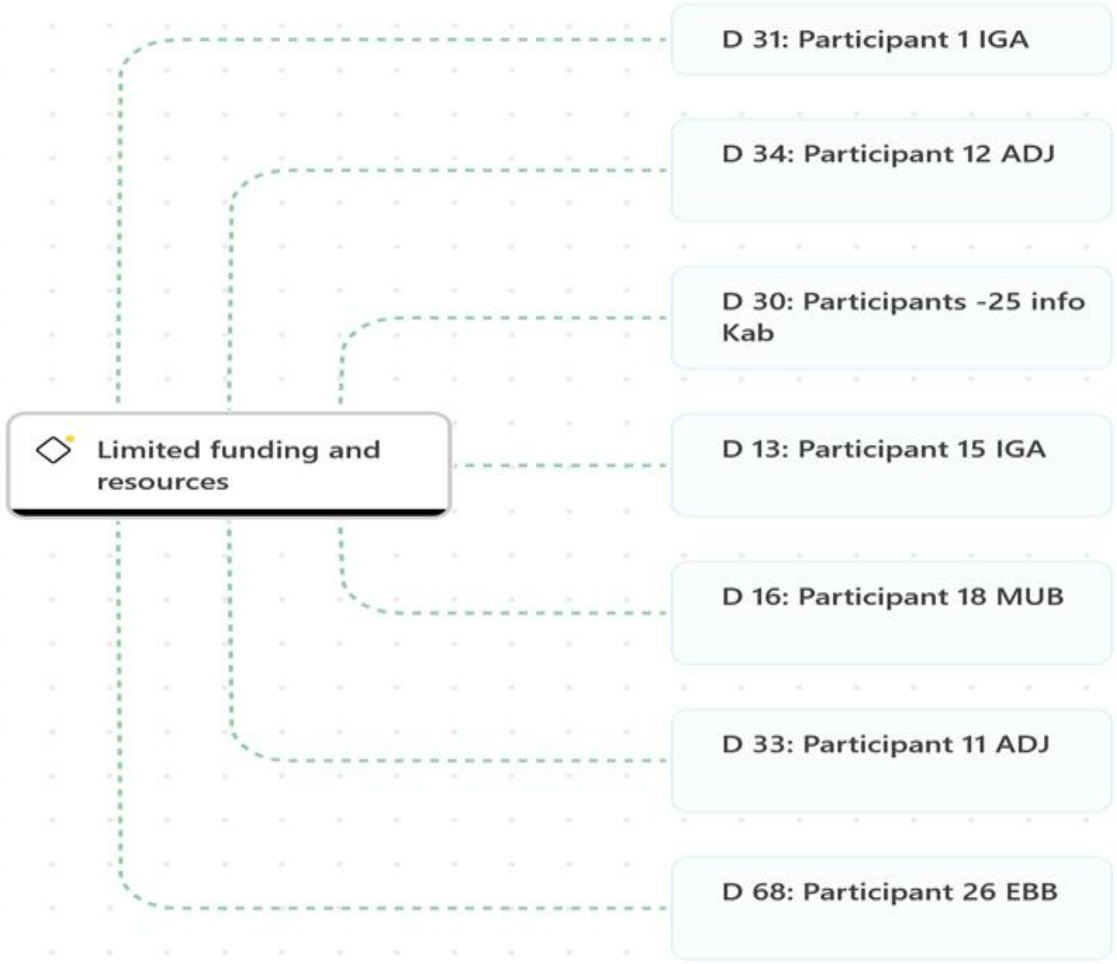

Figure 25: Limited funding and resources by the participants

Participants from Adjumani (ADJ), Mubende (MUB), Iganga (IGA), Kabarole (KAB), and Entebbe (EBB) agreed and cited a lack of adequate financial support and infrastructure to use for dissemination of EBI concerning maize postharvest handling. Observation findings (PIGA; PADJ; PMUB; PKAB) indicated that the road network for rural smallholder farmers did not support maize postharvest handling. For example, there was no reliable transport that farmers could use to transport their maize to stores or markets, which resulted in high losses recorded through the transport system.

Table 29. Technology awareness, convenience of source and the training frequency (N=320, 100%)

	Responses					
Statements	Strongly agree	Agree	Not sure	Disagree	Strongly disagree	No response
The sources of EBI were inconvenient	146(45.6)	75(23.4)	30(9.4)	30(9.4)	33(10.3)	6(1.9)
Unaware of Hermetic bags for storage	152(47.5)	68(21.3)	32(10.0)	30(9.4)	28(8.8)	10(3.1)
Unaware of value addition	139(43.4)	54(16.9)	38(11.9)	46(14.4)	25(7.8)	18(5.6)
Periodic training	164(51.3)	33(10.3)	21(6.3)	43(13.4)	37(11.6)	22(6.8)

Inconvenient access to EBI

In terms of the convenience of farmers' access to maize postharvest handling EBI, the majority (221, 69%) indicated that they walked long distances to access EBI, as seen in Table 29, which means the sources were not convenient. However, 63 (20%) respondents indicated that they found the sources of evidence convenient. The qualitative findings confirmed that rural smallholder farmers often lived far from sources of EBI, and the roads they needed to travel to access training or information from extension workers were poor. However, some personal interview participants said that farm demonstrations and visits could be offered conveniently at rural smallholders' farms (FDG1 09.02.2024; FGD2 13.03.2024; observations; qualitative findings from the questionnaire). This was described by one questionnaire respondent as 'I move long distances *to get information*' (qualitative findings from the questionnaire).

Unawareness of the maize postharvest technologies

Farmers were asked about their awareness of specific maize postharvest storage facilities that could improve the storage of maize to prevent it from being destroyed by weevils. The responses are shown in Table 29. The majority (220, 68.8%) of respondents were not aware of the hermetic bags that are used to store maize. A small proportion of farmers (100, 18.2%) indicated they were aware of these bags, were not sure or did not respond to this question. The majority (193, 60.3%) were not aware of these value-addition technologies, 71 (22.2%) respondents were aware of technologies for value addition, and 38 (11.9%) were unsure. The document analysis indicated that the 2019 BMAU report revealed similar findings in that farmers did not adopt technology, as seen in the following quotation.

'Poor adoption of technologies and best practices: Only 15% of technologies generated by research institutions reach the farming communities. The optimal utilisation of these technologies is estimated at 28%, indicating low uptake and utilisation of improved technologies' (BMAU 2019:3).

Periodical training

Farmers were asked whether training was seasonal because it forms a critical element in practical knowledge transfer and application (Table 29). The frequency of available training could transform farmers' attitudes and thereby contribute to effective postharvest maize handling. Over half (164, 51.3%) of the respondents strongly agreed that the available training was not consistent but rather ad hoc in nature, and farmers felt they never benefited from it. However, 60 (25%) respondents disagreed with this statement, which suggested that they perceived the training as regular and beneficial to farmers. The qualitative findings confirmed that the training was seasonal and offered when funds were available. This suggested that training was not consistently offered, as seen in the ATLAS.ti network visualisation below (Figure 26).

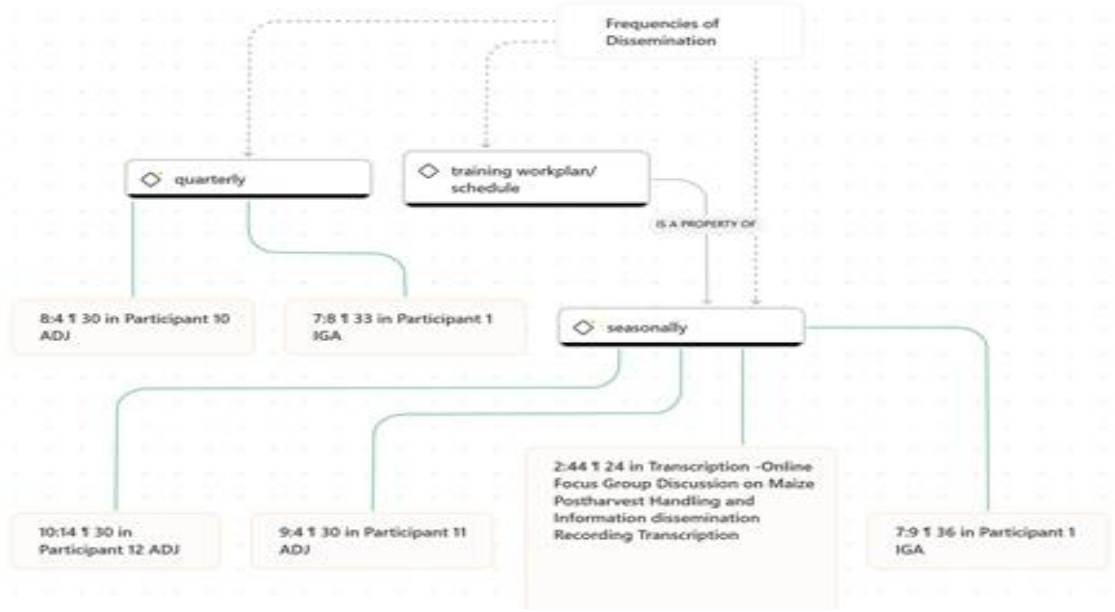

Figure 26: Frequency of evidence-based maize postharvest handling information dissemination

A shown in Figure 26, FGD1 (09.02.2024) participants and some other participants (P1-IGA; P11-ADJ; P12-ADJ) affirmed that training was offered quarterly, seasonally scheduled when funds allowed, occasionally and only what the officers wanted to train the farmers on rather than

what the farmers needed. One participant commented that, '…*the work of extension workers is not to be in the offices but in the field disseminating information; however, it has not been the case; the extension workers were 80% in the offices and 20% only in the field. Therefore, their impact is minimal*' (P22-EBB).

Unfavourable maize postharvest handling EBIP framework

Respondents were asked whether the current EBIP framework was favourable. The findings are presented in Figure 27.

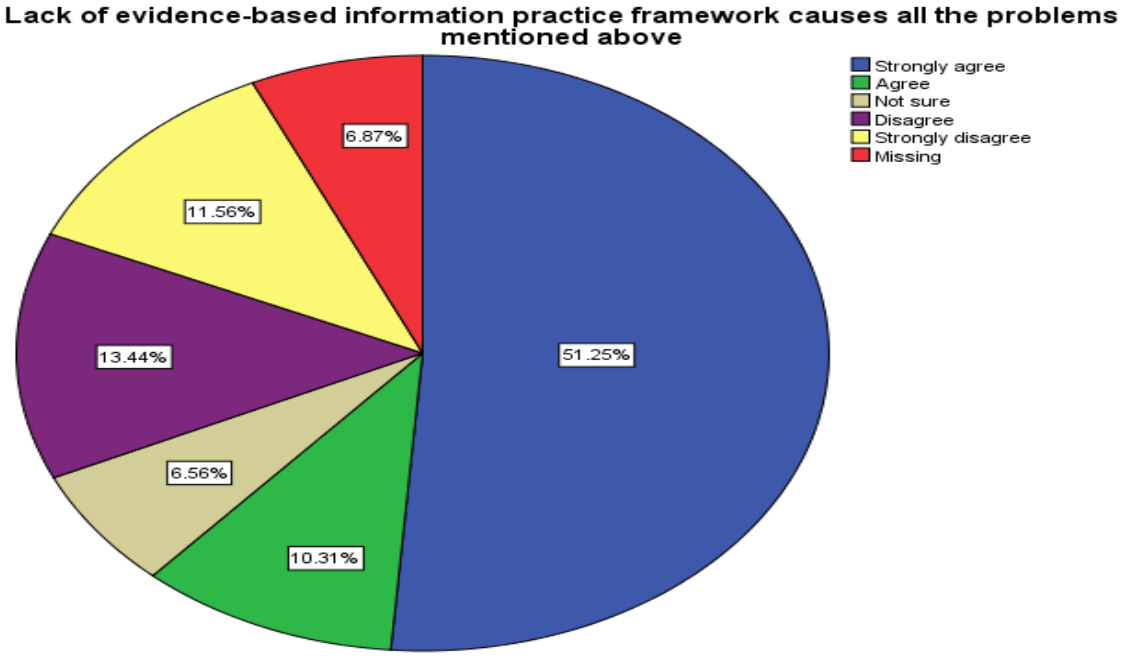

Figure 27: Lack of a maize postharvest handling evidence-based information practice framework

Over half of the respondents (164, 51.25%) strongly agreed that there was no clear mechanism that brought stakeholders together to support rural maize smallholder farmers in accessing and using maize postharvest handling EBI. However, only 32 (10.3%) agreed that the unfavourable EBIP introduced difficulties in accessing and using this information. In contrast, 43 (13.4%) respondents disagreed that the unfavourable mechanism contributed to the failure to access and use EBIP for maize postharvest handling.

Furthermore, the qualitative findings suggested that reaching all farmers was difficult as most were not organised. In addition, ICTs were not distributed across all parts of Uganda, so some

rural smallholder farmers could not access EBI online, even via platforms such as WhatsApp. Rural smallholder farmers were not aware of the available EBI for maize postharvest handling and how to access it. Low levels of literacy among rural smallholder farmers also hindered opportunities for some farmers to access information. Furthermore, the district extension workers were not directly answerable to the MAAIF, which made implementation of maize postharvest handling EBIP difficult. To be useful and promote access, information materials needed to be translated for farmers into local languages, but the large number of languages made this difficult. Political interference and limited financial, human, equipment and machinery resources also hindered effective dissemination. Participants suggested that farmers required consistent training, and EBI adoption was sometimes difficult as farmers' conservativeness in changing their attitudes negatively impacted their training, learning and adapting to new technologies. Moreover, facilitation by the MAAIF was reported as unpredictable. Unreliable rainfall, floods, pests, diseases and inadequate agricultural mechanisation to provide irrigation water for crop production posed additional challenges.

The document analysis supported the findings concerning the lack of a clear mechanism to bring stakeholders together, which resulted in ineffective EBIP. These documents revealed that Uganda experienced uncoordinated extension services, as evidenced in the following quotation.

> *Agricultural Extension Services in Uganda are fragmented and uncoordinated due to the diverse players involved in their delivery. These operate largely independently of each other and in some cases, their operations are unknown* (BMAU 2019:3).

5.9 Suggestions for improving maize postharvest handling EBIP to influence smallholder farmers' access to and use of EBI

The last questionnaire item (question 24) asked respondents to offer any recommendations. Table 30 presents these findings.

Table 30. Suggestion for improved maize postharvest handling evidence-based information practice(N=320)

Suggestion	Number	%
Consider specific maize postharvest handling EBI needs	312	97.5
Adequacy and convenience of the sources of maize postharvest handling EBI	268	83.8
EBIP (ask, acquire, appraise, aggregate, apply and assess) be implemented for access to quality maize postharvest handling EBI	225	70.6
Frequent training for rural smallholder farmers on maize postharvest handling	179	55.94
Increase the ratio of extension workers to farmers	200	62.50

EBI: evidence-based information; EBIP: evidence-based information practice.

Table 30 shows that most respondents (312, 97.5%) agreed that the EBIP framework should include a mechanism that asked for farmers' specific maize postharvest handling EBI needs, such as drying, storage, value addition, credit access and training. Farmers suggested that they would like the EBIP framework to include the components of adequacy and convenient access to maize postharvest handling EBI (268, 83.8%). To ensure that the evidence was credible, relevant and of high quality, the EBI should include the 6As (ask, acquire, appraise, aggregate, apply and assess) (225, 70.6%). Many (179, 55.9%) respondents suggested continuous training for rural smallholder farmers on maize postharvest handling to create awareness of technologies and influence their mindset. Furthermore, 200 (62.5%) respondents recommended the government should increase the number of extension workers at parish levels under the current Parish Development Model initiative.

Suggestions from the qualitative dataset were to increase the number of extension officers, as evidenced in one participant's comment: '*Recruit more extension officers. At least every parish should have one*'(P1-IGA). Improving road networks was a suggestion to enable better movement to disseminate information to the rural population. Furthermore, another participant said, '*Take the information centres nearer the farmers for ease of access*'(P26-EBB) as this would enhance EBI access and use among rural smallholder farmers.

The qualitative findings suggested that it was important to retool and update extension officers and information officers with ICT knowledge and skills for packaging and disseminating information to better support smallholder farmers (P11-ADJ; P14-ADJ). A comment in support of this was: '*Information is changing; we need to learn new ways and methods*' (P22-EBB). Another suggestion was to improve extension service facilitation by providing '*adequate facilitation for extension work*' (P10-ADJ). This was thought to promote high-quality standardised maize products that could attract markets nationally and internationally. It was also noted that the government should coordinate all the stakeholders, including the private sector, civil societies, communities and local authorities, in disseminating EBI.

The qualitative data revealed that rural smallholder farmers also had specific information needs around proper and timely harvesting, drying, storage and market access (FGD2 13.03.2024). These participants mentioned that there was a need for monitoring the application of post-harvesting practices among smallholder maize farmers because the lack of feedback and adoption hindered progress. For example, '*Feedback and updates of the outcomes after dissemination and use of the information will be useful and help to identify areas of improvement*' (P26-EBB).

The document analysis examined material that was relevant to agricultural extension services, as presented in Figure 28.

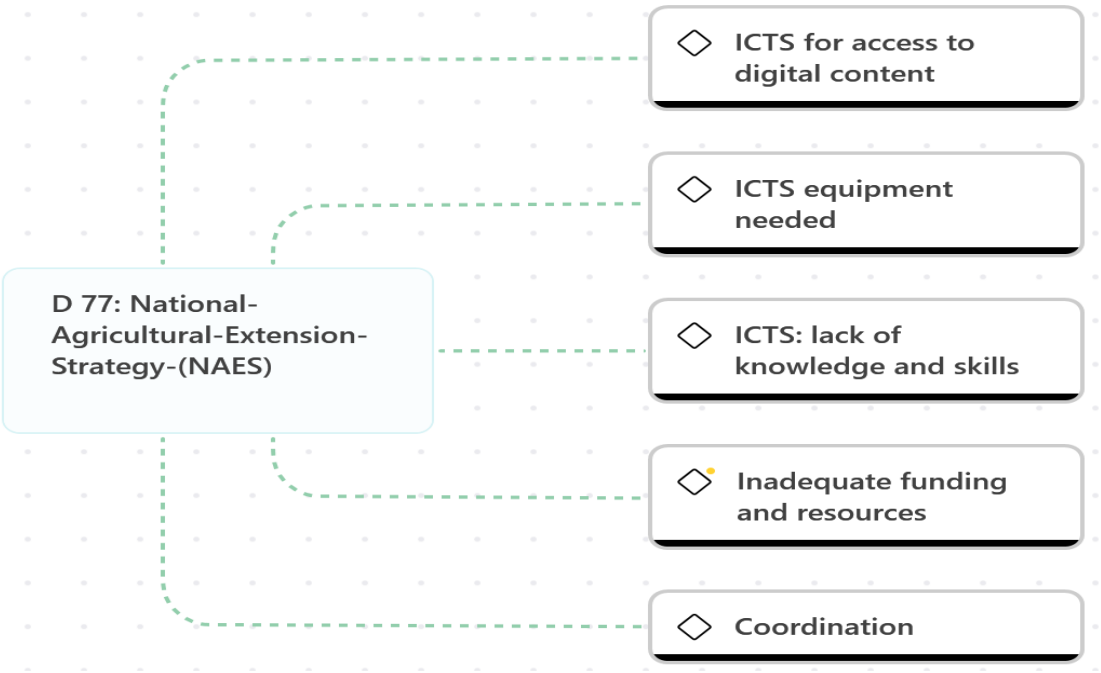

Figure 28: Government of Uganda Strategy for Agriculture Extension Services

The document analysis revealed that the Government of Uganda had a strategic plan for extension services that recognised the need for coordination, the use of ICT to facilitate access to information for rural smallholder farmers and connection to digital content. However, there was no proof of the strategy's implementation for rural smallholder maize farmers, which was attributed to inadequate funding.

5.10 Chapter summary

This chapter presented findings from the qualitative and quantitative datasets concurrently. The study objectives, research questions and themes from the data guided the presentation of the findings. The chapter started by outlining the study response rate, followed by a summary of respondents/participants' demographic information, access to and use of maize postharvest information, the influence of EBIP, sources of evidence, stakeholders, and small farmers' specific EBI needs and the difficulties they faced. The findings concluded with the suggestions/recommendations offered by respondents/participants.

The response rate was 80% (N=320) for the quantitative data set, 54.1% (n=26) for the personal interviews, and 68.8% (n=15) for the focus group discussions. The demographic information indicated that 135 (42.0%) respondents were female and 182 (57.0%) were male. Four districts representing the four regions of Uganda, along with the MAAIF Head Office participated in this study. Most respondents were aged 18–40 years (76.8%). Maize postharvest loss was reported in the four districts studied by many (75%) rural smallholder farmers, with about 40% and 60% of the maize reportedly lost in Iganga and Kabarole, respectively.

The quantitative results showed that 84.4% of rural smallholder farmers accessed a variety of postharvest handling information and 82.8% agreed they had used the information they accessed. Conversely, the qualitative findings from the personal interviews and focus group discussions indicated that few rural smallholder farmers were accessing and using maize postharvest handling EBI. Most questionnaire respondents (88.1%) and focus group participants agreed that EBIP largely influenced the access to and use of maize postharvest handling EBI and farmers' daily practices. The maize postharvest handling information accessed through the extension services was evidence-based, but it was not possible to determine if that accessed through other sources (e.g. friends, family) was evidence-based. The most prevalent EBIP components among rural smallholder farmers were asking about farmers' needs and acquisition of evidence, whereas the remaining practices were uncommon (aggregating, appraising, applying and assessing).

The findings indicated that there was no significant relationship between those who lost a quantity of maize and access to EBI for effective postharvest practices. However, there was a significant relationship between the quantity of maize harvested and access to EBI that influenced maize postharvest handling practices. There was also a statistically significant relationship between the sources of evidence and access to relevant evidence.

The interviewed agricultural production/extension officers acquired their information from the MAAIF, the Internet, AGORA and partners such as NARO and WFP. These officers used training, farm visits and demonstrations, radio talk shows, WhatsApp, farm explorers and exhibitions to disseminate EBI to rural smallholder farmers. Monitoring and evaluation of the use or application of EBI was performed periodically. The information officers from community libraries and the district information offices did not have maize postharvest handling EBI to disseminate to farmers. Agricultural production/extension officers did not think that such personnel would be able to disseminate this technical information to farmers. Translation and repackaging of the EBI were not performed at the district level but at the Ministry level. The quantitative respondents and qualitative participants all mentioned that the major difficulties encountered were inadequate resources, the high farmer-to-extension worker ratio, and rural smallholder farmers' poor mindset and unwillingness to adopt new evidence.

Suggestions offered were to increase the number of extension officers and improve road networks for better and easier movement to disseminate EBI to the rural population. Questionnaire respondents further recommended improved access to EBI among rural smallholder farmers, extension workers and information officers. The importance of retooling and updating extension and information officers with ICT knowledge and skills for packaging and disseminating information, better facilitation and more support for smallholder farmers was emphasised. To promote high-quality, standardised maize products that attracted national and international markets, it was suggested that the government should coordinate all stakeholders, including private companies. The findings revealed that rural smallholder farmers needed specific information concerning proper and timely harvesting, drying, storage and market access. There was also a need for monitoring the application of post-harvesting practices among smallholder maize farmers. Lack of feedback and limited adoption of technologies further hindered progress. Solutions such as providing postharvest technologies, training and study tours may help improve practices.

CHAPTER 6

INTERPRETATION AND DISCUSSION OF THE FINDINGS

6.1 Introduction

This chapter presents the interpretation and discussion of the research findings that were reported in Chapter 5. The researcher assumed that EBIP would influence the access to and use of maize postharvest handling EBI by rural smallholder maize farmers in Uganda. This chapter discusses this assumption in relation to the findings and extant literature. Themes were developed based on the research questions and objectives that guided this study, and the data were interpretated and discussed in terms of these themes. Narration and themes were used to pragmatically present the interpretation and discussion (Clark & Ivankova 2015; Ngulube 2019). The specific themes discussed are as follows.

1. Influence of EBIP on access to and use of relevant maize postharvest handling EBI.
2. Sources of maize postharvest handling EBI.
3. Specific maize postharvest handling value chain EBI needs.
4. Difficulties rural smallholder farmers experienced when accessing EBI.
5. Suggestions for improving maize postharvest handing EBIP to influence access to and use of EBI by rural smallholder farmers in Uganda.

6.2 Influence of EBIP on the access to and use of relevant maize postharvest handling EBI

EBP theory (Eldredge 2016) and the evidence-based library and information practice model, as fronted by Koufogiannakis (2013) and implemented by the UNC Health Science Library (2024), suggested that major components of EBIP were the evidence, professional expertise, users' needs (problems) and the step-by-step approach (ask, acquire, appraise, aggregate, apply and assess). Consistent with EBP theory, this study's first objective was to establish the status of the influence of EBIP on access to and use of EBI for maize postharvest handling by rural smallholder farmers in selected districts in Uganda. The findings (reported in Chapter 5) are discussed in terms of maize farming activity for rural smallholder farmers, including farm size, harvest quantity, postharvest loss, access to and use of information, EBIP, sources of evidence, the evidence itself, translation and repackaging of evidence, means of dissemination and the stakeholders in EBI dissemination.

6.2.1 Maize farming activity and postharvest handling by rural smallholder farmers

Questionnaire respondents were asked to declare their maize farming activity status in the last season in terms of the land they farmed, the quantity of maize harvested, and the postharvest loss experienced (bags or kilograms). Most respondents (98%) had harvested maize from 1–5 acres of land. These findings confirmed that respondents belonged to the 'smallholder farmers' category as they owned less than 5 hectares of land and depended on household labour for agriculture (85% of all farmers in Uganda) (Atube et al 2021). In terms of maize farming output, most respondents (96%) had harvested less than 5,000 kilograms of maize, with the low yield attributed to poor soils, fake seeds and poor weather conditions. Maize postharvest loss was reported by 75% of respondents across the four districts (Adjumani, Iganga, Mubende and Kabarole). The qualitative findings confirmed that around 40% of the maize was lost in Iganga and 60% in Kabarole. Tibagonzeka et al. (2018) reported a similar loss estimate (44%) because of poor storage leading to aflatoxin contamination. The Uganda Bureau of Statistics (2019) and Shee et al. (2019) reported a loss of 23.8%, and Muwereza (2024) noted that postharvest loss had not reduced significantly in Uganda. These findings suggested that food loss remains high, which implied that this area needs expert attention from various fields, including strategies to contribute to alleviating food loss using EBI dissemination.

6.2.2 Access to and use of maize post-harvest handling EBI

The Ranganathan (1931) laws of library and information science emphasised that information is for use. The Uganda Information Access Act 2005 and Constitution of the Republic of Uganda 1995 give all Ugandans the right to access information for life transformation and growth. Furthermore, the Uganda Extension Services Guidelines and Standards together with the Uganda National Extension Services Strategy 2016–2021 recognise the importance of access to and use of information for better farming practices among rural smallholder farmers. This study investigated whether rural smallholder farmers were accessing and using information to support improved mindsets and maize postharvest handling practices.

The quantitative findings showed that most respondents (84.4%) had accessed a variety of postharvest handling information and 82.8% said they had used the information accessed. However, the personal interviews and focus group discussions suggested that few rural smallholder farmers accessed and used maize postharvest handling EBI disseminated by extension workers. They noted that most of the information accessed by farmers was obtained from friends, meaning it was hard to establish its quality. Furthermore, the situation on the ground showed that little EBI was accessed and used, as postharvest handling practices were

still not effective or efficient. The New Vision newspaper published by the Ugandan government offered an innovative information pathway in the form of a weekly pullout known as the 'Harvest Money Expo Guide' aimed at bridging the gap between farmers and farm produce input dealers. This newspaper provided useful researched scientific information about seeds, farm mechanisation and postharvest handling techniques (Kato & Musoke 2021). However, this pullout was relatively unknown among respondents in this study; those that were aware of it indicated the advice needed money that they could not afford. These findings were consistent with those of Atube et al. (2021), in that information was reaching a few who had means but the majority still lacked access to EBI. Ariong, Okello, Otim and Paparu (2023:18) further explained that the information smallholder farmers received was often not useful for postharvest handling.

These findings suggested that the majority of rural smallholder maize farmers were not accessing and using maize postharvest handling EBI. Therefore, more effort is needed to make such EBI accessible and usable for these farmers.

6.2.3 Influence of EBIP on access to and use of maize postharvest handling EBI

EBP theory states that evidence should be checked for quality and relevance to produce the desired goals through the implementation of EBP. This idea was proposed by EBP scholars as the '6As' (ask, acquire, appraise, aggregate, apply and assess) (Eldredge 2016; Koufogiannakis 2013; Smith & Rennie 2014; UNC Health Science Library 2024). Therefore, to check the influence of EBIP on access to and use of evidence-based maize postharvest handling information, questionnaire respondents were asked to mention the EBIP components that were implemented in their access to and use of maize postharvest handling information. Most respondents (88.1%) and qualitative participants indicated that EBIP largely influenced access to and use of maize postharvest handling EBI and farmers' daily practices, although it was not fully implemented. Questionnaire respondents said the most commonly known EBIP components among rural smallholder farmers were asking about farmers' needs and acquisition of the evidence; the other practices were uncommon (i.e. aggregating, appraising, applying and assessing). Furthermore, the findings confirmed that the maize postharvest handling information accessed through extension services was evidence-based. This meant that information was scientifically researched, although it was not possible to confirm the status of information that was accessed through friends/family members.

The data analysis indicated that there was no significant relationship between the loss of maize (quantity) and access to EBI for effective postharvest practices. However, there was a significant

relationship between the quantity of maize harvested and access to EBI to influence maize postharvest handling practices. Furthermore, there was a significant relationship between the acquisition of evidence and access to relevant evidence (p=0.000). These findings suggested that the concept of EBIP had a role in smallholder farmers accessing and using quality, credible and relevant EBI. If well implemented, the use of quality and relevant EBI can mitigate the identified problem of the information that smallholder farmers received not being useful for post-harvest handling (Ariong, Okello, Otim & Paparu 2023:18).

6.2.4 Translation and repackaging of evidence

EBP theory highlights that knowledge (sayings) is implemented through actions in the social context to achieve goals (Kemmis, Wilkinson et al. 2014; Lloyd 2010; Mahon, Kemmis, Francisco & Lloyd, 2017). The rural smallholder farmers, information officers and extension officers in this study lived in communities that provided a social context with values, cultures, socio-political and economic factors, preferences, experiences and expertise that should be reflected in EBIP. Furthermore, Lloyd (2010) demystified the practices that were involved in information work to enable achievement of the purpose of information practices. Maize postharvest handling EBI is the knowledge that undergoes aggregation or actions to enable its application by rural smallholder farmers who are diverse in terms of language, level of understanding, economy, technology, politics and culture.

In this context, the evidence, which is technical and mostly in the English language, goes through translation and repackaging processes in various forms to be appropriate for rural smallholder farmers to access and use to achieve the goal (i.e. effective access to and use of evidence for improved maize postharvest handling). Participants in this study were asked to explain how maize postharvest handling EBI was translated and repackaged for easy access and use by rural smallholder farmers. The qualitative dataset suggested that agricultural production/extension officers did not think that information officers would be able to disseminate such technical information to farmers. Furthermore, translation and repackaging of the evidence was not done at the district level, but rather at the level of the Ministry and partners. Information repackaging was generally in the form of training manuals, leaflets, materials, technological equipment, tacit knowledge and experiments for easy access through farm demonstrations, onsite application in farm visits, tests of postharvest equipment and materials.

As previously noted, the weekly Harvest Money Expo Guide had provided useful EBI about seeds, farm mechanisation and postharvest handling techniques and showed that it is possible to translate, package and disseminate this information to farmers. However, this was only

reaching a few farmers who had the means and could read English; the majority still lacked access to knowledge that was translated and repackaged for easy use by rural smallholder farmers (Atube et al. 2021).

6.3 Sources of maize postharvest handling EBI

Kumar (2017) highlighted that information was an important component of agricultural growth, and blending indigenous and scientific knowledge sources was crucial for sustainability. EBI sources are those that contain scientific knowledge and include journals, textbooks, databases, blogs, websites and newspapers. People generally prefer sources of information that they are aware of and feel they can trust to provide relevant information that is easy to access/use and available. For example, a previous study showed that 85% of farmers in Spain relied on personal experience as their information source, 70% had low levels of education and agriculture training, and information service seeking was considered a private rather than a public affair (Cruz, Albisub, Zamoranoa & Sayadi 2021). Therefore, accessing and using information depends on the users' level of education, information literacy levels (Kumar 2017) and exposure to sources of information.

This study examined the various sources of the maize postharvest handling information available to rural smallholder farmers. Participants in the personal interviews and focus groups were asked to declare how and where they accessed maize postharvest handling information, and what information they accessed. The interview participants reported they acquired information from the MAAIF, the Internet, AGORA and partners such as NARO and the WFP. They used training, farm visits and demonstrations, radio talk shows, WhatsApp, farm explorers and exhibitions to disseminate this information to rural smallholder farmers. Furthermore, the quantitative respondents reported that they accessed relevant maize postharvest handling information through friends (85.8%), meetings (82.0%), the Agricultural Extension Office (80.4%), NGOs (69.4%), media (e.g. radio/TV/newspapers) (60.6%), online/Internet (35.3%), district/village/sub-county information offices (42.6%) and community libraries (11.0%). These findings were consistent with previous studies that showed rural smallholder farmers preferred informal over formal information sources (Phiri, Chipeta & Chawinga 2019; Essougong, Fouepe & Degrande 2018; Mwantima 2018; Sam, Osei, Dzandu & Atengble 2017).

The qualitative data confirmed that community libraries and district information offices, although they could be good information sources, did not have maize postharvest handling EBI to disseminate to farmers. Importantly, farmers perceived friends as the preferred source of

information followed by meetings, extension workers and media. Online/Internet and libraries were the least preferred sources of information. This was consistent with the findings from Spain that most farmers relied on personal experience for information and had low levels of education (Cruz, Albisub, Zamoranoa & Sayadi 2021). Furthermore, given that the majority of rural smallholder farmers accessed information from unofficial sources (i.e. friends), it was difficult to verify the quality of the information and assess its effectiveness in influencing the right mindset, decisions and postharvest handling practices to reduce loss and improve household incomes, food security and ways of life. Of note, few farmers accessed EBI via official sources (i.e. extension services offices, libraries and information centres).

Maize postharvest handling EBI can be grouped into the following five categories (Baributsa, Bakoye, Baoua & Murdock 2020; Darfour & Rosentrater 2020; Ahmad & Shausi 2020; United Republic of Tanzania 2019). i) Explicit information found in databases, the Internet, research bodies' websites and other collections. ii) Implicit or tacit knowledge from experts. iii) Farmers' experience through practices over time that had worked for them. iv) Technological materials. v) Equipment found in factories or industries. This study examined rural smallholder maize farmers' access to and use of explicit scientific research information found in databases, manuals, books and journals. The qualitative dataset suggested that EBI disseminated to rural smallholder farmers included traditional or local evidence as well as scientific evidence. Participants reported that the agricultural, extension and information officers accessed explicit knowledge from the MAAIF Manual, databases (e.g. AGORA), textbooks, NARO and the Internet. This information was then disseminated to farmers in the form of training, demonstrations and hands-on farm practices. In addition, materials such as PICS bags, hermetic bags and threshing equipment were made available to farmers through the WFP and the MAAIF.

This study clarified the stakeholders who supported EBIP efforts related to maize postharvest handling in Uganda. The Uganda National Extension Services Strategy 2016–2021 recognised the need to work with partners to implement effective extension services. The quantitative dataset showed that NAADS was the most commonly known supportive stakeholder (90.8%), followed by district extension officers (73.9%) and NARO (54.6%). Interestingly, community libraries were least often considered a supportive stakeholder (4.7%). The qualitative participants further explained that extension workers did not work with community librarians or district information officers and cited being unaware of their ability to disseminate technical evidence to farmers. Some participants recommended that community libraries should be

located in rural areas and work to actively introduce themselves to farmers. Participants from community libraries explained that they were disseminating information to rural smallholder farmers using Internet services through the library reference services. However, they lacked postharvest handling evidence, the library and skills on how to help the farmers. These participants suggested that the extension workers should work with community libraries and equip them with pre-packaged evidence to disseminate to the farmers that visited their libraries. Participating agricultural extension officers indicated they preferred ICT-enabled sources, libraries and databases.

6.4 Specific maize postharvest handling EBIP needs for rural smallholder farmers

Garrido and Wyber (2019) reiterated that achieving the second SDG, which is concerned with zero hunger, depended on having timely access to information. Many farmers lack access to knowledge about current farming practices, sustainable inputs, market opportunities, prices and weather forecasts. This is particularly the case for rural smallholder farmers in Uganda, and it is also possible that they are ignorant of pertinent postharvest technologies, legislation and subsidies. Governments, NGOs, academic institutions and other stakeholders make use of available open information resources to provide timely information to smallholder farmers to ensure food security. To this effect, the third objective of this study was to examine the specific maize postharvest handling EBIP needs of rural smallholder farmers. The findings revealed that rural smallholder farmers had several EBIP needs, as follows.

Questionnaire respondents expressed the need for rural smallholder farmers to be asked about their EBI needs before information was acquired. The current top-to-bottom approach, where information was disseminated to farmers without asking their specific needs, was considered unfavourable. This top-to-bottom approach meant that farmers accessed information that did not apply to their specific needs. Respondents said they needed quality and relevant technological evidence to support various postharvest handling practices, such as proper and timely harvesting, drying, storage and market access. The most commonly cited EBI needs were storage (97.1%) and drying (94.3%). The needs for EBI on value addition and credit support were also high (90.4% and 76.4%, respectively). The qualitative findings from personal interviews were consistent with the quantitative findings. However, participants also identified the need for the application of post-harvest practices among smallholder maize farmers to be monitored.

Other information needs mentioned in the qualitative dataset included soil management, insurance for postharvest loss, marketable crops, reliable water for production and markets for

maize. These findings supported those of previous studies that showed rural farmers needed specific scientific research information on: technological knowledge and skills; prices; contacts; transport facilities; proper harvesting, drying, storage and transport; marketing; credit; and climate change (Essougong, Fouepe & Degrande 2018; Campenhout 2021; Kumar & Kalita 2017; Abodoulaye et al. 2016; Affognon, Mutungi, Sanginga & Borgemeister 2015; Baributsa, Ibrahim & Murdock 2020; Balungi 2016; Darfour & Rosentrater 2020; Kadjo et al. 2018; Manandhar, Milindi & Shah 2018; Mondal et al. 2020; Mutambuki & Likhayo 2021; Mutiga, Mushongi & Kangethe 2019; Walker, Wolfe & Davies 2017; Viola 2017). A systemic review by Villar et al. (2023) confirmed that farmers had marketing information needs, including market locations, prices and connections to buyers.

The findings from this study highlighted that the government had supplied grinding mills for value addition, but farmers still needed support. These findings implied that various stakeholders need to improve their efforts to ensure rural smallholder farmers can access and use timely and specific maize postharvest handling EBI. This information must be acquired from the right sources, appraised, aggregated, applied and assessed for proper practices to avert loss and ensure food security for sustainable development.

6.5 Difficulties rural smallholder farmers and extension workers experienced when accessing EBI

The third objective of this study was to examine the difficulties that rural smallholder farmers and extension workers experienced when accessing and using maize postharvest handling EBI. Questionnaire respondents were asked to note the difficulties they experienced. They reported difficulties such as the EBIP being inadequate and inconvenient, they lacked awareness of maize postharvest handling technologies, available training was occasional and available maize postharvest handling EBI was unfavourable. The details of these findings are presented below.

6.5.1 Inadequate resources and funding

The findings suggested that there were limited postharvest handling resources in terms of personnel, materials, equipment, transport and funding that hindered efforts to disseminate EBI to rural smallholder farmers. The qualitative data showed there was a lack of adequate financial support and infrastructure to disseminate EBI, which was consistent with the barriers noted in previous studies (Ayoubia et al. 2020; Booth 2011; Kato & Musoke 2021; Nalweyiso et al. 2024; Nkeiruka, Noreen & Iroro 2024; Viola 2017). Furthermore, the poor road network for rural smallholder farmers did not support maize postharvest handling and there was no reliable

transport that farmers could use to transport their maize to stores or markets. Therefore, loss was recorded through the transport system.

Questionnaire respondents strongly agreed (63.8%) or agreed (20%) that the current EBI was not adequate to empower rural small farmers to overcome post-harvesting difficulties. This highlighted that for most farmers, the current maize postharvest handling EBI was inadequate. The qualitative dataset also revealed that the current EBIP was inadequate in terms of frequency of dissemination, the top-to-bottom approach of providing evidence, the evidence itself and the personnel mandated to disseminate evidence. In terms of the personnel, these participants reiterated that the ratio of farmers to extension workers was high, meaning agricultural extension workers had not reached farmers. Furthermore, the evidence was mostly traditional and rarely scientific. These findings were confirmed by a FAO, WFP and IFAD (2019) survey report that noted Uganda lacked effective extension services, and reliable postharvest handling knowledge and skills. Löwe and Sanyu (2017) and the UBOS (2020) confirmed that extension services for smallholders in Uganda were minimal and did not encourage youth to engage in agriculture. Nampijja and Birevu (2016) noted the ratio of one extension worker to 25,000 farmers. These findings highlighted that extension services are limited in Uganda and in other Sub-Saharan African countries. For example, Kadjo et al. (2018) reported that post-harvest interventions were a project activity and often funded by donor (i.e. development partner) support; there was no continuity once a project was completed. Extension workers' knowledge and skills were also limited and needed updating and retooling to equip them with new technologies for improved services. These findings implied that extension services were inadequate in terms of personnel, knowledge, skills and facilitation. Therefore, it is necessary to increase the number of extension workers, equip them with knowledge and skills, increase funding and provide facilitation. The document analysis for this study showed that the BMAU Brief 25-19 reported that extension services were inadequate, inefficient transport facilities affected the frequency of visits and the majority of farmers were not benefiting from the services.

In addition, EBI was not available in some sources such as information centres or libraries, and district information officers did not have EBI available for dissemination. These findings were consistent with those of Campenhout (2021) and Sobalaje (2020), who noted that community libraries had irrelevant and inadequate postharvest and general farming information. Therefore, it is necessary to equip information centres and community libraries with relevant and quality EBI for easy access and use by rural smallholder farmers.

6.5.2 Inconvenient access to EBI

In terms of convenience for farmers to access maize postharvest handling EBI, the majority (69%) had to walk long distances to access EBI in extension offices and libraries. The focus groups and observation data confirmed that rural smallholder farmers had to travel long distances on bad roads to reach trading centres for training or to access information from extension workers in sub-counties. However, personal interview participants said that farm demonstrations and visits were offered conveniently at rural smallholders' farms, and farmer groups were convenient places for extension workers to deliver farm demonstrations and training. These findings were consistent with those of Muhanguzi and Ngubiri (2022), who conducted a convergent parallel mixed methods study on the challenges smallholder farmers faced in extracting value agricultural information in Uganda. Those authors reported that the poor quality of information, lack of training, costs and poor pathways were challenges farmers faced.

In this study, farmers also cited costs and time waste as barriers related to the inconvenient sources of information. For example, community libraries and agricultural extension offices were official sources of information but were urban-oriented and therefore located far from where rural smallholder farmers resided. Cruz, Albisub, Zamoranoa and Sayadi (2021) reported that farmers in Spain needed quality information, which could be realised through collaboration between farmers, researchers, extension advisors and manufacturers. These findings highlighted the need for a mechanism to bring together the different stakeholders to harmonise the way scientific information is disseminated to rural communities.

6.5.3 Unreliable, unavailable and costly ICT facilities

The findings from both the qualitative and quantitative datasets suggested that ICTs had not reached all parts of Uganda, and some rural smallholder farmers could not access EBI online, even via WhatsApp. The document analysis showed that the Uganda National Extension Strategy 2016–20/21 recognised the capabilities of digital information and ICTs to improve extension services. However, there was no clear implementation of this strategy for maize farmers. These findings were consistent with previous studies that reported ICTs were poor, costly or non-existent in rural areas in most developing countries (Bernard, Makhija & Spielman 2023; Achora 2018; Muhanguzi & Ngubiri 2022). Taken together, these findings indicated that ICTs should be improved for farmers in rural areas to enable them to access EBI. In addition, extension workers should use ICTs, including AI-enabled technologies like chatbots, blockchain, and AI-generated content (AIGC), to package and disseminate EBI as suggested by Hussain et

al. (2022); Liu et al. (2022); Maginga et al. (2024); Maria (2024); Raj et al.(2024); TuYizere et al. (2024); Zhang et al. (2024).

6.5.4 Unawareness of maize postharvest handling EBI technologies

The questionnaire asked smallholder farmers about their awareness of specific maize postharvest storage facilities and other technology that could improve maize storage and protect it from pests (e.g. weevils). The majority of farmers (60.3%) were not aware of technologies such as hermetic bags, hermetic bins, modern threshers, metal silos, plastic tanks, separators and solar driers. Among the minority who knew of these technologies, some farmers indicated that they were so costly that they could not afford them. Most farmers knew of sisal bags, sunshine, fireplaces and tarpaulins to support the maize postharvest handling value chain. However, these local technologies were vulnerable to damage via human weakness, climate change and insects, which affected the quality and quantity of maize. Mbagwu, Benson and Onuoha (2018) explained that a lack of awareness about the need for farming information among rural smallholder farmers and stakeholders contributed to the failure to ensure a proper mechanism for access and use of such information was available.

Similarly, Balungi (2016) conducted a study among smallholder farmers in Kiryandongo, Uganda, and reported that farmers were unaware of scientific technologies. Booth (2011) and Nkeiruka, Noreen and Iroro (2024) also highlighted a lack of awareness as among the EBIP barriers. The findings of the document analysis for this study revealed that only 15% of technological information was reaching farmers (Uganda Ministry of Finance, Planning and Economic Development 2019). These findings implied that awareness of technology and services contributed to its access and use; therefore, there was a need to create awareness of the need to implement EBIP and available maize postharvest handling technologies for rural smallholder farmers and extension workers.

6.5.5 Periodical or seasonal training

Smallholder farmers in this study were asked how often they received training because there were reports in the literature that farmers received ad hoc training on maize postharvest handling. Over half of the respondents (51.3%) strongly agreed that the available training was not consistent but seasonal, and they felt they did not benefit. However, some respondents (11.6%) indicated that they saw the training as consistent and sufficient. The qualitative arm of this study confirmed that training was seasonal and delivered when funds were available, which suggested that training was inconsistent. FGD1 (09.02.2024) participants also said the

occasional training was only covered what the officers wanted to train farmers on and not what the farmers desired to learn.

One participant emphasised that the work of extension workers should not be in offices but in the field disseminating information. However, this was not the case, as extension workers were mostly in offices and spent limited time in the field disseminating information. Therefore, their impact was minimal. Rural smallholder farmers needed to receive training several times before they could adopt or apply EBI. The document analysis (BMAU Brief 25-19) revealed that few extension workers could reach rural smallholder farmers during pre-season, on-season and after the season for adequate support. These findings suggested that EBI was disseminated seasonally (e.g. once or twice a year), which was not sufficient to influence rural farmers' mindset to implement effective maize postharvest handling practices. These findings highlighted the need to ensure EBI dissemination is more frequent and sufficient to positively influence rural smallholder farmers.

6.5.6 Unfavourable maize postharvest handling EBIP

Questionnaire respondents were asked whether they believed the current EBIP was favourable. Over half (51.25%) strongly agreed that there was no clear EBIP framework that brought stakeholders together to support rural maize smallholder farmers to access and use EBI. Some respondents (31%) agreed the unfavourable EBIP created difficulties in accessing and using EBI, whereas others (44%) disagreed that the unfavourable framework contributed to the failure to access and use EBI. Furthermore, some qualitative participants stated that reaching all farmers was difficult because they were not organised, although some noted that farmer groups offered a convenient avenue. These findings were consistent with those of AfranaaKwapong and Nkonya (2015), who reported that farmer groups were good channels for information access. However, the document analysis for this study revealed that farmers and extension services were fragmented and not coordinated, which resulted in inefficient and ineffective services. The low level of literacy among rural smallholder farmers also hindered opportunities for some farmers to access information. In addition, district extension workers were not directly answerable to MAAIF, which along with political interference, made implementation of maize postharvest handling EBIP difficult. These findings were consistent with previous studies (AfranaaKwapong & Nkonya 2015; Kiconco et al. 2023; Rwamigisa, Birner, Mangheni & Semana 2018) that reported political will, or interference was a hindrance to vibrant extension services in Uganda, and led to unfavourable dissemination of EBI to rural smallholder farmers.

The rural smallholder farmers in this study reiterated that information materials needed to be translated for them to have better access. However, the number of languages made it difficult, and limited resources (financial, human, equipment and machinery) hindered effective dissemination. Farmers indicated they wanted to be trained consistently. However, farmers' conservativeness about change was attributed to their lack of training, learning and adopting technology. Other issues identified as contributing to farmers' postharvest loss were unpredictable facilitation by the MAAIF, unreliable rainfall, floods, diseases, cost of farm supplies, poor maize prices, lack of markets for maize, pests and lack of pesticides, theft of maize, and inadequate facilitation. It was noted that the government should consider the provision of water for production. In other words, farmers had invested heavily, but after harvest, the gains were not proportional, meaning they experienced loss.

6.5.7 Limited knowledge and skills

The findings revealed that limited knowledge and skills hindered access to and use of EBI among rural smallholder farmers. This study identified four major areas of limited knowledge and skills: the use of ICTs, new ways of packaging and disseminating information, implementation of EBIP and information literacy. All of these areas of limited knowledge and skills were identified among the rural smallholder farmers, extension workers and information officers. These findings were consistent with the literature that highlighted rural smallholder farmers lacked information literacy skills, which hindered them from accessing and using information effectively (Antwin-Agyei, Dougill & Abaidoo 2021; Phiri, Chipeta & Chawinga 2019). The documents analysed (e.g. Uganda Extension Services Guidelines and Standards 2016) recognised the need to train and equip extension workers for quality services, but this study suggested that the guidelines and standards were not effectively implemented. The BMAU Brief 25-19 2019 confirmed that extension workers in Uganda required skills and noted that the 'MAAIF remains constrained by limited capacity building resources and largely depends on donor projects' (Uganda Ministry of Finance, Planning and Economic Development 2019:3). Rural smallholder farmers, extension workers and information officers need knowledge and skills to use ICTs including AI for translation and repackaging of maize postharvest handling information, implementation of EBIP and information literacy.

6.6 Suggestions for improving the maize postharvest handling EBIP to influence access to and use of EBI among rural smallholder farmers in Uganda

The quantitative and qualitative datasets offered several suggestions for improved access to and use of maize postharvest handling EBI by rural smallholder farmers in Uganda to improve their mindset and positively influence postharvest handling.

Increase resources and funding to facilitate EBIP access and use

The quantitative and qualitative findings suggested that the government should increase funding and the number of extension officers to support better dissemination of EBI to the rural population. Improved funding would support EBIP implementation efforts and increase the frequency of dissemination. This would lead to rural smallholder farmers' access to and use of relevant maize postharvest handling EBI, increase the number of extension workers and facilities and improve maize postharvest handling technological awareness campaigns. To increase funding, the government could diversify sources of resources and fund mobilisation by entering into private-public partnerships. This would secure an increase in funding and facilitation, and improve the ratio of extension workers to farmers. Furthermore, the majority of questionnaire respondents (62.50%) and qualitative participants recommended that the government should increase the number of extension workers to parish levels.

A clear mechanism for rural smallholder farmers to share their EBI needs, monitor application of the evidence and provide feedback

The personal interviews, focus groups and document analysis suggested there should be a mechanism that asks farmers' specific maize postharvest handling EBI needs, such as drying, storage, value addition, credit access and training. When evidence had been applied, it was suggested that a clear mechanism for feedback should be developed. Farmers suggested that they would like the EBIP mechanism to include components of adequate information and convenient access to maize postharvest handling EBI (83.8%). A need was also identified for monitoring the application of post harvesting EBIP among smallholder maize farmers. Lack of feedback and adoption was noted as hindering progress.

Consider specific EBI needs, change from a top-to-bottom approach and apply a bottom-up approach

A top-to-bottom approach is a method of information communication whereby those in authority take the lead in making decisions about what, when, how and where information should be

communicated. Conversely, in a bottom-up approach to information communication, the beneficiaries are involved in decisions about what, when, how and where the information is communicated (Meerkerk 2019). Both approaches have advantages and disadvantages; for example, some people can quickly receive information that they did not decide on, whereas others reject information if they were not involved in the decision-making. Conversely, they access information if they were involved because they feel they were part of the process. This study revealed that rural smallholder farmers would like to be part of decisions about access to and use of maize postharvest handling EBI. This was consistent with the Extension Services Guidelines and Standards 2016, which indicated that farmers were supposed to have access to relevant services that benefited them. This suggested that a bottom-up approach would consider farmers' specific needs, including proper and timely EBI about harvesting, drying, storage and market access. There should also be a mechanism that regularly asks for farmers' specific maize postharvest handling EBI needs.

Provide adequate and convenient sources of EBI

Most respondents (83.8%) suggested that the EBIP framework should include the components of adequacy and convenient access to maize postharvest handling EBI for rural smallholder farmers. These findings were further explained by the qualitative data that suggested farmers required nearby information centres where they could easily access and use information without needing to travel long distances. It was noted as necessary to improve access to EBI for rural smallholder farmers, extension workers and information officers. Participating information officers reported that they did not have maize postharvest handling EBI available for rural smallholder farmers to access and use. The extension workers revealed that they lacked updated EBI to disseminate. Rural smallholder farmers also reported that the EBI they could access and use was inadequate. Some respondents (55.94%) strongly suggested that frequent and continuous training for rural smallholder farmers on maize postharvest handling should be implemented to create awareness of technologies and influence their mindset. Better road networks were also suggested to allow easier movement to access and disseminate information for the rural population.

Furthermore, the government should coordinate all stakeholders, including private companies, as stated in the analysed strategic plan and standards to provide EBI about maize postharvest handling technologies, training, farm tours and practices. Focus group participants suggested that governmental coordination of stakeholders was needed to translate, repackage and harmonise the EBI disseminated to rural smallholder farmers. These findings were consistent

with those of Kiconco et al. (2023), who reported that farmer groups and other stakeholders should work together to facilitate the proper dissemination of evidence to farmers.

Harmonise, retool and train for effective maize postharvest handling EBIP

The personal interviews suggested that the MAAIF and other stakeholders, such as farmer groups, NARO and the WFP, should work together to harmonise, retool and update extension, and information officers with ICTs knowledge and skills for online access, use, packaging and disseminating relevant maize postharvest EBI. This would improve farmers' mindsets and practices to alleviate loss and improve food security and household incomes for rural smallholder farmers. A similar suggestion was highlighted in previous studies (Sobalaje 2020; Sam, Osei, Dzandu & Atengble 2017; Elueze 2016). The majority (76%) of questionnaire respondents in this study suggested that to ensure the evidence was credible, relevant and quality, extension service providers should have knowledge and skills to include the EBIP 6As (ask, acquire, appraise, aggregate, apply and assess). A further suggestion was that the government should equip sub-counties, districts and the MAAIF to prioritise translation and repackaging of maize postharvest handling EBI for rural smallholder farmers. Knowledge and skills on EBIP (i.e. the 6As) should also be implemented to ensure access to quality EBI.

Promote high-quality standardised maize products that attract national and international markets

This study suggested that no marketing information had been disseminated to rural smallholder farmers in the last season. The personal interviews indicated that maize prices were as low as 200/=, which did not equal the costs of cultivating the maize. These findings suggested the need to improve and equip farmers with marketing information and value addition information for maize to allow them to seek additional markets and achieve better prices.

6.7 Chapter Summary

This chapter interpreted and discussed the study findings, using the study objectives, research questions and themes from the data as a guide. The discussion connected the findings to the theoretical framework and existing literature, and highlighted areas of agreement and disagreement. The next chapter (Chapter 7) summarises the key findings, draws conclusions and offers recommendations based on these findings. Furthermore, the researcher proposes a model aimed to address the challenges faced by rural smallholder farmers in Uganda in accessing and using EBI for maize postharvest handling.

CHAPTER 7

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

The previous chapter presented the interpretation and discussion of the findings drawn from this study. This chapter builds on the previous chapter and presents the summary, conclusions and recommendations. In the recommendations, the researcher focused on suggesting practical strategies to ensure smallholder farmers can access and use relevant EBI concerning maize postharvest handling for improved mindsets and daily practice. The recommendations also include a proposed model for maize postharvest handling EBIP.

7.2 Summary of the findings

This section provides a summary of the findings from this study based on the following five research questions.

1. To what extent does EBIP influence access to and use of evidence for maize postharvest handling practice by smallholder farmers in Uganda?
2. What is the specific maize postharvest handling EBIP needed for rural smallholder farmers in Uganda?
3. How and where do rural smallholder farmers access maize post-harvest handling EBI?
4. What are the difficulties smallholder farmers and extension service providers experience with the available maize postharvest handling EBIP?
5. What can be done to ensure EBIP are implemented within extension services and contribute to access to and use of maize postharvest handling EBI by rural smallholder farmers in Uganda? Why?

7.2.1 Influence of EBIP on access to and use of maize postharvest handling EBI by smallholder farmers in Uganda

a. The quantitative arm of this study found that maize postharvest loss was experienced in all four studied districts by the majority (75%) of respondents. This was corroborated by the qualitative findings that showed 40%–60% of the maize harvested was lost. This loss was attributed to various difficulties, including lack of climate information (e.g. maize rotted because of the amount of rain during the harvest season), lack of scientific information on where to access scientifically-proven dryers, how to handle termites and weevils that

destroyed maize and proper storage facilities, along with lack of pesticides, poor threshing methods, theft and poor transport facilities. Relatively few (22.18%) respondents said they did not experience postharvest loss. This study showed that there was no significant relationship between the loss of maize (quantity) and the access to EBI for effective postharvest practices. However, a chi-square test indicated there was a significant relationship between the quantity of maize harvested and farmers who had accessed EBI on maize postharvest handling practices.

b. This study found that most rural smallholder farmers (84.4%) had accessed a variety of postharvest handling information, and most (82.8%) said they used the information they had accessed. The most common source of information accessed was through friends; however, it was difficult to verify if this information was scientifically researched. The findings from the personal interviews and focus groups were not consistent with the quantitative findings, as these participants reported that few rural smallholder farmers were accessing and using officially approved information for maize postharvest practices through extension services. These participants also noted that many farmers had the wrong attitude towards attending training where information was disseminated.

c. The results of this investigation showed a corroboration between the quantitative and qualitative data in that EBIP largely influenced access to and use of maize postharvest handling EBI and farmers' daily practices, although EBI was not fully implemented. This influence was thought to be large because rural smallholder farmers' mindsets, decisions and practices depended on the nature of information accessed and used. The most commonly implemented of the six EBIP components among rural smallholder farmers were asking about farmers' needs and acquiring the evidence; the other practices were uncommon (i.e. aggregating, appraising, applying and assessing). A chi-squire test showed there was a significant relationship between the acquisition (source) of EBI and access to relevant EBI. Both the quantitative and qualitative datasets confirmed that the maize postharvest information disseminated through extension services was evidence-based. Qualitative participants reported that the failure to fully implement EBIP was because the implementers lacked sufficient knowledge and skills, insufficient facilitation from the line Ministry and the bottom-up approach, which did not accommodate the beneficiaries' needs. The EBI was appraised by the Ministry and delivered to farmers to apply, but was sometimes not specific and irrelevant. There was no reported awareness of any checklist that was used to appraise the information for quality or relevance.

d. The descriptive analysis showed that NAADS was the most known supportive stakeholder (90.8%) followed by district extension offices (73.9%) and NARO (54.6%). Interestingly, community libraries were the least known supportive stakeholder (4.7%). The Agricultural Extension Services Strategic Plan 2016/17–2020/21 did not recognise community libraries as partners in extension services. Participants further explained that extension workers did not work with either community libraries/librarians or the district information officers. They did not know their existence and were not aware of their ability to disseminate technical evidence to farmers. Some participants recommended that community libraries should be located nearer to rural smallholder farmers and work to actively introduce themselves to farmers.

7.2.2 Rural smallholder farmers' EBIP needs for maize postharvest handling

a. The quantitative respondents and qualitative participants expressed the need for rural smallholder farmers to be asked about their EBI needs before it was acquired. The current top-to-bottom approach was not considered favourable for farmers, and meant they sometimes accessed and used EBI that was not applicable to their specific needs.
b. There was agreement between the two datasets that EBI on maize storage and drying were the topics most needed by rural smallholder farmers, as reported by 97.1% and 94.3% of respondents, respectively. The needs for EBI on value addition (90.4%) and credit support (76.4%) were also high. Qualitative participants also noted that additional information needed by farmers included soil management, insurance for postharvest loss, marketable crops, postharvest financial support (e.g. loans), reliable water for production, sellers of quality seed and markets for maize.
c. The personal interviews showed there was a need to retool, equip and update extension and information officers with ICT knowledge and skills for packaging and disseminating information, EBIP, the search for evidence itself and more support for smallholder farmers.

7.2.3 Sources (where and how) of access to and use of maize postharvest handling EBI by rural smallholder farmers and extension workers

a) The personal interviews showed that agricultural production/extension officers accessed evidence information from the MAAIF and partners such as NARO and the WFP in the form of training manuals, leaflets, materials, technological equipment and knowledge and skills. The Internet and AGORA were also among the commonly used sources of EBI. Furthermore, these officers used training, farm visits and demonstrations, radio talk shows, WhatsApp, farm explorers and exhibitions to disseminate EBI to rural smallholder farmers.

A chi-square test indicated there was no significant relationship between access to and use of evidence.

b) This study showed that for farmers, friends were the most dominant source of EBI (85.8%), followed by village meetings (82.0%) and agricultural extension officers (80.4%). Community libraries were the least commonly used information source (11%) by rural smallholder farmers.

7.2.4 Difficulties smallholder farmers and extension service workers experienced with the available maize postharvest handling EBIP

a. The qualitative and quantitative datasets both showed that the most outstanding difficulties experienced were the lack of clear funding, facilitation and resources for EBIP. The agreement in these findings was that the unclear budgets, flow of finances, and limited resources and facilitation did not support extension work in terms of EBI dissemination to rural smallholder farmers.
b. The second major finding concerning the difficulties experienced was the high farmer-to-extension worker ratio. The majority of the respondents/participants mentioned that few personnel were mandated to disseminate maize postharvest handling EBI, which contributed to rural smallholder farmers failing to access and use EBI. It was perceived that one extension worker per sub-county resulted in a minimal impact felt on the ground.
c. The third finding concerning the difficulties experienced was the lack of updated EBI in the districts studied. The community libraries and district information offices did not have maize postharvest handling EBI to disseminate to farmers. They lacked postharvest handling evidence in terms of materials, knowledge and skills to help farmers who visited them. They suggested that extension workers should work with community libraries and district information offices to equip them with pre-packaged EBI to disseminate to local farmers.
d. This study showed there was inadequate EBIP. The majority of quantitative respondents (83.8%) either strongly agreed or agreed that the EBIP was not adequate to empower rural small farmers to overcome post-harvesting difficulties. These findings were confirmed by the qualitative participants, who explained that the EBIP was inadequate in terms of frequency of dissemination, training, knowledge and skills, the top-to-bottom approach of providing evidence, the lack of evidence itself and the personnel mandated to disseminate EBI. Many smallholder farmers (51.3%) felt that the available training was inconsistent as it was ad hoc and periodic, and they felt they did not benefit. The qualitative data revealed that training was seasonal, occurred when funds were available and did not cover what

farmers desired to learn. One participant noted that the work of extension officers was meant to be in the field disseminating information rather than being office-based; however, extension workers were mostly (80%) in offices and only spent 20% of their time in the field. Therefore, the impact of EBI was minimal.

e. Limited ICT facilities, including Internet connectivity, knowledge and skills was a major issued identified in both the qualitative and quantitative datasets. The majority of rural smallholder farmers lacked ICT skills, facilities, Internet and connectivity, and they could not access EBI online, even via WhatsApp.
f. Lack of awareness of maize postharvest technologies was highlighted in this study, as the majority (60.3%) of quantitative respondents said they were not aware of various technologies for value addition to maize, along with drying and storage practices.
g. Farmers having poor mindsets and being unwilling to adopt new evidence was also a difficulty identified in this study. The qualitative data revealed that few rural smallholder farmers were attending training to access and use EBI; this was perceived as contributing to them having poor mindsets and being unwilling to adopt new technologies and apply the EBI.
h. Inconvenient access to EBI was a further factor noted in this study, as the majority of quantitative respondents (69%) said they had to travel long distances on poor roads to consult or access EBI. Some qualitative participants who conducted observations corroborated these findings. However, the personal interviews revealed that farm demonstrations, farm visits and farmer group training were convenient sources of EBI as they were carried out within the localities.
i. Importantly, this study found that there was no one stopover in the studied districts where farmers could go to easily access and use maize postharvest handling EBI, such as a documentation centre or community library. For example, the findings revealed that there was no community library at all in Adjumani district, whereas the three other districts (Iganga, Mubende and Kabarole) had community libraries but these were urban-oriented and had no access to maize postharvest handling EBI.
j. Furthermore, this study highlighted there was no clear mechanism that was available that brought stakeholders together to harmonise maize postharvest handling EBIP for rural smallholder farmers. This point was noted by over half of the quantitative respondents (51.25%).

7.2.5 Suggestion or recommendations for effective EBIP for maize postharvest handling by rural smallholder farmers in Uganda

The results of this study showed that the quantitative and qualitative datasets generally agreed on the following suggestions.

a) The government should increase available funding and the number of extension officers to improve the dissemination of EBI to the rural population. Improved funding would support the full implementation of EBIP efforts, increase the frequency of dissemination and lead to rural smallholder farmers' increased access to and use of relevant maize postharvest handling EBI.
b) MAAIF and other stakeholders (e.g., farmer groups, NARO, and the WFP) should work together to harmonise, retool, and update extension and information officers with ICT knowledge and skills for online access, use, packaging, and dissemination of relevant maize postharvest EBI to improve farmers' mindsets and practices, alleviate loss, and improve their food security and household incomes.
c) MAAIF, the Ministry of ICTs, and other stakeholders should exploit artificial intelligence and mobile technologies to package and disseminate maize postharvest handling EBI to rural or smallholder farmers.
d) The MAAIF should open the mandate of disseminating maize postharvest handling EBI that is translated and repackaged to community libraries and district information offices. In other words, extension workers should work with community libraries by equipping them with pre-packaged evidence to disseminate to the farmers who visit these libraries and information offices. This is because extension workers alone cannot sufficiently meet the ever-increasing diversified EBI needs of farmers.
e) The government should develop a clear mechanism and checklist for implementing EBIP, which will allow rural smallholder maize farmers to access and use relevant and quality EBI.

7.3 Conclusions

The following conclusions were drawn from findings of the present study, as guided by the research objectives.

7.3.1 Influence of EBIP on access to and use of maize postharvest handling EBI by rural smallholder farmers in Uganda

Despite rural smallholder farmers being the target for EBIP, they do not access and use maize postharvest handling EBI as desired, meaning EBIP is limited. These farmers need maize

postharvest handling EBI. They also need their maize postharvest handling problems studied (asked) to determine what EBI they need to acquire. The EBI acquired should be appraised for relevance and quality to suit rural smallholder farmers' needs and solve their problems. The EBI should also be aggregated (i.e. translated and packaged) for easy access and use by rural farmers in their social context. Finally, the applied EBIP needs to be monitored and assessed for feedback before the next dissemination to correct any errors and measure effectiveness.

This study found that there was a significant relationship between the quantity of maize harvested and farmers' access to and use of EBI. There was also a significant relationship between the acquisition of evidence and access to relevant EBI. Both the quantitative and qualitative findings showed that EBIP influenced farmers' access to and use of maize postharvest handling EBI and their daily practices, although it was not fully implemented. Therefore, this study concluded that EBIP has a role to play in the access to and use of maize postharvest handling EBI and improved practices by rural smallholder farmers in Uganda.

7.3.2 Specific EBIP needs for rural smallholder farmers for maize postharvest handling

This study found that rural smallholder farmers have specific maize postharvest handling value chain EBIP needs (e.g. storage, drying) that should be the focus of service providers.

7.3.3 Sources of access to and use of maize post-harvest handling EBI by rural smallholder farmers and extension workers

This study concluded that rural smallholder farmers need convenient and adequate sources of EBI on maize postharvest handling that are well facilitated. Extension workers, information officers and rural smallholder farmers need updated EBI on maize postharvest handling. This study also highlighted the need to retool and update extension workers, information officers and rural smallholder farmers with ICT skills, EBIP skills and maize postharvest technological knowledge. There is also a need to increase ICT infrastructure in rural maize farming communities and leverage emerging ICT trends like AI. Such measures will increase their ability to access, use and disseminate relevant maize postharvest handling EBI for improved mindset, better application of scientific technologies, reduced postharvest loss and improved household food security and incomes.

7.3.4 Difficulties experienced by smallholder farmers and extension service librarians with the available maize postharvest handling EBIP

This study concluded that there are various difficulties that hinder the implementation of EBIP to influence access to and use of maize postharvest handling EBI by rural smallholder farmers in the selected districts of Uganda. The most common difficulties are lack of reliable funding, lack of maize postharvest handling EBIP skills and knowledge, lack of ICTs skills and knowledge for packaging and accessing EBI, lack of information centres with packaged EBI and lack of a mechanism to bring together stakeholders to harmonise the EBIP process for maize postharvest handling.

7.3.5 Maize postharvest handling EBIP model to influence access to use of maize postharvest handling information by rural smallholder farmers in Uganda

In addressing the difficulties affecting access to and use of EBI for maize postharvest handling by rural smallholder farmers, this study proposed a model that stakeholders such as the MAAIF and the Department of Extension Services could adopt to use in the agricultural extension service framework, as illustrated in Figure 29.

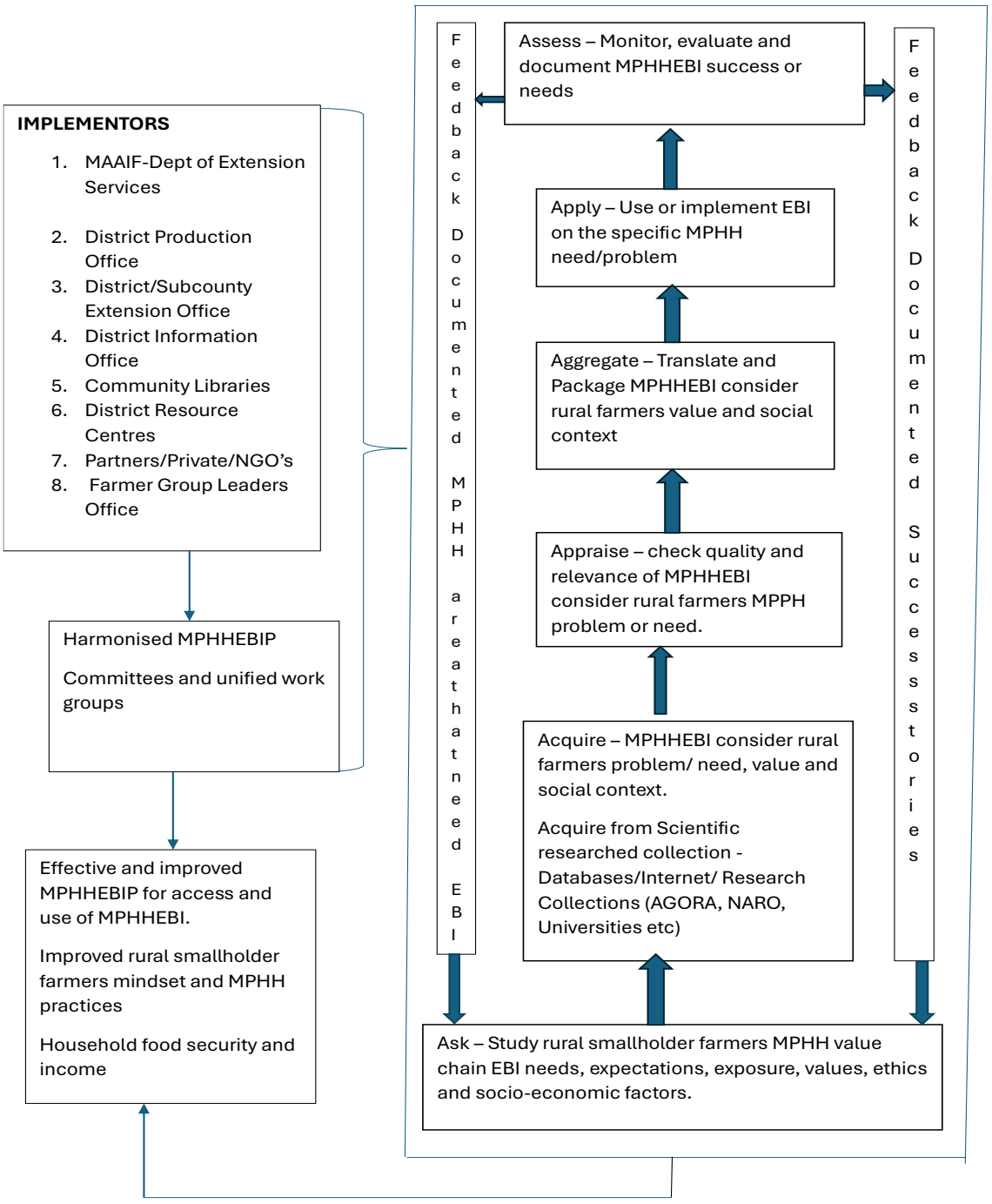

Figure 29: Model for access to and use of evidence-based maize postharvest handling information by rural smallholder farmers

The maize postharvest handling EBIP model, as seen in Figure 29, comprises the stakeholders who are implementors of the relevant EBIP, the evidence source and the EBIP process. This model was developed based on the difficulties identified in this study, the theories that were employed in executing this study, the conceptual framework and the reviewed literature as described in the following steps.

Step 1: Ask

The first step of EBP theory suggests that the need, query or problem should be studied well, using the PICO framework if possible. The need should be well interpreted to indicate the population where the needs will be applied, the intervention itself, an alternative intervention and the outcome or goal. This EBIP step is the process of asking rural smallholder farmers for their specific EBI needs in relation to the maize postharvest handling value chain. As shown in this study, various EBI needs were identified in the rural smallholder farmer maize postharvest handling value chain, such as technologies for storage information, threshing, drying, marketing, value addition, marketing, pricing and transportation. These specific information needs lead to a specific goal to be achieved by the application of the EBI. EBP theory states that actions and goals are implemented in the social context. This means that rural smallholders' EBI needs relating to maize postharvest handling should be studied in the context of the rural communities where farmers live and act, and consider their values, norms, education level and culture so that the remaining EBIP steps can be effectively guided.

Step 2: Acquire

This study highlighted a significant relationship between access to EBI and the source where the EBI was acquired. This means that the quality of EBI depends on the source where it is acquired. Therefore, this EBIP step concerns being aware of the available scientific research sources that hold maize postharvest handling EBI, identifying the right sources, and then searching, retrieving and making the EBI available for access and use. This EBI can be drawn from research and manufacturing institution collections, databases such as AGORA and NARO, university websites, the Internet, DOAB and DOAJ. The process of EBI acquisition is guided by the specific needs identified and the users' social context. In open-access sites, search and retrieval can be performed to gather information in the form of journal articles, e-books or print books, and case studies.

Step 3: Appraise

EBP theory emphasises the importance of appraising the evidence to establish its suitability. In the medical field, evidence is appraised using established checklists. Some of these checklists may be adopted in maize postharvest handling EBI appraisal. This is the process of checking through the acquired EBI and ascertaining its relevance, quality and suitability for the specific needs or problems identified in the local or social context. Exploiting the emerging AI

technologies will enhance the implementation of EBIP among extension workers, information workers and rural smallholder farmers.

Step 4: Aggregate

EBP theory and the Ranganathan laws of librarianship suggest that information should be aggregated for a specific user and save the time of that user. This means that every rural smallholder farmer or farmer group has specific norms or social contexts that should be considered, and the information should be translated and repackaged for easy use by that specific user. The appraisal of maize postharvest handling EBI in step three is then aggregated through a process of translating it from technical language to more suitable language for the rural smallholder farmers' social context. It can also be translated to a local language used in the specific target community. After translation, the EBI is repackaged to be suitable and easy to use for rural smallholder farmers.

This repackaging can be in the form of audio-visual materials, handbook or manual step-by-step practices, a talk show, AI Chatbot, a leaflet or a brochure. The format should be guided by the ideas from the practice theory of knowledge that can be practically demonstrated and implemented. Uganda Extension Services Regulations and Strategic Plans should also be consulted for guidance. For example, if rural smallholder farmers do not have ICT facilities and skills but do have power, they may not be able to use computers or smartphones but could use a TV. Therefore, this type of detail should be put into perspective. This study identified that the MAAIF Extension Services Manual was the most commonly used source by extension workers to identify relevant information for farmers; therefore, this manual should be enhanced and updated frequently with relevant information.

Step 5: Apply

This is the process of connecting the maize postharvest handling EBI with the specific problem or needs identified in the rural smallholder value chain, implementing the EBI and using it to solve the problem. The application can be in relation to the expert's knowledge or the rural smallholder's preferences or experience to ensure its effectiveness. For example, if the need or problem identified related to drying maize on the ground and the EBI acquired concerned drying maize on tarpaulins, then a demonstration could be given and tarpaulins made available free or at a small, subsidised fee. This should also include sufficient information on where rural smallholder farmers can continue to purchase tarpaulins.

Step 6: Assess

The EBP model suggests it is necessary to monitor and evaluate the effectiveness of the evidence applied. This study also found that no clear assessment was performed in this regard. Assessment helps to identify what worked and what did not work. This is the process of monitoring the implementation of the applied maize postharvest handling EBI, and identifying success stories, areas of improvement or further problems and documenting these factors for feedback to the implementers and rural smallholder farmers. This feedback should guide the next cause of action for the EBIP.

Feedback

The findings from both the quantitative and qualitative datasets showed that there was no feedback documented or shared with implementors or rural smallholder farmers. This model proposed in this study includes a way to address the issue of feedback. This model shows that there should be a connection from the start, which is based on asking farmers to assess where the EBI implementation or use is monitored, evaluated and documented. Success stories should be documented and shared with farmers to offer encouragement and support further implementation. The areas of improvement or documented problems and needs should also be discussed and the process of acquisition, appraising, aggregation, applying and assessing then performed. Therefore, this model shows a continuous process.

Implementers

The findings of this study suggested that there was no connection between the stakeholders mandated to disseminate EBI concerning the maize postharvest handling value chain to rural smallholder farmers. The present model shows how this challenge can be handled. To ensure the effectiveness of the EBIP for maize postharvest handling, the MAAIF, Department of Extension Services, District Production Office, sub-country extension offices, district or sub-county information/communication offices, community libraries, resource centres and partners in the community interested in disseminating information to rural smallholder farmers should work together. These stakeholders have various expertise, connections, capabilities and facilities that can contribute to the implementation of EBIP and ensure farmers' EBI access, use and success stories are realised. These stakeholders can work together in committees and workgroups so that there is a harmonised way of improving evidence and practices.

For example, farmer groups have a duty to share the problems farmers are experiencing; they can also mobilise and encourage farmers to turn up for training. District information officers have a communication platform that they can use to disseminate information to farmers. Community

librarians have the knowledge and skills to search and retrieve relevant information; they also have libraries where the EBI can be housed, and training carried out. Private and public partners have various specialised connections and equipment (e.g. the WFP and FAO), which they can bring to the working group and mobilise funding through private-public partnerships. The Ministry can supervise this process, and the district production officers, information officers and extension workers have the expertise to disseminate the relevant EBI. In the long term, there will be improved maize postharvest handling EBIP for rural smallholder farmers to support improved practices, as well as improved food security and household incomes among rural smallholder farmers.

7.4 Study implications

This section discusses the practical implications of this study for the Government of Uganda, MAAIF, the Department of Extension Services, rural smallholder farmers and library and information science professionals.

7.4.1 Practical implications for the Government of Uganda, MAAIF and the Department of Extension Services

The present findings imply that maize postharvest loss remains a significant challenge, and there is a need for clear strategies to alleviate it.

a) The government and other stakeholders should prioritise translating and repackaging scientific research information on the maize postharvest handling value chain for rural smallholder farmers and equip sub-counties, districts, and the MAAIF to support this effort.
b) The government should allocate more resources to support maize postharvest handling research and extension services.
c) The government should invest in digital infrastructure, including Artificial Intelligence capabilities, to support online information dissemination and access to rural communities.
d) The MAAIF should develop public-private partnerships to sponsor and enhance EBI dissemination and access.
e) The Department of Extension Services should implement existing extension services policies such as the National Extension Services Regulations and Standards and other programmes to promote EBIP and theory-practice approaches in agricultural extension services.

f) The Department of Extension Services should strengthen partnerships with research institutions, as recognised in the Uganda Extension Services Strategy 2016/17–2020/21. This requires including community libraries as partners to enhance access to maize postharvest handling EBI.

g) The Department of Extension Services should develop capacity-building programmes for retooling agriculture extension workers to update them with maize postharvest handling EBI, digital methods of disseminating information and EBIP to rural smallholder farmers, and practice theory processes to align with the Uganda National Extension Services Regulations and Standards, 2016.

h) The Department of Extension Services should develop context-specific maize postharvest EBI materials and channels for rural smallholder farmers. Specifically, it is necessary to regularly update the maize training manual for extension workers in Uganda with scientifically researched information.

7.4.2 Practical implications for library and information science professionals

The present findings imply that providing rural smallholder farmers with access to credible sources of EBI on the maize postharvest handling value chain can significantly impact their knowledge and practices. This highlights the importance of libraries and information services to practically support maize farming practices as follows.

a) Develop community-specialised services and collections focused on maize postharvest handling research and extension services.

b) Train community librarians and information professionals in maize postharvest handling EBIP to equip them to specifically support rural smallholder farmers.

c) Establish collaboration between community libraries and agricultural extension services to develop information literacy programmes for rural smallholder farmers.

d) Establish rural farmer-centred information services and networks in the rural communities to share maize postharvest handling knowledge and best practices with rural smallholder farmers and extension workers.

e) Develop capacity to critically evaluate, package and use maize postharvest EBI that is available in digital databases and collections (e.g. AGORA, DOAJ and DOAB) for rural smallholder farmers with the community libraries.

7.4.3 Practical implications for rural smallholder farmers

This study suggests that by accessing and using EBI, rural smallholder farmers can improve their maize postharvest handling practices, thereby leading to reduced food loss and improved food security. This can also increase their household incomes and overall well-being.

a) Rural smallholder farmers should prioritise the use of maize postharvest handling EBI and technologies for improved practices.

b) Rural smallholder farmers should organise themselves in groups and advocate for and demand access to maize postharvest handling EBI from the government, as it is their right as provided for by the Constitution of the Republic of Uganda 1995 and the Information Access Act of 2005.

7.5 Areas for further research

a) This study examined the influence of EBIP on access to and use of EBI for maize postharvest handling by rural smallholder farmers in selected districts in Uganda. This study did not look at other groups of farmers such as large-scale farmers, medium-scale farmers and urban farmers. Further studies could focus on those populations.
b) The study did not consider the way the extension workers and other experts synchronised EBI and indigenous knowledge for rural smallholder farmers. A further study could investigate at whether EBIP can also influence access and use of indigenous knowledge for maize postharvest handling.
c) This study was limited to maize postharvest handling, but there are other crops that could be examined in further studies, such as fruits, bananas, millet and beans.
d) This study found no specific literature on EBIP in Uganda, and more studies are needed on this concept in Uganda and other African countries, including on how librarians practice EBIP.

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Appendix 1: Survey questionnaire for rural smallholder maize farmers in selected districts in Uganda

Dear respondent,

I am Mrs. Jackline Estomihi Kiwelu Mayende, a Ph.D. student at the University of South Africa and the Deputy University Librarian at Kampala International University located on Ggaba Road Kansanga, Kampala. I am the principal investigator for this study.

This research seeks to collect views and opinions on evidence-based information practices for maize postharvest handling by smallholder farmers in Uganda. You have been selected as one of the respondents in this study. Are you willing to participate? Yes….. No…..

This is a voluntary activity, and you are requested to complete the questionnaire as honestly as possible. It is your right to withdraw at any time without notification. The responses will be used for the study purpose and your identity will remain anonymous in the report.

The findings of this study will be used to contribute toward developing an evidence-based information dissemination practices framework for maize postharvest handling by smallholders in Uganda. Smallholder farmers, Ugandan households and beyond will benefit from the information you will provide by way of informing policy formulation to alleviate the challenges of postharvest handling.

For any inquiry, please contact the researcher on +256782007793

Section A: Background Information

1. Gender: Female Male ☐
2. Literacy levels

I can read and write ☐ I cannot read and write ☐

3. Age

18 - 20 ☐

21 – 40 ☐

41 – 60 ☐

61 – 80 ☐

81 and above ☐

4. Am a member of a financial Group or SACCO

YES ☐ NO ☐

5. Name of the District and sub counties [tick as appropriate]

Iganga		Adjumani		Mubende		Kabarole	
1.Bulamagi		1.Adropi		1.Kitenga		1.Kasenda	
2.Nabitende		2.Pachara		2.Kalonga		2.Ruteete	
3.Nakalama		3.Ciforo		3.Kayebe		3.Mugusu	
4.Nakigo		4.Ukusijoni		4.Madudu		4.Busoro	
5.Nambale		5.Pakele		5.Kiyuni		5.Kabende	
6.Namungalwe		6.Dzaipi		6.Butoloogo		6.Kicwamba	
7. Nawandala		7.Arinyapi		7.Kiruuma		7.Karangura	
8.Nawaningi		8.Ofua		8.Kasambya			
		9.Itirikwa		9.Kigando			
				10.Nabingoola			
				11.Lubimbiri			
				12.Kibalinga			
				13.Bagezza			

Section B: Current Status of Maize Postharvest handling

6. What was the total acreage of land under maize cultivation for the last season

Less than one (1) acre ☐ One (1) to five (5) acres ☐

7. What was the estimated quantity of maize you harvested last season? (One bag = 100kgs)

Less than 10 bags ☐

10 bags to 50 bags ☐

51 bags and above ☐

8. What was the estimated quantity of maize you lost after harvesting due to postharvest challenges? (One bag = 100kgs)

Less than 10 bags ☐

10 bags to 50 bags ☐

51 bags and above ☐

No maize postharvest loss experienced ☐

Section C: Access and use of evidence-based information influence on maize postharvest handling.

Please tick the most appropriate response to the statement for question 9 to 16

9. Before storage of maize, I access evidence-based information to influence my decisions and practices. 9a. Strongly agree 9b. Agree ☐ 9c. Not sure ☐
   9e. Disagree ☐. 9f. Strongly Disagree ☐

10. Before storage of maize, I use evidence-based information to influence my decisions and practices. 10a. Strongly agree☐10b. Agree ☐ 10c. Not sure ☐
    10e. Disagree ☐ . 10f. Strongly Disagree ☐

11. Before drying of maize I access evidence-based information to influence my decisions and practices. 11a. Strongly agree ☐ 11b. Agree ☐ 11c. Not sure ☐ 11d. Disagree ☐ 11e. Strongly Disagree ☐

12. Before drying of maize, I use evidence-based information to influence my decisions and practices. 12a. Strongly agree ☐ 12b. Agree ☐ 12c. Not sure ☐12d. Disagree ☐ 12e. Strongly Disagree ☐

13. Before selling of maize, I access value addition evidence-based information to influence my decisions and practices. 13a. Strongly agree ☐ 13b. Agree ☐ 13c. Not sure ☐

13d. Disagree ☐ 13e. Strongly Disagree ☐

14. Before selling of maize, I use value addition evidence-based information to influence my decisions and practices. 11a. Strongly agree ☐ 14b. Agree ☐ 14c. Not sure ☐ 14d. Disagree ☐ 14e. Strongly Disagree ☐

15. Before maize postharvest handling, I access financial information to influence my financial decisions and practices 15a. Strongly agree ☐ 15b. Agree ☐ 15c. Not sure ☐ 15d. Disagree ☐ 15e. Strongly Disagree ☐

16. Before maize postharvest handling, I use financial information to influence my financial decisions and practices 16a. Strongly agree ☐ 16b. Agree ☐ 16c. Not sure ☐ 16d. Disagree ☐ 16e. Strongly Disagree ☐

17. Before maize postharvest handling, I participate in continuous training to gain knowledge on how to handle maize effectively. 17a. strongly agree ☐ 17b. Agree ☐ 17c. Not sure ☐ 17d. Disagree ☐ 17e. Strongly Disagree ☐

18. What Evidence-based Information Practices are you aware of? [Tick as many as applicable]

Asking farmers' information needs on maize postharvest handling ☐

Acquisition of maize postharvest information ☐

Appraising maize postharvest handling information for credibility and quality ☐

Aggregating maize postharvest handling information for easy access and use ☐

Applying maize postharvest handling information for better decisions and practice ☐

Assess maize post-harvest handling information application for improvement ☐

No evidence-based information practices are available ☐

19. Source of evidence-based information practices implemented in Uganda? [Tick as many as applicable]

Village meetings/church meetings ☐

Agricultural Extension Office ☐

Through Nongovernmental Organizations (NGOs) ☐

Through personal experience/ learning offline or online means ☐

Through District/Village/Sub County Information Officers ☐

Community Libraries ☐

Friends ☐

Media (Radio/Tv/Newspapers) ☐

I do not know any source ☐

20. Tick the following stakeholders whom you know support you with evidence-based information. [Tick as many as applicable]

National Agricultural Advisory Services (NAADS) ☐

District Extension Officers ☐

World Food Programme (WFP) ☐

Food and Agricultural Organization (FAO) ☐

National Agricultural Research Organization (NARO) ☐

Agriculture Cluster Development Project ☐

Community Librarians ☐

21. Which are the specific maize postharvest handling evidence-based information practice needs for rural smallholder farmers in Uganda? (Tick as many as applicable)

Drying ☐
Storage ☐
Value addition ☐
Credit support ☐
Continuous training ☐
Not mention ☐ (specify)

22. Does the current maize postharvest evidence-based information practices influence your daily decisions and practices?

YES ☐ NO ☐

23. What are the difficulties you experience with the current evidence-based information practices in Uganda? [Tick as appropriate according to the scale: 1- Strongly agree, 2- agree, 3- not sure 4- disagree, 5- strongly disagree

No	Difficulties	1	2	3	4	5
1.	Evidence-based information is not adequate enough to empower small farmers to overcome post-harvesting difficulties					
2.	Farmers walk long distances to access evidence-based information					
3.	Farmers are not aware of hermetic or any other evidenced storage facilities					
4.	Farmers do not know possible technologies for value addition methods					
5.	Farmers are not aware of credit/financial facilities available to support postharvest handling					
6.	Training provided are ad hoc in nature, so farmers do not benefit					
7.	Lack of evidence-based information practice framework causes all the problems mentioned above					
8.	No known source of maize postharvest handling evidenced information					

9.	The difficulties we experience is not mentioned here. It is……..					
10.	No difficulties experienced					

D: Proposed recommendations by Rural Maize Smallholder Farmers in Uganda

24. What would you like to be included in the evidence-based information practice framework for maize postharvest handling by smallholder farmers in Uganda? Tick as appropriate according to the scale: 1- Strongly agree, 2- agree, 3- not sure 4- disagree, 5- strongly disagree

No	Recommendations	1	2	3	4	5
1.	A mechanism for involving smallholder farmers to share their evidence-based information needs in terms of drying, storage, value addition, credit access, and training					
2.	A mechanism that can enable smallholders to access adequate and convenient evidence-based information					
3.	A mechanism that can ensure the evidence-based information practice is (Ask, Acquire, Appraise, Aggregate, Apply and Assess) implemented					
4.	A mechanism that can ensure continuous training is done for smallholder farmers					
5.	A mechanism to ensure smallholder farmers access information on financial/credit support					
6.	All the above-mentioned mechanisms					
7.	Not mentioned above: It is…….					

25. Why do you say the mechanisms mentioned in 25 above should be included in the framework?

Tick as appropriate according to the scale: 1- Strongly agree, 2- agree, 3- not sure 4- disagree, 5- strongly disagree

No	Reasons	1	2	3	4	5
1.	Because a framework will ensure all the necessary inputs into implementation of an evidence-based information practice are included					

2.	The framework will ensure smallholder farmers are empowered with the knowledge on specific evidence-based information needs in terms of drying, storage, value addition, credit access, and training.					
3.	The framework will ensure smallholders are empowered to access adequate and convenient evidence-based information.					
4.	The framework will ensure the evidence-based information practices (Ask, Acquire, Appraise, Aggregate, Apply and Assess) for maize postharvest by smallholder farmers are implemented.					
5.	A framework will ensure continuous training is done for smallholder farmers.					

THANK YOU

Appendix 2: Madi language survey questionnaire for Adjumani District

Lazi ma goliba ta usoka kare ture kuru rii.

Ma ba la e' ba.

Ma rusi Jackline Estomihi Kiwelu Mayende ii, ka founyi la University Africani leale rii ii ga ongo ma gaga madi buku ta badi Kampala international university ani Ggaba, lati mudri Kansanga, kampala, ma madi tavu uchudri ria amba i.

Ma ta vu'uchu anya ra asujo, anya ra rokodi cee ofu serii okojo rii ba' tro rii i, jo any ji baru ra i, drodrole anyi ba gogoli ba serii usoka ciriciri rii ba I vu Uganda ni drii. Upe nyi ba alua I lazi di a'I leni di a'I, dria nya nya ra du wa lazi di a'e jo I? …..oyoo……..ku……..

Dii ebu ma ori laka bar ii ku rii, ki adi nyi a'e kolea yusu a'e asi egkwe si, ani ya dribkwe gajo egkwe ofu khweka aco, nya lae' ni adri abua ta nijo, ki ewa nyi ni jo rii kolu te ofu di a.

Ta esule leni dia rii, adi ebua oso rokodi cee ofu kwele rii di I ovi serii ta bajo rii I, jo aji a'e a ra I, dii okoru ba serii saka ciriciri rii ba tro rii i. a'e vu Uganda nit ii rii, ziti Uganda aku rii tro ka ki loso loso ofu dii drii esu raa, amasi ku ko ba ka chara ba ovi serii okojo rii drii jo ata pa baru ra i.

Jo e lee ta nika jar ii, nyungkwe nukuta +256782007793.

Ewa A: ofu ta ni jo nyi dri rii.

Ovi nyi bijo rii. Ago zaa ☐

Founyi laka ni drii.

Ma ta la vua ma siya wa ☐ Ma ta la vua ma siya pkgwe ☐

3) Kinya

18 – 20 ☐

21 -40 ☐

41 -60 ☐

61 -80 ☐

81 oya andraga. ☐

4) ma alua lemu asusu a rii kusa SACCO.

Oyoo ☐ ku ☐

Ru district drii I vua ana sub-counties tro (nyipe kare nyi laka rii I)

Iganga		Adjumani		Mubende		Kabarole	
1.Bulamagi		1.Adropi		1.Kitenga		1.Kasenda	
2.Nabitende		2.Pachara		2.Kalonga		2.Ruteete	
3.Nakalama		3.Ciforo		3.Kayebe		3.Mugusu	
4.Nakigo		4.Ukusijoni		4.Madudu		4.Busoro	
5.Nambale		5.Pakele		5.Kiyuni		5.Kabende	
6.Namungalwe		6.Dzaipi		5.Kiyuni		6.Kicwamba	
7. Nawandala		7.Arinyapi		7.Kiruuma		7.Karangura	
8.Nawaningi		8.Ofua		8.Kasambya			
		9.Itirikwa		9.Kigando			
				10.Nabingoola			
				11.Lubimbiri			
				12.Kibalinga			
				13.Bagezza			

Ewa B drii I : Ovi seri ta bajo udi rii i, jo eta pa ra i.

6. iso anvu seri drii ocsa ingkwe ti? sa golidri alidi pi rii si.

Oca acra alu kuru ☐ Rijo Acra alu dri tou ☐

7. Seri iso oca gunia si nya urata si? sa golidi alidi pi rii si. (gunia alu ni kilo 100)

Oca gunia mudi kuru ☐

Rijo gunia 10 ndri oca gunia 50 ☐

Rijo gunia 51 otu andraga. ☐

8. Seri nya igwele raa rii gunia si, sa nyu ta pa raa dru i, sa ta bajori si I, ovi dru dri luci anya e' sule ovi seri ta bajo rii si i? (gunia alu ni kilo 100).

Oca gunia 10 kuru ☐

Rijo gunia 10 ndri oca gunia 50 ☐

Gunia 51 otu andraga. ☐

Serii alusa nyi khwe kuru nyi cee nye ji ra dru i. ☐

Ewa C: nyavala lati cee vua ofu cee ana sateni tro rii ebu jo rii ka lecho aji engoni nya, jo eta seri pa a'e ga raa i. (Nyipe ti vu di ovi nya ekwi na erijo rii si)

9. ocha seri ta mbadi ero a' ku, ma vala ofu cee sateni tro dii, adu echo ovi ma ra dujo rii ra? 9a. a'i ru ra lokuloku ☐ a'I ru ra ☐ 9c. nosi naa'ni ☐

9d . a'I ru ku ☐ 9e. a'I ru ku kwa rere. ☐

10. ocha seri ta mbadi ero a' me'bu vala ofu cee sateni tro dii, adu echo ovi ma ra dujo rii ra? 10a. a'i ru ra lokuloku ☐ 10b. a'I ru ra ☐ 10c. nosi naa'ni ☐

10d . a'I ru ku ☐ 10e. a'I ru ku kwa rere. ☐

11. ocha seri di eweriku ma vala ofu cee sateni tro dii adu echo ovi ma ra dujo rii ra.

11a. a'i ru ra lokuloku ☐ 11b. a'I ru ra ☐ 11 c. nosi naa'ni ☐

11 d . a'I ru ku ☐ 11 e. a'I ru ku kwa rere. ☐

12. ocha seri di eweriku me'bu vala ofu cee sateni tro dii adu echo ovi ma ra dujo rii ra.

12a. a'i ru ra lokuloku ☐ 12b. a'I ru ra ☐ 12 c. nosi naa'ni ☐

12 d . a'I ru ku ☐ 12 e. a'I ru ku kwa rere. ☐

13. ocha seri azire ku, ma vala ofu cee satani tro dir ii ka konyi kwa wa, adu echo ovi ma ra dujo rii ra.?

13a. a'i ru ra lokuloku ☐ 13b. a'I ru ra ☐ 13 c. nosi naa'ni ☐

13 d . a'I ru ku ☐ 13 e. a'I ru ku kwa rere. ☐

14. ocha seri azire ku, me'bu vala ofu cee satani tro dir ii ka konyi kwa wa, adu echo ovi ma ra dujo rii ra.?

14a. a'i ru ra lokuloku ☐ 14b. a'I ru ra ☐ 14c. nosi naa'ni ☐

14 d . a'I ru ku ☐ 14 e. a'I ru ku kwa rere. ☐

15. Ocha seri seriku, ma vala ofu cee rukodi siti tro rii echo ma uradara ovi siti abujoa dru rii ra.

15a. a'i ru ra lokuloku ☐ 15b. a'I ru ra ☐ 15 c. nosi naa'ni ☐

15 d . a'I ru ku ☐ 15 e. a'I ru ku kwa rere. ☐

16. Ocha seri seriku, me'bu vala ofu cee rukodi siti tro rii echo ma uradara ovi siti abujoa dru rii ra.

16a. a'i ru ra lokuloku ☐ 16b. a'I ru ra ☐ 16 c. nosi naa'ni ☐

16 d . a'I ru ku ☐ 16 e. a'I ru ku kwa rere ☐

17. Ocha seri seriku, a rii lini esure ovi seri ta bajo palera rii I saa cidru si ovi seri ta bajo rii I ga.

17a. a'i ru ra lokuloku ☐ 17b. a'I ru ra ☐ 17 c. nosi naa'ni ☐

17 d . a'I ru ku ☐ 17 e. a'I ru ku kwa rere. ☐

18. cee ofu sateni tro di nya bale ebu ga ongo okhwe anyi nii lini laka ra rii I ingo i?. (Nyipe a 'i teriteridru nya lobi si)

Nyizi goliba ni ra, di oleki ofu seri ta bajo rii ra nya I? jo ejiki aé ga ra i. ☐

Ofu esuka seri pa trale baru ra rii a' dri ni ga. ☐

ovi ofu esule seri ta bajo ae ga drii eji leco seri ru ra vua okwe anzo anzo raa. ☐

ovi ofu seri ta bajo kesua eji aé ga kgbwa drii oba seri esua ka ongo ebuga ni engwe ape ☐

ofu cee seri ta bajo di baka ebuga raa ni eji leco ovi nya ra dujo rii ra. ☐

Nyavala ovi ofu cee seri ta bajo kasua oji aé ga rii di baka ebuga ni eji leco ra. ☐

Ofu cee vua sadeni tro na di a iyoo ☐

19. leti ofu cee sadeni tro di esujo dru vua baka ebuga vu Uganda ni a, (nyipe nya nika rii ani)

Ti leci aé lafo rii kusa lemu jo ekelezia. ☐

Jo tandreka goliba dri rii Iga ☐

Lemu ciriciri gameti paga ku rii. ☐

Adi nia madi ebu di edidi raa ri disi, kusa lini eria si ri ba i. ☐

Adi esua ba gameti a ri di si erijo oru ndri calo a. ☐

Karee baka waraga ta umba laka rii igaa ☐

Ozi ga si. ☐

kare ofu esu ri I ga, ovidru radio, karatasi dri. ☐

Ani kare zii alu saa ku ofu di kenga laka sir i i ☐

20. nyipe ba dii baa ti nyaa ba nya nile ote ikonyi kii nyi raa ndre jo a, ofu dii ofu cee rii i. (nyipe I a nya lobi a vi si, nya ni ka rii ani.)

Lemu ta ndre ka golidri ungwele leti alisii NAADS ri. ☐

Ba gameti a ta ndre ka goli dri rii i. ☐

Lemu vu ndutu drii ta ndre ka lonya dri rii, ungwe le leti alisi WFP rii i ☐

Lemu ta ndre kaa lonya drii vua goli drii ungwele leti alisi FAO rii i ☐

Lemu tra vu uchudri golidri rii ungwele leti alisi NARO rii i ☐

Lemu ungwele ogaroba ti sii agriculture cluster development project. ☐

Madizi upele tematema ta unzele bani laki lafo ewo goli dri rii adri ga. ☐

Lemu ungwele ogaroba ti sii community librarian. ☐

21. lati ovi seri okojo ewaa kesua oji ae ga ra rii ba ingo ee ewa' rokodi ofu cee sateni tro rii ga i? (Nyipe nya amale cee rii ba i)

Ekwika ☐

Ta ba ka Ero a ☐

Mori enjaka ☐

Mori esuka ☐

Lini esuka sa chidru si. ☐

Alu sa ojo ku ru. ☐

22. ofu cee sadeni tro di, dia ovi seri ta bajo kesua ejijo ae ga kpwe dru ni, eji lecho ovi ra dujo rii iga ra ya?

Oyoo ☐ ku ☐

23.Dia ledi okbwo nya esule ovi ofu cee sadeni tro di ba jo ebu ga Uganda a rii engo ii? (Nyipe nya uraka rii ani ki nyibu ovi kwe jo rii ani).

1- a'i ru ra lokuloku 2- a'I ru ra 3- nosi naa'ni 4- a'I ru ku

5-a'I ru ku kwa rere.

s/no	Ledri okpwo	1	2	3	4	5
1	Ofu cee sadeni tro di ocha ku mori kwe jo goliba ciriciri di bani ovi seri ta bajo jo aji ae gar a i.					
2	Goliba koya loolu ofu cee sadeni tro di esujo ii					
3	Goliba ani okwe ofu cee ovi ta, ta bajo rii kuru.					
4	Goliba oni ki ku leti ovi udwi ka mori khwe ai ni rii.					
5	Goliba ni okwe ofu kuru, leti siti esujo a I ni rii a, ovi dru, asusu kusa aero a si.					
6	Lini khwele goliba ni rii ikonyi ai kuru.					
7	Ofu cee sadeni tro di baka ebuga ni aci lejo abu sile rii ni					
8	Oniku ofu cee sadeni tro di enga engwa ya i.					
9	Lidri okpwo okpwo' ama esule rii dri so osi di a kuru…….					
10	Lidri okpwo opkwo mesu kuru.					

D: Ovi goliba ciriciri jalo a rii a tati umbale Uganda a rii.

24. Ile enja ofu cee sadeni tro di a adu? ovi goliba seri usoka ciriciri Uganda rii ni, ovi seri okojo kasua eji ae a kbwe i? (Nyipe nya uraka rii ani ki nyibu ovi kwe jo rii ani).

1- a'i ru ra lokuloku 2- a'I ru ra 3- nosi naa'ni 4- a'I ru ku

5-a'I ru ku kwa rere.

s/no	Ledri okpwo	1	2	3	4	5
1	leti goliba ciriciri ri ejijo alu awu si dru kaki aia ra ni ami wa ovi lini esule ofu sadeni tro ri a, ovi dru iwika, tata baka, mori koka.					

2	Leti ko ba goliba bunyi ciriciri rii ka dro ofu cee sadeni tro rii ka ki esua leka rii ani wa.					
3	Leti ko ba ofu cee sadeni tro dib a kesuwa wa, ba koba ebuga wa, ba ka echuwa wa.					
4	Lati ko ba lini khwaka koya andraga goliba ciriciri rii ni.					
5	Lati koba goliba ciriciri ka ofu esu ovi konyi siti dri esujo wa ri i.					
6	Lati usele oru na ba ti tuadu.					
7	Dri so osi ai kuru, ai i……..					

25. Nyi jo adutasi lati sile nukuta 25 ga rii obga ani ci ebuga ii.

(Nyipe nya uraka rii ani ki nyibu ovi kwe jo rii ani).

1- a'i ru ra lokuloku 2- a'I ru ra 3- nosi naa'ni 4- a'I ru ku

5-a'I ru ku kwa rere.

s/no	Ledri okpwo	1	2	3	4	5
1	Ovi tati ubwale rii I si, nyasua ta lele oba ebuga rii ka ruba sa drii ewa rukodi ofu cee sadeni tro rii ba ka ebuga si.					
2	Ovi tati ubwale rii si, ewa rukodi Goliba ni mori khwejo of lini siri i.					
3	Ta ti ubwale rii koba ba ae lofo rii ka mori esu ofu cee sadeni tro di dri.					
4	Ovi tati ubwale ri si koba ofu cee sadeni tro di adi ba ebuga wa goliba ni ovidru, ta cika, ta ecuka.					
5	Ovi tati ubwale ri si, koba a goliba ka lini esu sa chidru si.					

Ma anzo ra.

Appendix 3: Lusoga language survey questionnaire for Iganga District

OLUKALALA LW'EBIBUUZO BY'ABALIMI BA DUMA MU BYALO

Munange eyetabye mukunonereza kuno,

Ninze Mukyala Jackline Estomihi Mayende, omusomi wa PhD ku University ya South Africa era Omumyuka wa University Librarian ku Kampala International University eri Ggaba e Kansanga, Kampala.

Ninze omunonereza omukulu mu kunonereza kuno

Okunonereza kuja kukugania endowooza ku enkoola edo kukozesa amawulire aga kakasibwa mu kulabilial duma ka kunguilwa abalimi abe Uganda

Nsaba wetaabe mu kunonereza kuno nga omulala kwabo abanailamu ebibuuzo byange

Okwetaba kwa kyeyendere era osabibwa okumaliliza olukalala lwebibuuzo namazima nga bwekisoobooka.

Kiri gyoli okubivamu sawa yona yona woyendeile nga tontemye naku

Byona ilamu bija kozesebwa mukunonereza era toja kwogelwaku nga iwe iwe wantu wona wona mu lipota.

Ebinava mu kunonereza bija kozesebwa okukola framework ya enkozesa y'amawulire aga kakasibwa ago kulabilila duma akunguilwa abalimi e Uganda

Abalimi, amaaka ga ban a Uganda nokusooba nabaja okuganulwa mu ndowooza yo jonatuwa.

Bwoba olina k'yobuuza kyona kyona tukulila omunonereza ku: +256782007793

1. Ekukuula: Mukyala ☐ Mwami ☐

2. Obwegerese

Nsooma era mpandika ☐ Tisoboola kusoma na kuwandika ☐

3. Emyaka

20 nokwika wansi ☐

21 – 40 ☐

41 – 60 ☐

61 – 80 ☐

81 nokwi suuka wo ☐

4. Am a member of a financial Group or SACCO

Iyi ☐ Be ☐

5. Elina lya District na subcounty

Name of the District and sub counties [tick as appropriate]

Iganga		Adjumani		Mubende		Kabarole	
1.Bulamagi		1.Adropi		1.Kitenga		1.Kasenda	
2.Nabitende		2.Pachara		2.Kalonga		2.Ruteete	
3.Nakalama		3.Ciforo		3.Kayebe		3.Mugusu	
4.Nakigo		4.Ukusijoni		4.Madudu		4.Busoro	
5.Nambale		5.Pakele		5.Kiyuni		5.Kabende	
6.Namungalwe		6.Dzaipi		6.Butoloogo		6.Kicwamba	
7. Nawandala		7.Arinyapi		7.Kiruuma		7.Karangura	
8.Nawaningi		8.Ofua		8.Kasambya			
		9.Itirikwa		9.Kigando			
				10.Nabingoola			
				11.Lubimbiri			
				12.Kibalinga			
				13.Bagezza			

B. The current status of maize postharvest handling evidence-based information practice among rural maize smallholder farmers in Uganda

6. Okalima bukotoki obwomusiri gwe'ebicooli sizoni eyingwire?

hansi wa ika emu (1) ☐ ika emu (1) Hali itaanu (5) ☐

7. Okungula bungi ki obwa duma buli season? (Ensaawo endaala ebaamu Kilo Kikuumi)

Wansi we esaawo eikuumi (10) ☐

Okuva ku nsaawo eikuumi (10) paka ku ataano (50) ☐

Ensaawo ataano (50) paka ku bibiiri (200) ☐

Ensaawo bibiiri (200) paka ku bitaano (500) ☐

Ensaawo bitano na'ndala (501) nokusooba ☐

8. Nsaawo imeka do tela okufirwa mukungula no oluvainuma lw'okungula olwa okusomozebwa embeila yokukuma duma komaze omukungula? (Ensaawo endaala ebaamu Kilo Kikuumi)

Wansi we esaawo eikuumi (10) ☐

Okuva ku nsaawo eikuumi (10) paka ku ataano (50) ☐

Ensaawo ataano (50) paka ku bibiiri (200) ☐

Ensaawo bibiiri (200) paka ku bitaano (500) ☐

Ensaawo bitano na'ndala (501) nokusooba ☐

Tifilwa ke nkungwile ☐

The extent of how access and use evidence-based information influences maize postharvest handling

Okuva kukibuuzo 9 paka 17 ta tiki ku kwilamu okwilizagania nekiwandikibwa.

9. Bwemba nkali kuteleka duma mala kufuuna mawulire agakakasibwa kubyo kuteleka duma era na gakozesa mu ku salawo ni mungeri gye nteleka mu duma. 9a. Nkikililiza ilala 9b. Nkikiliza ☐ 9c. Tyekakasa ☐ 9d. Tikikiliza ☐. 9e. Tikikiliza yaile ☐

10. Bwemba nkali kuteleka duma mala nakozesa amawulire ge nafuuna agakakasibwa kubyo kuteleka duma era na gakozesa mu ku salawo ni mungeri gye nteleka mu duma. 10a. Nkikililiza ilala 10b. Nkikiliza ☐ 10c. Tyekakasa ☐ 10d. Tikikiliza ☐. 10e. Tikikiliza yaile ☐

11. Bwemba nkali kukaaza duma mala kufuuna mawulire agakakasibwa kubyo kukaaza duma era na gakozesa mu ku salawo ni mungeri gye nkaaza mu duma. 11a. Nkikililiza ilala 11b. Nkikiliza ☐ 11c. Tyekakasa ☐ 11d. Tikikiliza ☐. 11e. Tikikiliza yaile ☐

12. Bwemba nkali kukaaza duma mala nakozesa amawulire ge nafuuna agakakasibwa kubyo kukaaza duma era na gakozesa mu ku salawo ni mungeri gye nkaaza mu duma. 12a. Nkikililiza ilala 12b. Nkikiliza ☐ 12c. Tyekakasa ☐ 12d. Tikikiliza ☐. 12e. Tikikiliza

13. Bwemba nkali kutunda duma mala kufuuna mawulire agakakasibwa kubyo kutumbula omutindo gwa duma wange nebyo butaale era na gakozesa mu ku salawo ni mungeri gye ntunda mu duma. 13a. Nkikililiza ilala 13b. Nkikiliza ☐ 13c. Tyekakasa ☐ 13d. Tikikiliza ☐ . 13e. Tikikiliza yaile ☐

14. Bwemba nkali kutunda duma mala nakozesa amawulire ge nafuuna agakakasibwa kubyo kutumbula omutindo gwa duma wange nebyo butaale era na gakozesa mu ku salawo ni mungeri gye ntunda mu duma. 14a. Nkikililiza ilala 14b. Nkikiliza ☐ 15c. Tyekakasa ☐ 16d. Tikikiliza ☐. 16e. Tikikiliza yaile ☐

15. Bwemba nkali kulabilila duma gwe nkungwile mala kufuuna mawulire aga e'bye sente era na gakozesa mu ku salawo kubye sente ni bwendikozesa. 15a. Nkikililiza ilala 15b. Nkikiliza ☐ 15c. Tyekakasa ☐ 15d. Tikikiliza ☐. 15e. Tikikiliza yaile ☐

16. Bwemba nkali kulabilila duma gwe nkungwile mala nakozesa amawulire ge nafuuna aga e'bye sente era na gakozesa mu ku salawo kubye sente ni bwendikozesa. 16a. Nkikililiza ilala 16b. Nkikiliza ☐ 16c. Tyekakasa ☐ 16d. Tikikiliza ☐. 16e. Tikikiliza yaile ☐

17. Bwemba nkali kulabilila duma gwe nkungwile mala kwetaaba mu misoomo okufuuna obumanilivu mu ngeri yok u labilila mu duma omukungule obulungi. 13a. Nkikililiza ilala 17b. Nkikiliza ☐ 17c. Tyekakasa ☐ 17d. Tikikiliza ☐. 17e. Tikikiliza yaile ☐

18. Biliwa kukukozesa amawulile aga kakasibwa kubino by'oidi? [Ta tiki buli kukyokola]

Okwebuza abalimi by'ebenda okutegela ku kulabilila duma ka akunguilwa ☐

Okufuna amawulire kubigemagana n’ebyo kulabilila duma ka akunguilwa

Okwetegereza oba amawulire agagemagana n’ebyo kulabilila duma ka akunguilwa matuufu era ga mutindo gwa waigulu

Okuta awalala amawulire aga gemagana n’ebyo kulabilila duma ka akunguilwa okusobozesa abegataga okugafuna amangu no kugakozesa

Okukozesa amawulire aga gemagana n’ebyo kulabilila duma ka akunguilwa mukusalawo ekyokola

Okwetegereza enkozesa y’amawulire agagemagana n’ebyo kulabilila duma ka akunguilwa olwo kulongosamu

Wazila nkola ya kukozesa mawulile aga kakasibwa

19. Ensibuuko y’enkoola y’okukozesa amawulire agakakasibwa aga kozesebwa mu Uganda? [Tick as many as applicable]

Enkugana d’ebyalo/enkugana d’akanisa

Y’afiisi y’ebyobulimi

Okuva mu bitongole bya nakyeewa (NGOs)

Okuva mu bye tubitamu, mu kweyegereza ku mikutu gya internet oba ebitaabo

Okuva kuba offisa ba amawulire ku district, ebyalo ne miluka

Library de byalo

Ku mikwano

Tidi webiva

20. Ta tiki ku buli kitongole kyodi nti ki kuyamba okufuna amawulire aga kakasibwa. [Ta tiki kubuli akugasa]

NADISI (NAADS)

Abilimisa ☐

World Food Programme (WFP) ☐

Food and Agricultural Organization (FAO) ☐

Aba NARO (NARO) ☐

Agriculture Cluster Development Project ☐

Abakola mu library de kyalo (Community Librarians) ☐

Specific maize postharvest evidence information needs and difficulties

21. Abalimi ba Uganda ba sing☐a kwetaga mawulire aga kakasibwa ki aga gemagana ku kulabilila duma akunguilwa? (Ta tiki ku buli watuufu)

Okukaza ☐

Okuteleka ☐

Okutumbula omutindo ☐

Okwewola ☐

Okwegelesebwa omwilingano

Tikyogeilwaku ☐ (Kiwandike wano) _____

22. Amawulire aga kakasibwa kubi gemagana no kulabilila duma akunguilwa ga lungamya okusalawo kwo ni byokola bulido?

Iyi ☐ Be ☐

23. Buzibu ki bwofuna ne enkozesa y'amawulire agakakasibwa mu Uganda? [Ta tiki nga okozesa omutendera guno: 1. Nkikililiza ilala 2. Nkikiliza ☐ 3. Tyekakasa ☐ 4. Tikikiliza ☐. 5. Tikikiliza yaile ☐

No	Difficulties	1	2	3	4	5
01	Amawulire agakakasibwa gonka tigamala kusobozesa balimi okuwangula ebisomoza mu kuteleka duma akunguilwa					
02	Abalimi balina kutambulila wawanvu okufuna ku mawulire agakakasibwa					

03	Abalimi tibaidi nsawo da PIC oba ebintu ebindi ebyakakasibwa okuteleka duma akungwilwa					
04	Abalimi tibaidi tekinologiya owendawulo owo kutumbula omutindo gwa duma akungwilwa					
05	Abalimi tibaidi wa kwewola sente da kulabilla duma nga kungwilwa					
06	Okusomesebwa kumala gagwawo, era abalimi tibaliganulwa mu					
07	Okubulwa framework yenkoozesa y'amawulire agakakasibwa nekileta ebizibu ebyogeilwa ku waigulu byona byona.					
08	Wazila mulimu watola mawulire agakakasibwa kubigema gana nendabilila y'a duma akunguilwa					
09	Ekitusinga otusomoza tikyogeirwa ku. Ni ----------					
10	Wazila buzibu bwetubitamu					

Recommendations from rural maize smallholder farmers in Uganda

24. Kiki kye wandyenze kibe mu framework ye enkozeesa y'amawulire aga kakasibwa ag'endabilila ya duma akungwilwa abalimi ba Uganda? Ta tiki awasanile ngo okozesa omutendero guno: 1. Nkikililiza ilala 2. Nkikiliza ☐ 3. Tyekakasa ☐ 4. Tikikiliza ☐. 5. Tikikiliza yaile ☐

No	Okulungamya	1	2	3	4	5
1.	Engeri esobozesa abalimi okwetaba mu kugabana amawulire agakakasibwa gebetaga aga gemagana ku kukaza duma, okumuteleka, okumutumbula omutindo, okwewola, n'okwegeresebwa					
2.	Engeri esobozesa abalimi okufuna amawulire agakakasibwa ag'egasa ate mu bwangu					
3.	Engeri esobozesa enkoola y'amawulire agakakasibwa okuba nga ya kubuuza, kufuuna, kwekeneenia, kukungania, kuta munkoola, n'okwetegereza k'etukilizibwa					
4.	Enkoola esobozesa abalimi okwegeresebwa omwilinganwa					

5.	Enkoola esobozesa abalimi bafuna amawulire aga gemagana kubye sente n'okwewola					
6.	Byona byona ebyogeirwa ku waigulu					
7.	Tikyogeirwa ku waigulu: Kiri ……					

26. Lwaki oyenda enkoola do yogeireku waigulu mu 18 okuteebwa mu framework?

Ta tiki awasanile ngo okozesa omutendero guno: 1. Nkikililiza ilala 2. Nkikiliza ☐ 3. Tyekakasa ☐ 4. Tikikiliza ☐. 5. Tikikiliza yaile ☐

No	Ensonga	1	2	3	4	5
1.	Kubanga framework eida kukasa nga buli kyetagisa mu nkozesa ya amawulire agakakasibwa bakitailemu					
2.	Framework eida kakasa nti omulimi afuna amawulire agakakasibwa gene gene ge yetaga ku kukaza duma, okumuteleka, okumutumbula omutindo, okwewola, n'okwegeresebwa.					
3.	Framework eida kakasa nti omulimi afuna amawulire agakakasibwa ag'egasa ate mu bwangu					
4.	Framework eida kakasa nti enkozesa y'amawulire agakakasibwa eyo okubuuza, okufuuna, okwekeneenia, okukungania, okuta munkoola, n'okwetegereza k'etukilizibwa					
5.	Framework eida kakasa nti abalimi basomesebwa omwilinganwa					
6.	Framework eida kakasa nti abalimi bafuna amawulire ku buyambi bwokwewola					
7.	Byona byona ebyo geilwa ku waigulu bwebinaba mu framework ate bya tebwa munkoola bida kutumbula endabilila ya duma ka kungwilwa, bida kendeza okufirwa kwa duma akwingwilwa, bida kutumbula ebyenfuuna, okwetuusa ku emeere, n'omutindo gwo obulamu okutwaliza awalala.					
8.	Tibyogeilwa ku waigulu: Framework eida ……					

WEBAALE INO

Appendix 4: Luganda language survey questionnaire for Mubende District

Adamuu omulunji

Nze Mrs. Jackline Estomihi Kiwelu Mayende, omuyizi owa PHD ku University eya South Africa ne Deputy University Librarian e Kampala International University esangibwa kulugudo lwe Gaba Kansanga, Kampala. Ndi munonyeleza mukusoma kuno.

Okunonyeleza kuno kunonya okukkunganya endowoza ne bwinoo ku mawulile agobukakafu ku makungula agakasoli nabaliimi abakolela ewatono mu Uganda. Obade olondedwa nga omu kwabo abadamu mukusoma kuno. Wetegese okwenyiga mu. Yee…….. Nedda…..

Kino ekikola weyagaliide ela osabibwa okumaliliza ebibuzo mumazimago nga bwosobola

Dembe lyo okuvamu akasera kona nga totegezeza muntu yena

Byonadamu bijakozesebwa nga ebyo kusomako ela ne bikwatako bigenda kusigal bikwekwedwa mu alipota eno

Byetunazula mu kusoma kuno bigenda kwozesebwa mukuzimba amawuile agobukakafu mukugabana mumiliu ejili mukwetegela amakungula kasoli agabalimi abatono mu Uganda

Abalimi abatono nge enju ya Uganda nokweyongelayo bagenda kuganyilwa mu mawulile gogenda okuwa amawulile mungeli yokuyamba okujamba okujayo ebizibu mu kukwasaganyamu amakugula

Mukumanya ebisingawo kuba kusimu yo munonyeleza +256782007793

Section A: Background Information

1. ekikula: mukyala] ☐ omusaja ☐
2. edala elyobuyigilize

Nsobola okusoma nokuwandiika ☐

Sisobola kusoma nakuwandika ☐

3. Age emyaka
   - 18 - 20 ☐
   - 21 – 40 ☐
   - 41 – 60 ☐
   - 61 – 80 ☐
   - 81 nokweyongelayo ☐
4. Ndi member mukibina oba sacco

Yee ☐ Nedda ☐

5. Amanya aga district ne miluka]londako ngabwosobola

Iganga		Adjumani		Mubende		Kabarole	
1.Bulamagi		1.Adropi		1.Kitenga		1.Kasenda	
2.Nabitende		2.Pachara		2.Kalonga		2.Ruteete	
3.Nakalama		3.Ciforo		3.Kayebe		3.Mugusu	
4.Nakigo		4.Ukusijoni		4.Madudu		4.Busoro	
5.Nambale		5.Pakele		5.Kiyuni		5.Kabende	
6.Namungalwe		6.Dzaipi		6.Butoloogo		6.Kicwamba	
7. Nawandala		7.Arinyapi		7.Kiruuma		7.Karangura	
8.Nawaningi		8.Ofua		8.Kasambya			
		9.Itirikwa		9.Kigando			
				10.Nabingoola			
				11.Lubimbiri			
				12.Kibalinga			
				13.Bagezza			

Section B: Current Status of Maize Postharvest handling

Ekitundu B;Embera eyo kukungula kasoli

6. Kipimo ki ekyetaka ekyalimilwako kasol sizoni ebiwede

tewela yika ☐ yika emu ku tano ☐

7. Kasoli eyakungul sizoni ebiwede yali yenkana atya [ensawo emu =kilo kikumi]

Etasuka nsawo kumi ☐

Ensawo kumi ku atano] ☐

ensawo atano mu emu nokweyongelayo ☐

8. Kasoli yali yenkana kigwewafilwa oluvanyuma lwamakungula olwebizibu ebili mu macula sizoni ewede

kuka wansi wensawo 10 ☐

ensawo kumi kwatano ☐

ensawo atano mu emu okuda wagulu ☐

tewali kufilwa mukukungula kasoli) ☐

Ekitundu C; Ofuna nokwozesa amawulile agobukakafu ku kungula kasoli

Londa ko ekitufu kubibuzo bino 9-13

9. Nga sinaba kuteleka kasoi nkozesa ela nina obukakafu obwamawulile okukyusa okusalawo kwange nebyenkola

9a. nzikililiza daala 9b. zikiliza ☐ 9c. sikakasa ☐

9e. sikiliza ☐. 9f. sikililiza daala ☐

10. Nga sinaba kuteleka kasoi naakhokozesa amawulire ela nina obukakafu obwamawulile okukyusa okusalawo kwange nebyenkola

10a. nzikililiza daala 10b. zikiliza ☐ 10c. sikakasa ☐

10e. sikiliza ☐. 10f. sikililiza daala ☐

11. Nga sinaba kukaza kasoli nina ela nkozesa obukakafu bwamawulile okukyusa okusalawo kwange ne beye nkola

11a.nzikililiza daala ☐ 11b. nzikiliza ☐ 11c. sikakasa ☐ 11d. sikiliza ☐

11e. sikililiza daala ☐

12. Nga sinaba kukaza kasoli naakhokozesa amawulire obukakafu bwamawulile okukyusa okusalawo kwange ne beye nkola

12a.nzikililiza daala ☐ 12b. nzikiliza ☐ 12c. sikakasa ☐ 12d. sikiliza ☐

12e. sikililiza daala ☐

13. Nga sinaba kutunda kasoli nina ela nkozesa amawulile amatufu aganyengedwako okukyusa okusalawo nebyekyola

13a. nzikililiza daala ☐ 13b. nzikiliza ☐ 13c. sikaka ☐

13d. sikiliza ☐ 13e. sikililiza daala ☐

14. Nga sinaba kutunda kasoli nina ela naakhokozesa amawulire amatufu aganyengedwako okukyusa okusalawo nebyekyola

14a. nzikililiza daala ☐ 14b. nzikiliza ☐ 14c. sikaka ☐

14d. sikiliza ☐ 14e. sikililiza daala ☐

15. Nga sinaba kukungula kasoli nina ela nkozesa amawulile agakwatagana kubyensiibi okukyusa okusalawo kwange kubyensiimbi nebyenkola

15a. nzikililiza daala ☐ 15b. sikiliza ☐ 15c. sikakasa ☐ 15d. sikiliza ☐

15e. sikililiza daala ☐

16. Nga sinaba kukungula kasoli nina naakhokozesa amawulire agakwatagana kubyensiibi okukyusa okusalawo kwange kubyensiimbi nebyenkola

16a. nzikililiza daala ☐ 16b. sikiliza ☐ 16c. sikakasa ☐ 16d. sikiliza ☐

16e. sikililiza daala ☐

17. Nga sinaba kukungula kasoli nteka munkola okutendekebwa okwokufuna amagezi eli engeli yo kukwatamu kasoli

13a. nzikililiza daala ☐ 13b. nzikiliza ☐ 13c. sikakasa ☐ 13d. sikiliza ☐

13e. sikiliza daala ☐

18. Bukakafu kyi obwa mawulile agokuteka munkola gomanyi ko [londa ko ngabosobola]

okubuza abalimi amawulile agetagisa kukukungula kasoli ☐

wa woja kasoli ngo maze kukungala kuwede ☐

okukebela amawulilie agomutindo mumakungula ☐

okukunganya amawulile agokukungula mukutukibwako mubwangu nokwozesa

okuteka munkola amawulile agamakungula eli okusalawo okulungi nokukola

okutuka eli amawulile ago kukungula nokugateka munkola nolwokukyusibwa

tewali bukakafu bwa mawulile bwakuteka munko labuliwo

19. Ensibuko eyobukakafu okusinzila kumawulile agatekebwamunkola mu Uganda

enkungana ezokukyalo/ekanisa

yafisi ezobyobuimi

okuyita mubitongole ebitali bya gavumenti

okuyita muyomabyi ngomuntu

okuyita mu yafisi zo ku district/kukyalo/esaza

lilrary zo ku kyalo

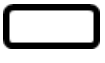
emikwano

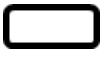
kumukutu radio/tv/amawulile)

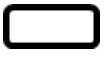
silina nsubuko jemanyi

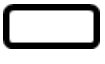
20. Londa kuba linamu omukono bwomanyi abakuyamba na mawulile agobukakafu

ekyokunonyeleza kubyokulima mugwanga (NAADS)

ba officer abo ku district 

ebikwata ku byemere (WFP) 

ekitongole kye emere ne byo bulimi (FAO) 

ekitogole kyo kunonyeleza ku byo bulimi (NARO) 

ekitumbula ebyo bulimi

Library ezokukitundu

21. Kubino bukakafu ki obwokuteka munkola eli ku byo kukungula

okukaza ☐

okuteleka ☐

okwongelamu omuwendo ☐

okuyambiba nensimbi ☐

okweyongela mukutendekebwa ☐

tekyogedwa ☐ kakasa…….

22. Amawulile agobukakafu agokuteka munkola gakyusa ebyo kusalawo byo ebywabulijo nebbyo kola]

yee ☐ nedda ☐

23. Bizibu kyi byo sanga mumawulile agaliwo agobukakafu mu Uganda.

kukungula eli abalimi abatono 1-,nzikililiza daala 2- nzikilizaa 3- sikakasa 4- sikiliza, 5. - sikililiza daala

No	Bizibu	1	2	3	4	5
01	Amawulile agobukakafu tegamala bulunji okuyamba abalimi abatono okuwangula ebiziibuu ebili mu makungula					
02	Abalimi batambula olugendo luwanvu okufuna amawulile					
03	Abalimi tebamanyi bya technologiyaokwongela kumutindo					
04	Abalimi tebamanyi byanfuna ebyatekebwawo okuyamba mukukungulla					
05	Okutendekebwa okutekebwa wo kwa kasela ate nabalimi tebafunamu					
06	Awatali bukakafu bwa mawulile buleta ebizibbu byona ebyo gedwa ko					
07	Tewali nsibuko yona emanyidwa eli ku makungulaa					
08	BIzibu byetusanga tebyogedwako wano bili……					
09	Tewali bizibu byetusanga					

D: Proposed recommendations by Rural Maize Smallholder Farmers in Uganda

24. Kyi kyewandiyagade okutekamu mu bukakafu obwamawulile mubyo kukungula eli abalimi abatono 1-nzikililiza daala 2- ,nzikilizaa 3- sikakasa 4- sikiliza, 5- sikililiza daala

No	Recommendations	1	2	3	4	5
1.	Enkolaa ebikozesebwa eli abalimi abatono okugabana amawulile agetagisa mu kukaza,mukutelleka,okwongelako omuwendo,ebyensimbi,nokutendekebwa					
2.	Enkola ebisobozesa abalimi abatono okutuka ku mawulile amatufu					
3.	Enkola ebisobola okukakasa amawulile amtufu[okubuza, saba, nonyeleza, pima, teka munkola					
4.	Enkola esobola okukakasa okweyongela mukutendekebwa nga kuwede okwabalimi					
5.	Enkola ekakasa abalimi abatono okufuna amawulile ei kubyensimbi					
6.	enkola zona ezogedwako					
7.	Tebyogedwakowagulu;kili…….....					

25. Kulwaki ogamba nti ekyuma ekyogedwa mu18 wagulu etekedwa okubela mu byokula londa ko okusinzila kubwebyenkana: 1- nzikililiza daala, 2- nzikiliza, 3- sikakasa 4- sikiliza, 5- sikililiza daala

No	Reasons	1	2	3	4	5
1.	Kubanga byetukola bija kakasa byona byetutekamu nkola eli amawulile agobukakafu bitekedwawo.					
2.	Byetukola bija kakasa abalimi abatono bawebwa amagezi eli ku mawulile gebetaga.					
3.	Byetukola bikakasa abalimi abatono basobola okutuka k mawulile agamala ela amatufu					
4.	Eja kutuwa obukakafu obwamawulile [buza, saba, nonyeleza, pima,tekamunkola, tukako					

5.	Eja kakasa okutendekebwa okweyongela yo nti kuwede eli abalimi abatono.					

WEBAALE NYOO

Appendix 5: Rutooro language survey questionnaire for Kabarole District

Waitu Mau/Taata,

Ninyowe Mrs. Jackline Estomihi Kiwelu Mayende, omwegi aidala lya Ph. D. (Deguri yakasatu) kuruga aitendekero lya South Africa (Univasite ya South Africa) kandi akugwera omukuru weyahuro ryebiitabu (Librarian) aitendekero lya Kampala International University ekusangibwa Kansanga Arugudo rukugenda Ggaba, Kampala. Ninyowe museruriza omukuru omukwega/kaseruriza kunu.

Omukuseruriza/okusoma kunu, nitugonza kutunga okurola no kurowoza/okunihira kwawe ha amaurire n'obutumwa obuhamizibwe mukulolera amagesa gebicooli gakwetagibwa abalimi abalimira atiito mu Uganda. Okomerwe/Ohairwe omugisa kwenyigiramu Omukuseruriza/okusoma kunu. Oikirize omugisa gunu kwenyigiramu? Ego….. Nangwa…..

Kinu nokikola wegondeize, kandi hati nosabwa kugarukamu ebikaguzo binu omumananu agasemerire. Oli wobugabe kuruga Omukuseruriza kunu kaire koona otatumanyisize.

Ebyolaijuza nibija kukozesabwa omukwega wonka kandi ebikukwataho nibija kusagala biri byansita

Ebiraruga mukuseruriza kunu biija kukozesabwa mukwombeka/kuhangaho omuhanda/Enkola yo kusasaniza/kugabana amaurire n'obutumwa obuhamizibwe mukulolera amagesa gebicooli ha bwabalimi abalimira atiito mu Uganda. Abalimi abalimira atiito, Abanya' Uganda, kandi no kuyingulamu baija kuganyirwa omubyolatuhereza kurabira omukumanyisa abebiragiro/abokola ebiragiro balwanise ebizibu byokukwatamu amagesa.

Bwolaba oine ekikaguzo kyoona, teerera Omuseruriza onu hasimu +256782007793

Section A: Background Information

1. Obutonde: Omuchala ☐ Omsaija ☐

2. Obwegi

Nkusobola kusoma n'okuhandiika ☐

Tinkusobola kusoma Na kuhandiikaI ☐

3. Age

Emyaka

18 - 20 ☐

21 – 40 ☐

41 – 60 ☐

61 – 80 ☐

81 Na haiguru ☐

4. Ndi memba wa nyauza nkuhole SACCO

Ego ☐ Nangwa ☐

5. Name of the District and sub counties [tick as appropriate]

Iganga		Adjumani		Mubende		Kabarole	
1.Bulamagi		1.Adropi		1.Kitenga		1.Kasenda	
2.Nabitende		2.Pachara		2.Kalonga		2.Ruteete	
3.Nakalama		3.Ciforo		3.Kayebe		3.Mugusu	
4.Nakigo		4.Ukusijoni		4.Madudu		4.Busoro	
5.Nambale		5.Pakele		5.Kiyuni		5.Kabende	

6.Namungalwe		6.Dzaipi		6.Butoloogo		6.Kicwamba	
7. Nawandala		7.Arinyapi		7.Kiruuma		7.Karangura	
8.Nawaningi		8.Ofua		8.Kasambya			
		9.Itirikwa		9.Kigando			
				10.Nabingoola			
				11.Lubimbiri			
				12.Kibalinga			
				13.Bagezza			

Section B: Current Status of Maize Postharvest handling

Akacweka B: Enkwata y'amakungura/magesa g'ebicooli

6. Okalima bukotoki obwomusiri gwe'ebicooli sizoni eyingwire?

hansi wa ika emu (1) ☐ ika emu (1) Hali itaanu (5) ☐

7. Okunihira bwingi Ki obwekicooli obugeseze/kungwire sizoni ehoire? (ensaho emu = 100kgs)

Hansi y'ensaho 10 ☐

Ensaho 10 kwika 50 ☐

Ensaho 51 kugenda haiguru ☐

8. Okunihira bwingi ki obwebicooli buwaferirwe anyuma yokugesa habwa ebizibu byomumagesa? (ensaho 1 =100kgs)

Hansi y'ensaho 10 ☐

Ensaho 10 kwika hali 50 ☐

Ensaho 51 kugenda haiguru ☐

Busaho bicooli binaferirwe mumagesa ☐

Akacweka C: Okutunga n'okukozesa amaurire n'obutumwa obuhamizibwe kukwatamu amagesa g'ebicooli.

Bambi golola ekikukirayo kuba kihikire omubikaguzo 9 kwika hali 13

9. Ntakauire ebicooli ntunga amaurire n'obutumwa obuhamizibwe nubwo nsalawo/ncwamu n'okukola 9a. Nkikirize muno 9b. Nkikirize ☐ 9c. Tinkumanya ☐

9e. Tinkikirize ☐. 9f. Tinkikirize muno ☐

10. Ntakauire ebicooli nkakoses amakuru ntunga n'obutumwa obuhamizibwe nubwo nsalawo/ncwamu n'okukola 10a. Nkikirize muno 10b. Nkikirize ☐ 10c. Tinkumanya ☐

10e. Tinkikirize ☐. 10f. Tinkikirize muno ☐

11. Ntakoomeze ebicooli ntunga amaurire n'obutumwa obuhamizibwe nubwo nsalawo/ncwamu n'okukola 11a. Nkikirize muno ☐ 11b. Nkikirize ☐ 11c. Tinkumanya ☐ 11d. Tinkikirize ☐ 11e. Tinkikirize muno ☐

12. Ntakoomeze ebicooli nkakoses amakuru ntunga amaurire n'obutumwa obuhamizibwe nubwo nsalawo/ncwamu n'okukola 12a. Nkikirize muno ☐ 12b. Nkikirize ☐ 12c. Tinkumanya ☐

12d. Tinkikirize ☐ 12e. Tinkikirize muno ☐

13. Ntakatunzire ebicooli ntunga amaurire n'obutumwa obuhamizibwe nubwo nsalawo/ncwamu n'okukola 13a. Nkikirize muno ☐ 13b. Nkikirize ☐ 13c. Tinkumanya ☐

13d. Tinkikirize ☐ 13e. Tinkikirize kimu ☐

14. Ntakatunzire ebicooli nkakoses amakuru ntunga amaurire n'obutumwa obuhamizibwe nubwo nsalawo/ncwamu n'okukola 14a. Nkikirize muno ☐ 14b. Nkikirize ☐ 14c. Tinkumanya ☐

14d. Tinkikirize ☐ 14e. Tinkikirize kimu ☐

15. Enkwata yamagesa gebicooli etakaikire, ntunga amaurire gebyensibi agankonyera kusalaho n'okukola omuntaya yange.15a. Nkikirize muno ☐ 15b. Nkikirize ☐ 15c Tinkumanya ☐ 15d. Tinkikirize ☐15e. Tinkikirize kimu ☐

16. Enkwata yamagesa gebicooli etakaikire, nkakoses amakuru ntunga amaurire gebyensibi agankonyera kusalaho n'okukola omuntaya yange.16a. Nkikirize muno ☐ 16b. Nkikirize ☐ 16c. Tinkumanya ☐ 16d. Tinkikirize ☐16e. Tinkikirize kimu ☐

17. Enkwata yamagesa gebicooli etakaikire, ntunga okwegesebwa ntunge amagezi nka oku nsemerire kukwatamu ebicooli kurungi 17a. Nkikirize muno ☐ 17b. Nkikirize ☐ 17c. Tinkumanya ☐ 17d. Tinkikirize ☐ 17e. Tinkikirize kimu ☐

18. Amaurire ki n'obutumwa obuhamizibwe bwomanyire? (Golola bwingi nka kisemerire)

Kukaguza amaurire abalimi gabakugonza hankwata yamagesa ☐

Kutunga amaurire agakwatagaine n'amagesa. ☐

Wetegereza amaurire gamagesa habwa amananu n'omutindo. ☐

Kusoroza hamu amaurire gamagesa gabalaukize kugatunga nokugakozesa ☐

Kukozesa amaurire gamagesa habwa encwamu n'enkola enungi/esemeire ☐

Wetegereza amaurire gamagesa kugakozesa habwa mpinduka enungi ☐

Busaho amaurire n'obutumwa obuhamizibwe oburoho ☐

19. Amaurire n'obutumwa obuhamizibwe kukozesabwa mu Uganda mugatunga nkaha? (Golola bwingi nka kisemerire)

Ensolorekano zekyaalo/ekereziya/ekanisa ☐

Omurimisa ☐

Ebitongole bya nkakyewa/ebigabirizi byobuyambi ☐

Ebyolabiremu/kwega habyoma byakarimagezi ☐

Kurabira omu nyamakuru wa District/ekyaala/eigombolola ☐

Eiyahuro ryebiitabu omukicweka ☐

Abenganjani/Abanywani

Amaurire/Amakulu (Radio/TV/empapula zamaurire/Amakulu)

Tinkumanya wakugaiya hona

20. Gololа abantu banu bwomanyire abakukonyera na Amaurire n'obutumwa obuhamizibwe (Gololа bwingi nka kisemerire)

National Agricultural Advisory Services (NAADS)

Mukulu webyobulimi ha District

(WFP) Ekitongole ky'ebyokulya ekyensi yoona (WFP)

Ekitongole kyemere nobulimi munsi (FAO)

Ekitongole kaseruriza habulimi (NARO)

Enkola yokulakulanya ebicweka mubulimi

Eiyahuro ryebiitabu omukicweka

21. Amaurire ki n'obutumwa obuhamizibwe mukulolera amagesa gebicooli gakwetagibwa abalimi abalimira atiito? (Gololа bwingi nka kisemerire)

Kwoomya

Kwaura

Kugaitoho/kwongeraho omuhendo

Kutunga obuhereza bwebyensimbi/Looni

Kutunga kwegesebwa kaire koona

Tikigambirweho (Ngambira)

22. Amaurire n'obutumwa obuhamizibwe bunu hati bukukonyera mucwamu n'enkola yawe bulikiro?

EGGO NANGWA

23. Bizibuki byokusanga na Amaurire n'obutumwa obuhamizibwe bunu hati mu Uganda? [(Gololа nka kisemerire kusigikira akadala kanu: 1- Nkikirize muno 2- Nkikirize 3- Tinkumanya 4- Tinkikirize 5- Tinkikirize kimu)

No	Ebizibu	1	2	3	4	5

1	Amaurire n'obutumwa obuhamizibwe tigakumala kusagika abalimi abalimira atiito kumalaho ebizibu mukulolera amagesa gebicooli					
2	Abalimi balubata engendo ndaira munu kutunga amaurire n'obutumwa obuhamizibwe					
3	Abalimi tibamanyire hali ebikwato/ebyombeko obuhamizibwe kuhuriramu.					
4	Abalimi tibamanyire muringo ki byakarimagezi ebisoobola Kugaitoho omuhendo					
5	Abalimi tibamanyire ngu haliyo obukonyezi bwebyensimbi/Looni ekubasobozesa mukulolera amagesa					
6	Okwegesa okuhebwa kuba kwabigendererwa bimu, nahabwekyo tikukonyera balimi					
7	Obutaba nantekateka ya Amaurire n'obutumwa obuhamizibwe kiretaho ebizibu ebyo byoona					
8	Busaho muringo gwona gwokutungamu amaurire n'obutumwa obuhamizibwe yoona mukulolera amagesa gebicooli					
9	Ebizibu byetusanga tibagambirwoho hanu. Nibyo binu …….					
10	Busaho bizibu byetusanga					

D: Engenderwaho ya /amagezi g'abalimi bebicooli mukyalo abalimira atiito gebaherize/gabahaire mu Uganda

24. Biiki byemukugondeze kuba biri munkola nentekateka ya Amaurire n'obutumwa obuhamizibwe mukulolera amagesa gebicooli habwalimi abalimira atiito mu Uganda (Golola nka kisemerire kusigikira akadala kanu: 1- Nkikirize muno 2- Nkikirize 3- Tinkumanya 4- Tinkikirize 5- Tinkikirize kimu)

No	Amagezi gabahaire/Engenderwaho	1	2	3	4	5
1.	Enkola yabalimi abalimira atiito kwenyigira mukugabana Amaurire n'obutumwa obuhamizibwe bwabu nka mukwomya, kwahura, kugaitaho omuhendo, ebyensimbi/Looni na kwegesebwa					
2.	Enkola yabalimi abalimira atiito ekubasobozesa kutunga Amaurire n'obutumwa obuhamizibwe agakumala kandi ataloho kuterebenizibwa					

3.	Enkola ekusobozesa entekateka ya Amaurire n'obutumwa obuhamizibwe (Kukaguza, Kutunga, Kugapimapima, Kugaitagaita, Kukozesa na Kwetegereza) bitekerwe munkola					
4.	Enkola ekusobozesa abalimira atiito kwegesebwa kaire kona					
5.	Enkola ekusobozesa abalimira atiito kutunga amaurire agakwatagaine nebyensimbi/Looni					
6.	Ebyo byoona ebigambirweho haiguru					
7.	Tikigambirweho: Nikyo kinu…….					

25. Haabwaki nogamba ngu Enkola egambirweho mu 18 haiguru esemerire ebeere mutegeka ennu? (Golola nka kisemerire kusigikira akadala kanu: 1- Nkikirize muno 2- Nkikirize 3- Tinkumanya 4- Tinkikirize 5- Tinkikirize kimu)

No	Ensonga/Ekigendererwa	1	2	3	4	5
1.	Habwokuba nti entegeka ennu eija kulora ngu ebyetago byoona ebikwetagisa kutekeesa Amaurire n'obutumwa obuhamizibwe munkola birumu/biriimu.					
2.	Entegeka ennu eija kulora ngu abalimi abalimira atiito bawairwe amagezi ha Amaurire n'obutumwa obuhamizibwe bumu mumiringo gyo Kwoomya, kwahura, kugaitaho omuhendo, ebyensimbi/Looni na kwegesebwa					
3.	Entegeka ennu eija kulora ngu abalimi abalimira atiito bawairwe Amani kutunga Amaurire n'obutumwa obuhamizibwe obukumala kandi ataloho kuterebanizibwa					
4.	Entegeka ennu eija kulora ngu Enkola y'amaurire n'obutumwa obuhamizibwe (Kukaguza, Kutunga, Kugapimapima, Kugaitagaita, Kukozesa na Kwetegereza) habwa amagesa gebicooli yabalimi abalimira atiito eteirwe mumikolero.					
5.	Entegeka ennu eija kusobozesa abalimi abalimira atiito kwegesebwa kaire koona.					

WEBAALE MUNO

Appendix 6: Focus Group Discussion Guide

1. Name of the office: …….
2. Date of the discussion…….
3. Number of participants……
4. Did you participate on the survey?
5. In your opinion, what are the postharvest handling information needs of the maize smallholder farmers?
6. Do the information providers ask you to get to know your information needs before dissemination?
7. To what extent does evidence-based information practice influence daily practice as a maize smallholder farmer in Uganda?
8. How and where do smallholder farmers access and use maize post-harvest handling evidence-based information?

09. Are you satisfied with the maize postharvest evidenced information dissemination practice?

10. What are the difficulties smallholder farmers experiences with the available maize postharvest handling evidence-based information practices?
11. In your opinion, what can be done to ensure evidence-based information practices contribute to access and use of maize postharvest handling information by rural smallholder farmers in Uganda?
12. Why do you say so in question 11?

Appendix 7: Observation schedule for smallholder farmers

OBSERVATION CHECKLIST			
Observer(s)	Review date:		
Questions	Yes	No	Comment
Is there a one stop over where evidence-based information is accessed?			
Are farmers walking long distances to access evidence-based information?			
Are the farmers using evidenced maize dryers?			
Are farmers using hermetic or any other evidenced storage facilities?			
Are farmers practicing technology for value addition on maize?			
Are there rural banks/ credit/financial facilities available to support maize postharvest handling?			
Are there available continuous training facilities for rural smallholder farmers?			
Are the extension librarians/Information providers have sufficient qualification and skills to implement maize postharvest handling evidence-based information practice?			

Appendix 8: Qualitative interview guide to librarians/information officers

I am Jackline Estomihi Mayende, a student at the University of South Africa (UNISA) and the Deputy University Librarian at Kampala International University. I am carrying out research on evidence-based information practices for maize postharvest handling by smallholder farmers in Uganda. This interview seeks to collect your views on the topic. Your responses will strictly be used for the study and your identity will remain anonymous. Thank you.

(I) SOCIO-DEMOGRAPHIC INFORMATION

1. Gender: ☐ Female Male ☐
2. Age: …….
3. Job title: ……
4. Qualification: …….
5. Work station
   a. Ministry of Agriculture Head Quarters ☐
   b. District Extension Office/Community Library ☐ Specify the name of the district……..

SPECIFIC INFORMATION

6. Which kind of maize post-harvesting handling information do you disseminate to small scale farmers?……
   ……..
7. Is that information scientific or evidence-based?.....
8. Where do you get (source) the maize postharvest handling information? How.....
9. Are you aware of AGORA database?..... Have you ever used it ……
10. Do you have a checklist which you use to evaluate the information for quality and credibility before disseminating it? Or to ensure it is evidence-based?……

11. How do you disseminate the maize postharvest handling information?

    ……
    ……..

12. Have your ever implemented evidence-based information practice (ask, acquire, aggregate, apply, assess) in your course of work to improve access and use of scientific maize post-handling information for rural smallholder
13. Do you study rural smallholder farmers' information needs before acquiring the information for dissemination? ……
14. How do you acquire the evidence-based information that you disseminate to maize smallholder farmers?

    ……
    ……

15. Do you monitor or evaluate the usage of the evidence by maize smallholder farmers? share?.....
    .....
16. How often do you disseminate or train maize smallholder farmers to ensure they apply best practices on postharvest handling?.....
17. Whom do you work with to ensure maize smallholder farmers access and eventually use evidenced-based information to improve on their practice?.....
18. In your own opinion, do you think the evidence-based information practices for maize postharvest handling by smallholder farmers in Uganda effective?

    ……
    ……

19. Why do you think it is inadequate or not adequate?

.....

20. Why do you think the evidence-based information is conveniently accessed and used by the smallholder farmers?

    ……
    ……..

21. Any challenges that you have faced in your daily work as an agriculture extension librarian in as far as supporting smallholder farmers with evidence is concerned?

    ……

22. Any suggestion for improvement?

……

……..

Thank you very much

Appendix 9: Qualitative Interview guide to agricultural extension officers

I am Jackline Estomihi Mayende, a student at the University of South Africa (UNISA) and the Deputy University Librarian at Kampala International University. I am carrying out research on evidence-based information practices for maize postharvest handling by smallholder farmers in Uganda. This interview seeks to collect your views on the topic. Your responses will strictly be used for the study and your identity will remain anonymous. Thank you.

(II) SOCIO-DEMOGRAPHIC INFORMATION

1. Gender: ☐ Female Male ☐
2. Age: ……

3. Job title: ……
4. Qualification: ……
5. Workstation
   c. Ministry of Agriculture Head Quarters ☐
   d. District Extension Office ☐ Specify the name of the district……..

SPECIFIC INFORMATION

6. Which kind of maize post-harvesting handling information do you disseminate to small scale farmers

   ……..

   ……

   ……..

7. Where do you get (source) the maize postharvest handling information?.....

   ……

   ……

8. Do you have a checklist which you use to evaluate the information for quality or credibility before disseminating it? Or to ensure it is evidence-based?

   ……

   ……

9. How do you disseminate the maize postharvest handling information?

   ……

10. Do you study rural smallholder farmers' information needs before acquiring the information for dissemination? ……

11. Do you have an official mechanism that monitor and evaluate the application of the knowledge acquired through your trainings?

    ……

12. Do you have any successful stories that are documented that you could share?.....

13. How often do you disseminate, train and monitor maize smallholder farmers to ensure they apply best practices on postharvest handling?.....

14. Do you work with librarians or information service providers who are skilled in information evaluation and dissemination? ……

15. In your own opinion, do you think the evidence-based information practices for maize postharvest handling by smallholder farmers in Uganda effective?

    ……

16. Why do you think it is inadequate or not adequate?

.....Why do you think the evidence-based information is conveniently accessed or used by the smallholder farmers?

    ……

    …….

17. Any challenges that you have faced in your daily work as an agriculture extension worker?

    ……

    ……..

18. Any suggestion for improvement?

    ……

    ……

Thank you very much

Appendix 10: Participants information sheet and consent form

PARTICIPANTS INFORMATION SHEET

South Africa(UNISA) Ethical clearance reference number: 12788279_CREC_CHS_2022
Research permission reference number: 1506 DIRST
Uganda (TASO REC/UNCST) Ethical clearance and study registration reference number : SS143ES

Title: Evidence-based information practice framework for maize postharvest handling by rural smallholder farmers in selected districts in Uganda

Dear Prospective Participant
My name is Jackline Estomihi Kiwelu Mayende and I am doing research with Professor Patrick Ngulube in the Department of Information Science towards a PhD information science at the University of South Africa. We are inviting you to participate in a study entitled Evidence-based information practice framework for maize postharvest handling by rural smallholder farmers in selected districts in Uganda.
I am conducting this research to find out your opinions, views on the influence of evidence-based information practice on the access and use of maize postharvest handling evidence in Uganda by rural maize smallholder farmers. This study intends to come up with strategies to empower extension information providers in Uganda to collaborate in translating information stored in scientific databases for specific maize smallholder's information needs.

I found you suiTable and you have been randomly selected to participate in the study because you are a direct beneficiary of the evidence-based information practice as a smallholder farmer or as a service provider in the field of information and communication agricultural extension service to farmers. Your opinions are highly valued for the success of this study. Your

participation in the study is anonymous and no name is required.

This is possibly an opportunity for you to be among the participants who will share your views that will contribute to evidenced information and knowledge for improved services to farmers. The information provided will be used to answer the study questions and help to come up with recommendations that will improve access and use of maize postharvest handling evidence-based information by rural maize smallholder farmers. The information may also be used for other academic purposes like paper writing and conference presentations not for any purpose beyond what is explained here.

The researcher is therefore requesting to consent to participate in the study. Should you be in need of any clarification or the outcome of this study contact the researcher through: 12788279@unisa.ac.za or +256782007793 or the supervisor Prof P Ngulube at ngulup@unisa.ac.za or 012 429 2832.

As a participant in the study kindly give in your opinions and views on the study in written or oral format. The study involves a survey questionnaire, a focus group discussion, semi-structured interview and semi-structured observation. The answers to the question will mostly be making choices by ticking the preferred opinion to agree or disagree with statements. The responses required for the questionnaires may take 60 minutes or less. The focus group discussion will be for few key participants as a way of follow up which will take approximately one hour.

Please note that you are free to withdraw yourself from this study at any time without any penalty because your participation is absolutely voluntary and your confidentiality will be maintained at that. There will be no any foreseeable risks or harm apart from taking care by observing COVID 19 standard operating procedures to keep safe from the infection. Otherwise the inconvenience that will be cause is using part of your pressured time to answer the questions asked in the study. In case you incur transport costs, the researcher will reimburse you or in case of any health injury medical bills will be supported by the researcher.

Your answers may be reviewed by people responsible for making sure that research is done properly, including the transcriber, external coder, and members of the Research Ethics Review Committee.

In focus group discussions, confidentiality may not be easy, however since the nature of information required for this study is not sensitive it will not be of any harm to you.

Hard copies of your answers will be stored by the researcher for a minimum period of five years in the institution of Affliation (KIU) for future research or academic purposes; electronic

information will be stored on a password protected computer. Future use of the stored data will be subject to further research ethics review and approval if applicable. After five years the hard copies will be discarded though burning and the soft copies will be permanently deleted. Indicate how information will be destroyed. This study received ethical clearance in Uganda and South Africa through the approved Research Ethics Review Committee of Unisa and local Research Evaluation Committee (REC) known as The AIDS Support Organization (TASO). A copy of the approval letter can be obtained from the researcher if you so wish. It is registered by Uganda by the Uganda National Council for Science and Technology (UNCST) with registration number SS143ES.

Should you have concerns about the way in which the research has been conducted, you may contact the supervisor Prof P Ngulube at ngulup@unisa.ac.za or 012 429 2832. Contact the research ethics chairperson, Dr Isabel Schellnack-Kelly, Department of Information Science: Ethics Committee and Dr Jjuko, Research Ethics Committee in Uganda Chairperson TASO jjuukoa@tasouganda.org or +256782169505.

Thank you for taking time to read this information sheet.

Yours sincerely,

Jackline Estomihi Kiwelu Mayende

CONSENT TO PARTICIPATE IN THIS STUDY

I, _____ (participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable). I am also aware I will be compensated ten thousand Ugandan shillings (10,000/=) for my time, incoveniencies the study may have caused. Where necessary, there will be a provision for a witness at appropriate specific stages of the informed consent process, for example, in the case of illiterate, mentally incapacitated or physically handicapped research participants.

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified. I agree to the recording of the interview if it is necessary.

I have received a signed copy of the informed consent agreement.

Participant Name & Surname…… (please print)

Participant Signature……..Date……

Researcher's Name & Surname……(please print)

Researcher's signature……..Date……

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Appendix 11: Participant information sheet and consent in Luganda – Mubende District

PARTICIPANTS INFORMATION SHEET

Olupapula olwo eyetabamu

Ethical clearance reference number: 12788279_CREC_CHS_2022

Research permission reference number: 1506 DIRST

Omutwe; obukakafu okusinzila ku byokukola eli okumaliliza okukungula kassoli nabalimi abo mukyaalo mu Ugaanda

Eyenyigilamu omulunji

Amanya nze Jackline Estomihi Kiwelu Mayende ela nkola kubyokunonyeleza wamu ne professor Patrick Ngulube mu department eye bya mawulile mu bya science eli PHD mu science ku tendekelo elya South Africa. Tukwaniliza okwetaba mukusoma kuno okutumidwa agokutekka munkola agobukakafu kubya makungula agakasoli eli abalimi abomukyalo mu Uganda. Nkolela mukunonyeleza kuno okuzula endowoza zamwe nebyemulaba kukukola okwobukakafu bwamawule engeli yo kugakozesa nokugatukako eli okumaliliza okwamakungula aga kasoli nobukakafu mu balimi abo mubyalo.

Okusoma kuno kuja nemitendela okubasobozesa abongelayo amawulile mu Uganda mukola mubyokukyusa amawulile agaterekedwa mu bikyusidwamu kulwa balilimi abatono byebetaga Nasanze nga osobola okukolela mu kusoma kuno kubanga ofunyemu mu bukakafu obwa mawulile nga omulimi alilimila awatono oba nga agaba amawulile kyobyobulimi eli abalimi. Endoza zo zamuwendoo nyo eli okusoma kuno. Okukola kwo mu kusoma kuno kukwekebwa

ela teli linya lisabidwa. Guno kulabika nga mukisa eli gwe okubela omu kwabo 448 abetyabyemu abagenda okugabana enndowoza zabwe ezigenda okwongelako ku mawulile na magezi eli okuweleza okukyusidwa eli abalimi. Amawulile agaweledwa gagenda kwozesebwa okudamu ebibuzo nokuyamba okujayo ebyetagisa okukyusa okufuna nokukozesa eli mubyokukungula kasoli ubalimi abo mubyalo.

Amawulile nago gasobola okwozesebwa nga ebyo kusomako nga okuwanadika kumpapula nemunkungana ela nga sibya kitu kyona ekitwogedwa.
Omunonyeleza ono akusaba okwenyigilamu mukusomma kuuno.onetaga okumatizibwa kwona oba ebinava mu kusoma kuno tukilila omunonyeleza okuyita 12788279 unisa.ac.az oba 012492832

Nga yetaba mu kusomma kuno bambi tuwe kundowoza zoeli okusoma okuwandikidwa. Okusoma kulimu ebibuzo ebyokunonyeleza, nokutesa ngekibina, okubuzibwa munkungana,nokunonyela nge nkungana

Ebidibwamu eli ebibuzo oja kuba olondako okusinzila kundowoza yo okukiliza oba obutakiliza muubigambo .

Ebidibwamu ebisabidwa eli ebibuzo biyinza okutwala edakika 60 oba wansi wazo. Okutesa okwekibina kugenda kubela kwa bo abakulu nga engeli eyo kulondola ekigenda okutwala nga esawa emu.
Tegela nti oli wadembe okwejamu mukusoma kuno akasela kwona awatali kusasuza kubanga okwetabamukwo kwwa kinomu ela ogenda kukumibwa bwekutyo.

Teli wagenda kubea yo balaba balala nga akatyabaga oba okukosa omukwelabilila nga tugodela amitendela eja COVID 19 okwekuma nga tuli bulunji eli obulwade.

Okutataganyizibwa okunabamu kujakuba mu budde bwo obwo kudamu ebibuzo ebikubuzidwa mukusoma kuno bwoba wetaze ebyentambula, omunonyeleza ajakutukako oba mubuzibu bwona mu byo bulamu ebisale bye dwalilo bijya kuswasulwa nomunonyeleza.

Ebyo kudibwamu byo bija kulabiba nabantu abavunanyizibwako eli okunonyeleza kuno nti kuwede bulunji,ngo atamu abantu abala abakozesa amawulile,akakyiko akanonyeleza.

No bibinja ebyo kuteesa, kiyinza obutaba kyangu, naye atte ekikula kyamawulile agetagisa eli okusoma kuno tekugenda kubela nakwosebwa kwona.

Eli ebyokudamu byo bigenda kutelekebwa no munonyeleza okumala oemyaka etano mu kantu akasibidwa oba mu kusomero kwa KIU kulwo kusomebwako okwomumaso oba ebyamasanyalaze nga mulimu password mu computer.

Okukozesebwa kwomumaso okwa mawulile agatelekedwa gaja kubela eli abo abanonyeleza abalala oluvanyuma lye myaka etano amawulile gagends kujibwamu newankubade okwokyebwa na mawulile amalala gagenda kujibwamu.
Tekawo ngeli amawulile jegagenda okujibwawo. Okusoma kuno kugenda kufunibwa mu kukasibwa okuwandikidwa. Naba kakyiko akebyabanonyeleza aka Unisa. Ezimu ku baluwa ezo kunonyeleza zisobola okufunibwa okuva kwa anonyoleza bwoba nga oyagade aba TASO, oba UNSCT.

Bwobela nobuzibu bwona ku ngeli okunonyelezebwa jekukoledwamu. Osobola okutuka ku mukulu , tuka ku chairperson mu kunonyeleza, Dr Isabel Schellnack-Kelly, ebyokunonyeleza kubya science, oba we TASO nne Dr. Jjuuko, Research Ethics Committee in Uganda Chairperson TASO jjuukoa@tasouganda.org or +256782169505.
Webale olwo kutwala obude nokusoma amawulile gano agokumpapula.

Nze mumazima

Jackline Estomihi Kiwelu Mayende

CONSENT TO PARTICIPATE IN THIS STUDY

Nze…….[elinya lye yetabamu] kakasa nti omuntu ansaba okwetaba mukunonyeleza kuno angambye ku kikula, emitendela, ebiganyilwamu ebyo kufuna mu nobyo ebisobola okuvamu mukwetaba kuno.
Nsomye[banyinyode] nentegela okusoma kuno nga bwe banyonyode mumawulile agolupapula luno.
Nfnye omukisa ogumala okubuza ebibuzo ela netegeza okukola mukusoma kuno.

Ntegela nti okukola kwange kwa kyeyagalile ela ndi wadembe okuvamu akasela kona.
Nkimanyi nti njakuliribwa omutwalo gumu (10,000/=).

Ntegela nti ebiva mu kunonyeleza kuno bigenda kutekebwa mu alipota eyo kunonyeleza,nemikutu oba enkungana ezeyongelayo, naye okukolela kwange kugenda kukumibwa okujako nga.
Nzikiliza eli ebiwandikidwa ebyoyo abuza.

Nfunye koppi jebatadeko omukono eli okukiliziganya.

Elinya elye yetabye mu……

Omukono…… olunaku…….

Elinya elya nonyeleza……..

Omukono ogwa nonyeleza olunaku……

Appendix 12: Participant information sheet and consent in Lusoga – Iganga District

PARTICIPANTS INFORMATION SHEET

OLUKALALA OLUTEGEEZA ABETABYE MU KUNONEREZA KUNNO B'YE BALINA OKUMAANA

ENNAMBA Y'OKUKAKASA NTI OKUNONEREZA KUNNO KUTUKIRIZA ENOONO DA OKUNONEREZA: 12788279_CREC_CHS_2022

ENNAMBA EKAKASA NTI OKUNONEREZA KUNNO KWA WEEBWA OLUKUUSA: 1506 DIRST

Omutwe: Abalimi ba buliddo e Uganda kwe basubuuka okufuuna amawulire agakakasibwa agafa ku bwe balabilila duuma nga amaaze okukungulwa

Munaife gwe tusuubira okwetaaba mu kunonereza kuno

Bandeta Jackline Kiwelu Mayende nga ndikunonereza awlaal ni Profesa Patrick Ngulube owe kitongoole kya sayansi wa ebya mawulire nsobole okukuguka nokufuna digiri ha PhD mu sayansi wa ebya mawulire ku Univasite ya South Africa.

Nkwaniliza okwetaba mu kunoneleza ku "Abalimi ba buliddo e Uganda kwe basubuuka okufuuna amawulire agakakasibwa agafa ku bwe balabilila duuma nga amaaze okukungulwa"

Okunoneleza kwenda kutegela ndowooza yaimwe kubigemagana kungeli abalimi ba duuma bwe bafuna no kukozesa amawulire aga kakasiibwa agafa ku bwe balabilila duuma nga amaaze okukungulwa

Okunoneleza kunno kusubiira okuzula enkoola ena yongela amaani abalimisa ba Uganda okukolagana nga bakozesa amawulire kumikutu eje ndawulo okutegeeza abalimi ba duuma byebetaga okutegela

Nasanze nga osanile okwetaba mu kunonereza kunno kubanga oli omu kwabo a betaaba mukukozeesa amawulire aga kakasibwa nga omulimi oba nga omulimisa

Endowooza yo ya muwendo ino eli okunonereza kuno. Okwetaba kwo mu kunonereza kuno kwa kyama, na maina go tigetagibwa.

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Guno gwandiba omukisa gwo, okuba omulala ku bantu ebiina ne ekumi no mukaaga abaja okwetaaba mu kuwayo endowooza daibwe ku by' okukozesa amawulire aga kakasibwa okulongoosa empeereza eli abalimi.

Endowooza yo eda kozesebwa okw nukula ebibuuzo by'okunonereza kuno era kuyambe okuwa amagezi agana yamba abalimi b'a duma okufuna no kukozesa amawulire aga kakasiibwa agafa ku bwe balabilila duma nga amaaze okukungulwa

Endoowoza yo eyinza no kukozesebwa mubifa ku kusoma nga okuwandika ebitaabo, okwogerwa ku mu nkugaana, aye tibida kozesebwa kuswika bino ebyogeirwa ku wano.

Omunonereza kyava akusaba okilize okwetaba mu kunonereza kuno. Bwonaba wetaaga okwebuza ekintu kyona kyona oba kubinava mu musoomo guno, oyinza okutukilila omunonereza ng'obita mu 12788279@unisa.ac.za oba +256782007793 oba amukulila Prof P Ngulube ku ngulup@unisa.ac.za oba 012 429 2832.

Nga omulala ku be tabye mu kunonereza kuno, bambi wayo endowooza yo ku kunonereza kuno mubuwandike oba neiroboozi lyo.

Okunonereza kulikozesa olukalala lwe'bibuuzo ebibuzibwa mulala ku mulala, okwogelamu okwawalala, okwebuuza abakugu mulala ku mulala no okwetegereza.

Okwilamu olonda ku iwe kyowulila kululwo nga kyo kiliza nakyo

Okwila mu ebibuuzo ebyo mulala ku mulala kuyinza okutwala dakika mkaga (60). Aye ebibuuzo ebya obibinja obwa walala bida kutwala oti saawa namba.

Oli waiddembe okuva mu kunonereza kuno esaawa yona yona awazila kukangaivulwa kuba okwetaaba kwo mu kunonereza kuno kuli joli era kwa kyama.

Wazila bubi bwonabwona bwe tusubila kutukaku okutolaku okwetaga okutulikiliza enoono d'okwewala COVID-19

Okutolaku nti oyinza okunigirizibwa olwo kwetaga okukozesa obwire bwo okwila mu ebibuuzo ebyo okunonereza kuno.

Bwoba nga wetaaze okusasula entambula okusobola okwetaaba mukunonereza kuno, omunonereza aida dikwiliza wo. Oba obulamu bwo bukoseibwa mu ngeri yona yona mu

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kwetaaba mukunonereza kuno, omunonereza aida kuyamba ku ni bill de idwaliro

Wandibayo abayinza okwekenenia byo nailamu okukakasa nga okunonereza kuno kukolebwa bulungi, abaamu kubaano nomuli avunula akatambi nokukaiza mubuwandike, abiiza mulufuti futi lwa computa, na abali ku kakiko ke nnono da ebyo kunonereza. Mu bibinja obwo kugaaya ensonga dino awalala, okukuma ekyama kuyinza obutaba kwangu, aye olwokuba ebilibwamu mu kunonereza kuno ti bya kyama kulyawo, toida kosebwa. Omunonereza aja kuteleka empapula ediliku okwilamu kwo okumala ebbanga lya myaka etaanu mu sanduku esibibwa mukuofisi Kampala Internationa University (KIU) kulwa kwongera okubinonereza ku, okubisooma ku. Ebili ku computer bi da kumibwa ku computer jota soboola kwiguula ngo zila kagambo kakubisawo. Omunonereza yenka naja okuba nakagambo kano.

Okukozesa ebiterekeibwa ebinava mu kunonereza kuno bida kwetaga okuwebwa olukuusa ak'akiiko ak'ebyonoono de ebyekunonereza bwe kiba kyetagibwa

Nga wabiseewo emyaka etaanu, ebili ku mpapula byona byona ebigemagana no okunonereza kuno bi da kuzikilizibwa no mulilo era ne ebili ku computer bida kusanizibwawo obutalekawo yaile.

Okunonereza kuno kwa ikilizibwa mu wandike ak'akiiko ak'ebyonoono de ebyekunonereza aka University ya South Africa oba TASO oba Uganda National Council for Science and Technogy (UNSCT).

Omunonereza asoboola okuwa kopi ya baluwa y'olukusa bwoba oje taaga.

Bwonaba ofuunie okwengela kwona kwona kungeri okunonereza kuno kwekuli kolebwamu, oyinza okutukilila omukulu w'okunonereza kuno Prof P Ngulube at ngulup@unisa.ac.za oba 012 429 2832. Oyinza okubila omukulu w'akakiiko kenoono dokunonereza, Dr. Isabel Schellnack-Kelly, owa depatimenti ya sayansi y'ebyamawulire ni Dr Jjuuko, akulila akakiiko kenoono dokunonereza aka TASO ku jjuukoa@tasouganda.org or +256782169505.

Webaale kutwala bwire okusooma olukala lwa amawulire gano

Nze mazima ilala,

Jackline Estomihi Kiwelu Mayende

CONSENT TO PARTICIPATE IN THIS STUDY
OKWIKILIZA OKWETABA MU KUNONEREZA KUNO

Nze, _____ (elina lya aja okwetaba mu kunonereza), nkakasa nti oyo alikunsaba okwetaba mu kunonereza kuno ankobeile ebigemagana no okunoneleza kuno, bwa kolebwa, emigaaso egisubilwa ne ngeli gye ninza okosebwamu bwe nkwetaba mu.
Nesomeile (oba ba ninonoile) era nategela ebili mulukalala lwo okunonereza kuno .
Bampaile omukisa okubuuza ebibuuzo era netegeike okwetaba mukunonereza kuno.
Ntegeile nti okwetaba nu kunonereza kuno kuli gyendi era ndi wa iddembe okubivaamu esaawa yona yona awazila kukangaivulwa (bwe mboona nga netaga okibivaamu).
Nkiidi nga ebina zulwa mu kunonereza kuno bida kusunsulwa biwandikibwe mu lipota y'okunonereza, mu ma jano oba mu lipota de nkugaana, aye okweetaba kwange kwi da kumibwa mu kyama okutolaku nga kintegezibwa.
Ndi kiliza nti emboozi yaife esoboola okutebwa kulutambi. Ntegela nti okukola kwange kwa kyeyagalile ela ndi wadembe okuvamu akasela kona. Nkimanyi nti njakuliribwa omutwalo gumu (10,000/=).

Nfuunye kopi yange ey'endagaano oyo kwikiliza okwetaaba mu kunonereza kuno

Amaaina gombi ag'agya okweetaba mukunonereza (kozeesa nukuuta emba)

Omukono gw'agya okweetaba mukunonereza (enaaku do mwaka)

Amaaina g'omunonereza gombi (kozeesa nukuuta emba)

Omukono gwo omunonereza (enaaku do mwaka)

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Appendix 13: Participant information sheet and consent in Madi – Adjumani District

Ofu ba la'i a'e ka rii ni nile ri ii.

Nukuta khwele ciki dii a vuni kojo ri : 12788279_CREC_CHS_2022

Nukuta dribkwo khwejo rii i: 1506 DIRST 20/07/2022.

Dii rongorongo karatasi di ndi ii: Ofu cee vua a'a bunyi ciriciri goliba seri usoka aei lofo si Uganda aa rii.

Maa baa umbile caa vua keyaa ta idere mee tro rii I.

Ma rusi Jackline Estomihi Kiwelu Mayende ii, vua ama ta vu ucuu Professor Patrick Ngulube tro bunyi ofu nijjo oruu PHD ga ri ii, University Africa ni leale rii ii ga. Ama nyi a'I ii remujo ame tro ebu ta vu ucujo di ii ga, vua karatasi di a dii rongorongo ri ba dii, ofu cee sadeni tro bunyi ciriciri goliba seri usoka vua ovii kakii seri dii atani mba jo Uganda aa ri ii.

Ma ta vu'uchu anya ra asujo, anya ra rokodi ofu cee sadeni seri okojo rii ba' tro rii i, jo any ji baru ra i, drodrole anyi ba goli ba seri usoka ciriciri rii ba i. ta vu ucuka di ole kasu leti ovi mori khwejo goliba ni ba lini uti khweka goliba nii ovi seri a ta ba jo rii i.

Ma su nyi ma'di cee rii ofu khwe drii mani rii, amasiku nyi goliba alu na I, vua ka ofu cee sadeni tro rii khweni ni rii I, ama lasiku nyi goliba alua I ka dra so ango ka ofu ce rii khwe wa vu ka konyi sa khwe wa goliba citiri nii. Nya uratani konyi tro mani maa lini di ikojowa I, remuka nyadro kare alu ga ni cuwii lini di ga i, vua ru ole ru ku karataci di dri i.

Dii andraloso reture ii nyini olujo ba 416 a' keya kaki nya rani ami ta vu ucujo ofu cee sadeni tro linidri ii, awusi kokhwe dru mori goliba ni. Ofu nyaa kwele dii keyaa ka konyi kwe lazi ti ai jo vua nyi kwe nyaa ra temari tro awusi ka lumba ti idru bunyi ciriciri goliba serii usoka aei lofo si rii ni. Ofu nya kwele dii keyaa ka rebu karatasi sijo ogboro, limu gbworogbworo rii ni, lini ini re ga vua tazi ni ga eburu ku.

Madi ta vuucu dii a liniga, anyi remujo anitro karealuga ta vu ucudia ga. Jo ile ta a avalaka rari, kusa ile ta nika dii ivii nyi ukwee ani nukuta dii: 12788279@unisa.ac.za kusaa +256782007793 kusaa supervisor Prof P Ngulube at ngulup@unisa.ac.za kusaa 012 429 2832.

Kende nyi alua madi ta vu ucudi rii a í ni, a í ka rii ani, kizasi nyi kwe nya urata ni lini di ii di sika cisi kusaa nyi kwe nya olobo ni ti si.Ta vu ucuka di keyaa karuko lazi ta vu ucujo ri tro,raa amika bunyi ciriciri rii tro,lazi bunyi ga ri ni tro,vua ra a,a avalaka bunyi a,a tro.Lai lazi di drii ii, canganaa ba kopeyape, nya drele cee rii i, ani kolu nya ‘’ai ra’’, kusa nya ‘’ai kuru’’, aia lazi ai ka ni kojia degiga 60 kusa ocaku wa. Ra amika bunyi ga dii kolu ba rongorongo rii ni awusi ba ka ta vu ucuca kende kojia sani mi alu.

Ale ma jo nyi ni, Nyi ni drii gbmo a’a ru njejopi lagbma kwe ka ako nyi ni I adusi ku ani ilili vua ra nya zuma drii dii ii efuku. kusaa laka icandi eyo ki oko ki ciki corona 19 drii I, awusini ba ka goga esu laza dii adujoa pi, Kende nyi ajiaji esu ra rii ani, dii presa lai lazi ta vu cujori kobaa ni, Jo nye bu okolongo ra acipani, kusaa eruwani Madi ta vu ucudi dii kokwea ra.

Nya lai di ba ka avala idri ndro lee a’i ta ndeka ewa karatasi vu ucuka dii dri rii ba I, awusini ta vu ucuka dii kolu dru pelere ba dii ba I ovi dru: ba pepa ti uba kari, ba nukuta kwe ka rii I, vue ai ba ciki bunyi ta vu ucuka rii.

Ta vu ucuka bunyi si bunyi si di ii, aa zumadii ni olu okgbwo kii ovi ofu ta vu ucujo dii, ani unzi ku vua oke asila nyi ni ku.

Karatasi nyaa sile ra dii, ma’di ta vu ucure dii ka ta nambga kinya ai tou university a’ [KIU] ana avalale ba zit i ni vule ga ri ni, ba ka tani mbga ovi udi rii si. Computer a, Vua karatasi dii, ero a si, ba keya kebua ciki si jo oleru ra ii, Kinya tou avuga karatasi dii kengwi ebu ako vua igwea ra ongo computer aa rii saa adi deya ra, Vua ta vu ucuka dii esu karatasi okwbpo ciki ta vu cujo ri ra bunyi UNISA a si, Vua bunyi Ugnda leti alisi ungwele [UNCST] , ni oru ta ndeka ewa linidrii rii a si, vu aba ta aa avalaka liele rii saa oni otee.[REC] kusaa]TASO[jo ilee karatasi ma’di ta vu ucudi dii di dri ra, kokwea wa.

,Jo nyi ni ta zi nile a a ,nyi ukwe nukuta Prof P Ngulube at ngulup@unisa.ac.za kusaa 012 429 2832. kusaa nyi ukwe Dr Isabel Schellnack-Kelly, bunyi ofu ni jo rii ga vua ciki tro rii ii Dr Jjuko, drii bunyi ta vu ucudii rii Uganda aaTASO jjuukoa@tasouganda.org or +256782169505.

.Anzo nyaa sa khweka ofu dii lajo si

Ma nyaa ingeni le ra rii ii.

Dii tika Karatasi drii…….

Ma rusi Jackline Estomihi Kiwelu Mayende .

Lai ba karatasi dii a í ka rii ni.

Ma_____[ru ba ta ai ka rii dii ii] mi geni cee ma di ma rani ziree dii madu palofu ta vu ucure ga rii okwe mani ovi karatasi di dri cee rii i, leti avalajo cee rii, ongo anaa loso I, saa cee riii i, vua anjianji laaka rii ii tro.

Alaa ta vuucuka dii caa vua meri ekwi ani ndree kendre selee ofu lai ga rii ani.

Ma esu andraloso candi lazi zijoa ra rii ra vua ma baba olujo ta vu ucudi lini dii alua i.

Meri luba dii ekwi ni ra ma oluka alua ni ta vu ucudi ga ni ilili vua ma ni drii kpwo a,a ebu dii ebee joa lamgba ako, Vua ani otre adii mani ta kwe ga adu ra [10,000 /= Ugandan shilling].

Ani otre zumadi karatasi dii ii ofu nile rii, buku ta lajo rii ii, kusaa ba keyaa kebua lemu okpworo rii ga, ki zumadi madrii, taa ani mgbwa ci ile ta zi mgbi rii si.

Ma a,I ra olobgo madrii koka ci jo oleru ra iii.

Me su karatasi ofu tro di ra a vua ati di raa.

Ru' ba lazi a'I ka rii dii ii…….. (please print)

Ma'di lazi a'I di rii a kare dii tirega rii……

Imba odu [Date]……

Ru karatasi dipi ta ucudi rii dii ii[Researcher Name]……..(please print)

Karee karatasi dipi a di tirega rii ii[Researcher's signature…]……

imba odu……..[Date]

Appendix 14: Participant information sheet and consent frorm in Rutooro – Kabarole District

PARTICIPANTS INFORMATION SHEET

Ethical clearance reference number: 12788279_CREC_CHS_2022
Research permission reference number: 1506 DIRST

OMutwe: Amaurire n'obutumwa obuhamizibwe mukulolera amagesa gebicooli gakwetagibwa abalimi abalimira atiito mu Uganda.

Waitu Mau/Taata

Amabala gange ninyowe Mrs. Jackline Estomihi Kiwelu Mayende, Ninkola Okuseruriza Na Prof. Patrick Ngulube owa Department of Information Science okwokumalira Diguri yange eyakasatu mu Information Science kuruga aitendekero lya South Africa (Univasite ya South Africa). Nitukweta okwenyigira/kwetaba Omukuseruriza kunu okuhairwe omutwe Amaurire n'obutumwa obuhamizibwe mukulolera amagesa gebicooli gakwetagibwa abalimi abalimira atiito mu Uganda.

Omukukola okuseruriza/okusoma kunu, ningonza kutunga okurola no kurowoza/okunihira kwawe ha ntugamu nenkozesa y'amaurire n'obutumwa obuhamizibwe mukulolera nokukwatamu amagesa gebicooli habw'abalimi abalimira atiito omubyalo mu Uganda. Okuseruriza kunu kukugonza kuretaho emihanda yokuha amani abagana amaurire gebyobulimi mu Uganda bakwatagane omukugabana amaurire gauirwe amiikutu kayunga bantu ejja science habwa amaurire abalimi bebicooli abalimira atiito bakugonza.

Nsangire osemerire okwenyigira/kwetaba omukuseruriza kunu, habwokuba noija kuganyirwamu kimu mu Amaurire n'obutumwa obuhamizibwe mukulolera amagesa gebicooli gakwetagibwa nka omulimi alimira atiito, oba nka omuhereza omukihanda kyamaurire nokuba kagambagamba webyobulimi hali abalimi. Ebyolatuhereza byona biija kuba byomuhendo/byomugaso ha kuseruriza kunu kandi kukawa kurungi. Okwenyigiramu/okwetaba omukuseruriza kunu tikukwetagisa ibira ryawe kuhandikibwa

hantu wona.

Gunu mugisa haliwe kuba oli omu (1) hali 416 anayenyigira mukugabana endohoza yabu erakonyera kuhereza amagezi na maurie agahamizibwe bikonyere omubuhereza obulungi hali abalimi. Amaurire goratuha gaija kukozesebwa kugalukamu ebikaguzo ebyokuseruriza kandi gakonyere mukuhereza engenderwaho erakonyera mukuraukiza kutunga no kukozeza amaurire n'obutumwa obuhamizibwe hankwata yamagesa gebicooli habwa abalimi abalimira atiito. Amaurire ganu gasobola kukozesebwa omumiring yokwegesa endi nka okuhandika empapura no kwegesa omunsorookano, taloho kindi kuyingura hali ekisobollirwe hanu.

Nabwekyo, Omuseruriza nakusaba oiriza kwenyigira/kwetaba omukuseruriza kunu. Obwolaba oine kyokwenda kwetegereza oba hali ebireruga omukuseruriza kunu, bazza nomuseruriza ha 12788279@unisa.ac.za oba teera +256782007793 oba Nampala womuseruriza Prof. P Ngulube ha ngulubp@unisa.ac.za oba teera 0124292832.

Nkanyakwetaba omukuseruriza nkwesingirize mpereza ensalaho nentekereza yawe ha kuseruriza kunu no wndika oba omubigambo.

Okuseruriza kunu hali olupapura lwebikaguzo,okuteseza omubinja/ebiitebe,ebikaguzo byokukaguza omuntu omu nebikaguzo byokurola niwetegereza namaiso gawe. Ebyokugalukamu habikaguzo binu kusinga biija kuba byakugola bugolola kiiki kyokunihira ekikusinga kuba kihikire noikiriza oba notaikirizagana nakikaguzo. Kugalukamu olupapaura lwebikaguzo nikisobola kutwala edakika nka nkaaga (60) rundi nobutaika. Okuteseza omubinja/ebiitebe kiija kuba kyabantu bake/batiito abakomerwemu nka omuringo gwokuwondekerera ekirabawo enyuma ya esaawa emu (1).

Ijuka ngu oli wobugabe kurugamu omukuseruriza kunu akaire kona ataloho musango gwona kuba okwenyigiramu kwawe wegondeize kandi nensita yawe eija kumibwa. Busaho kyamuterebanize kyona ekikuretaho kurumya kwiyawo okuhondera amaateka ga COVID 19 kwekuma obutakwatwa Kauka. Otuganyire habwa okuterebanizibwa kwoona okukwikireho habwa okukozesa obwire bwawe obwomuhendo mukugalukamu ebikaguzo ebikukaguzibwe omukuseruriza kunu. Kakuba olaba okozeseze transport yoona, omuseruriza naija kumukugaluliza oba kakuba aboho okuterebanizibwa

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omubyobwomezi, nka otunga obujune, omuseruriza naija kukonyeraho.

Ebyolagalukamu nibija kuba nibikeberwa/kucencurwa abantu abakujunanizibwa kurola ngu okuserurizibwa kukozirwe kurungi, halimu banu; Omucusa ndiimi, Omuhandiki kuruga ayeeru, na Akatebe akakwatisa engeso omukuseruriza.
Okuteseza omubinja/ebiitebe, okurinda ensita tikiraukire, nabwo amaurire agakwetagisa tigali makuru muno. Taija kubaho kizibu/kuterebanizibwa kwona hali iwe.
Ebitabu, aripota zebyolagalukamu byawe biija kukumibwa omuseruriza akaire kemyaka etanu (5) ha Itendekero lyetukwatagana nalyo (KIU, Kampala International University) habwa okuseruriza mumaiso okwo no kwegesa; Amaurire gabyakalimagezi, nigaija kwaurwa habyoma kalimagezi ebine ekisumuluzo. Okukozesa amaurire agauirwe gaija kumala kucencurwa akatebe akajunanizibwa n'engeso z'okuseruriza kakuba kyetagisa. Ampero yemyaka etanu (5), ebitabu, aripota biija kuba nibinagwa, byokebwe nomuuro kandi Amaurire gabyakalimagezi, nigaija kusimuribwa kimu kuruga omubyoma byakalimagezi. Yoleka omuringo amaurire galaleka kukozesebwa. Okuseruriza kunu kukatunga okwikirizibwa kuruga Akatebe akakwatisa engeso omukuseruriza aka Unisa. Ebaluha egi nosobola kugitunga kuruga hali omuseruriza obwokuba ogondeze. Okuseruriza kunu nabwo kukatunga okuhandikibwa mu Uganda akatebe/akakiko ka Uganda National Council for Science and Technology (UNCST) n a Local Research Evaluation Committee (REC) akamanyirwe nka The AIDS Support Organization (TASO).

Obwolaba oine kyotetegereize oba kyokwenda kumanya nka omuringo okuseruriza kwakozirwemu, osobola kubazamu na nampala wo museruriza Prof. Ngulube hamutimbagano gwe ngulubep@unisa.ac.za oba anamba yesimu 012 429 2832.
Terera Omukuru wa Akatebe akakwatisa engeso omukuseruriza, Dr. Isabel Schellnack-Kelly, Department of Information Science: Ethics Committee na Dr. Jjuuko, Omukuru wa Akatebe akakwatisa engeso omukuseruriza, TASO mu Uganda jjuukoa@tasouganda.org oba +256782169505.

Webale kutwala akaire kawe kusoma orupapura runu.

Ninyowe,

Jackline Estomihi Kiwelu Mayende

Ataireho omukono.

Kwikiriza kwetaba omukwega/kuseruriza kunu

I, Nyowe, _____ (ibara ryawe), ningumya ngu omuntu akunsaba kwetaba/kwenyigira omukuseruririza kunu angambire amuringo, engenderwaho, ebinsobolwa kuganyirwamu nebisobola kunterebaniza mukwenyigiramu/kwetaba mu.

Nsomere (ansoborire) kandi nayetegereza okuseruririza kunu nka oku kusoborirwe mumpapura zinu.

Ntungire omugisa gukumala kukaguza ebikaguzo kandi hati netegekere kwetaba/kwenyigira omukuseruririza kunu.

Nkimanyire ngu okwenyigiramu/kwetabamu kwenge timpambisirizibwe kandi ndi wabugabe kurugamu akaire kona ataloho musango gwona. Kandi nkimanyi ngu ndatunga akasiimo ka sente za Uganda Omutwalo gumu(10,000/=).

Nyikirize kuhandiika ebikaguza obukiraba nikyetagisa.

Ntungire ekihandiko kiteirweho omukono/ekinkumu ekyokwekiriza kwetabamu/kwenyigiramu.

Ibara ryanyakwetabamu/kwenyigiramu……(handiika)

Ekinkumu/sign……. Ebiro……(handiika)

Ibara ryomuseruririza……(handiika)

Ekinkumu kyomuseruririza…….. Ebiro……..(handika

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Appendix 15: Permission to carry out the study in Adjumani

ADJUMANI DISTRICT LOCAL GOVERNMENT
OFFICE OF THE CHIEF ADMINISTRATIVE OFFICER
P.O. Box 2, Adjumani
District Chairperson
Chief Administrative Officer
E-mail Address:
0772 541 807
0772 962 037/0751 223 045
cao.adjumani@gmail.com

IN ANY CORRESPONDENCE ON THIS SUBJECT
PLEASE QUOTE NO: CR/220/01

26th September, 2022

Ms. Jackline Estomihi Kiwelu Mayende
University of South Africa (UNISA)

ACCEPTANCE OF REQUEST TO CARRYOUT AN ACADEMIC STUDY

I am in receipt of yours dated 15th August, 2022 requesting to carryout a study entitled "evidence based information practice framework for maize postharvest handling by rural small holders farmers in Uganda. The study is to come up with strategies to empower extension information providers in Uganda to collaborate in translating information stored in scientific data bases for specific maize small holders information needs.

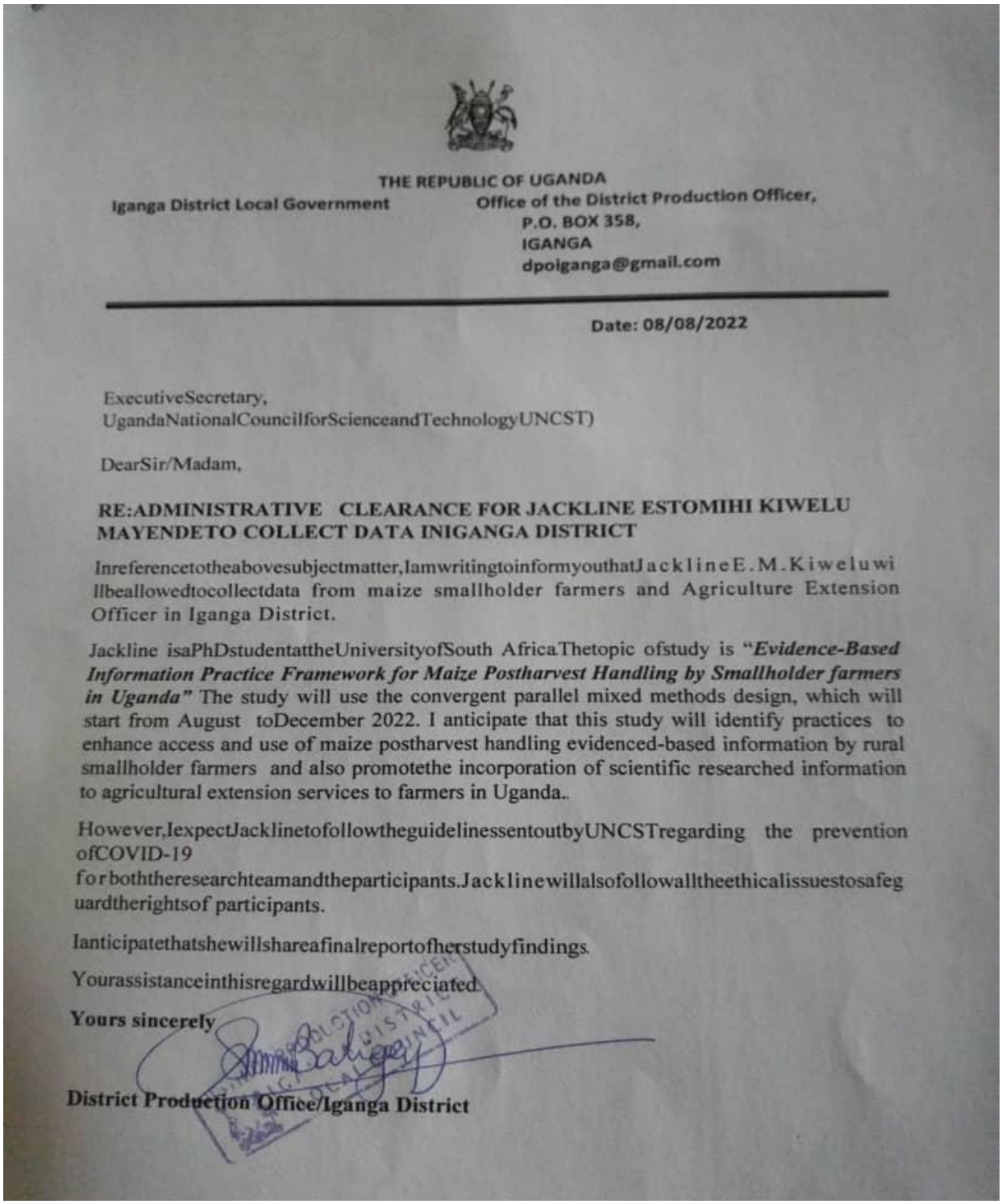
This is therefore, to communicate to you that, your request has been accepted. You are requested to liaise with the District Production Officer (Contact 0774 348 550) for effective coordination.

In service,

Ederua Richard Drichi
FOR CHIEF ADMINISTRATIVE OFFICER

Copy to: The Secretary for Production LCV, **Adjumani**
The District Production Officer, **Adjumani**

Appendix 16: Permission to carry out the study in Iganga



THE REPUBLIC OF UGANDA

Iganga District Local Government

Office of the District Production Officer,
P.O. BOX 358,
IGANGA
dpoiganga@gmail.com

Date: 08/08/2022

ExecutiveSecretary,
UgandaNationalCouncilforScienceandTechnologyUNCST)

DearSir/Madam,

RE:ADMINISTRATIVE CLEARANCE FOR JACKLINE ESTOMIHI KIWELU MAYENDETO COLLECT DATA INIGANGA DISTRICT

InreferencetotheabovesubjectmatterIamwritingtoinformyouthatJacklineE.M.Kiweluwi llbeallowedtocollectdata from maize smallholder farmers and Agriculture Extension Officer in Iganga District.

Jackline isaPhDstudentattheUniversityofSouth AfricaThetopic ofstudy is "***Evidence-Based Information Practice Framework for Maize Postharvest Handling by Smallholder farmers in Uganda"*** The study will use the convergent parallel mixed methods design, which will start from August toDecember 2022. I anticipate that this study will identify practices to enhance access and use of maize postharvest handling evidenced-based information by rural smallholder farmers and also promotethe incorporation of scientific researched information to agricultural extension services to farmers in Uganda.

However,IexpectJacklinetofollowtheguidelinessentoutbyUNCSTregarding the prevention ofCOVID-19
forboththeresearchteamandtheparticipants.Jacklinewillalsofollowalltheethicalissuestosafeguardtherightsof participants.

Ianticipatethatshewillshareafinalreportofherstudyfindings.

Yourassistanceinthisregardwillbeappreciated.

Yours sincerely

District Production Office/Iganga District

Appendix 17: Permission to carry out the study in Mubende

The Republic of Uganda
MUBENDE DISTRICT LOCAL GOVERNMENT
DDEPARTMENT OF PRODUCTION AND MARKETING
P. O. BOX 93,
MUBENDE

Mob. 0772474386, e-mail – kisaakyefredrick@gmail.com

16TH AUGUST 2022

M/s Jackline Estomihi Kiwelu Mayende
Principal Investigator
University of South Africa (UNISA)

Conducting of an academic study in Mubende District

This is in response to your request dated 15th August 2022 for conducting an academic study in Mubende District. The study theme is "Evidence-based information practice framework for maize post-harvest handling by rural smallholder farmers in Uganda".

Am pleased to inform you that as the production department of Mubende, we shall be able to support your academic work. I have carefully read the request letter and am fully convinced the findings and recommendations will be of value to the District and the country at large.

Please remember to take note of the ethical standards of confidentiality and integrity, and the COVID-19 SOPs while conducting the study

16 AUG 2022

Kisaakye Fredrick William
Ag. District Production Officer

1

Appendix 18: Permission to carry out the study in Kabarole

Telephone: 0772 626838
E-mail: Kabarole@yahoo.com

Office of the Chief Administrative Officer
Kabarole District,
P.O. Box 38, Fort Portal.

IN CASE OF ANY CORRESPONDENCE ON THIS
SUBJECT PLEASE QUOTE REF: CR/220/1

Date: 7th September, 2022

Jackline Estomihi Kiwelu Mayende
University of South Africa
P.O. Box 392
UNISA 0003
South Africa

REQUEST FOR PERMISSION TO CARRY OUT AN ACADEMIC STUDY IN KABAROLE DISTRICT

Reference is made to your communication dated 15th August, 2022 requesting for permission to carry out research in the study entitled evidence-based Information Practice Framework for maize postharvest handling by rural smallholder farmers in Uganda.

The researcher is also intended to provide further clue to extension workers on how post-harvest handling information can be effectively passed on to smallholder farmers to improve post-harvest handling practices to produce high maize grain.

Having scrutinized your request to carry out this research in Uganda particularly in Kabarole District (Production Department), it has been observed that your research can be useful to smallholder farmers in Kabarole District.

This is therefore, to inform you that your request has been accepted to carryout research in Kabarole District Local Government.

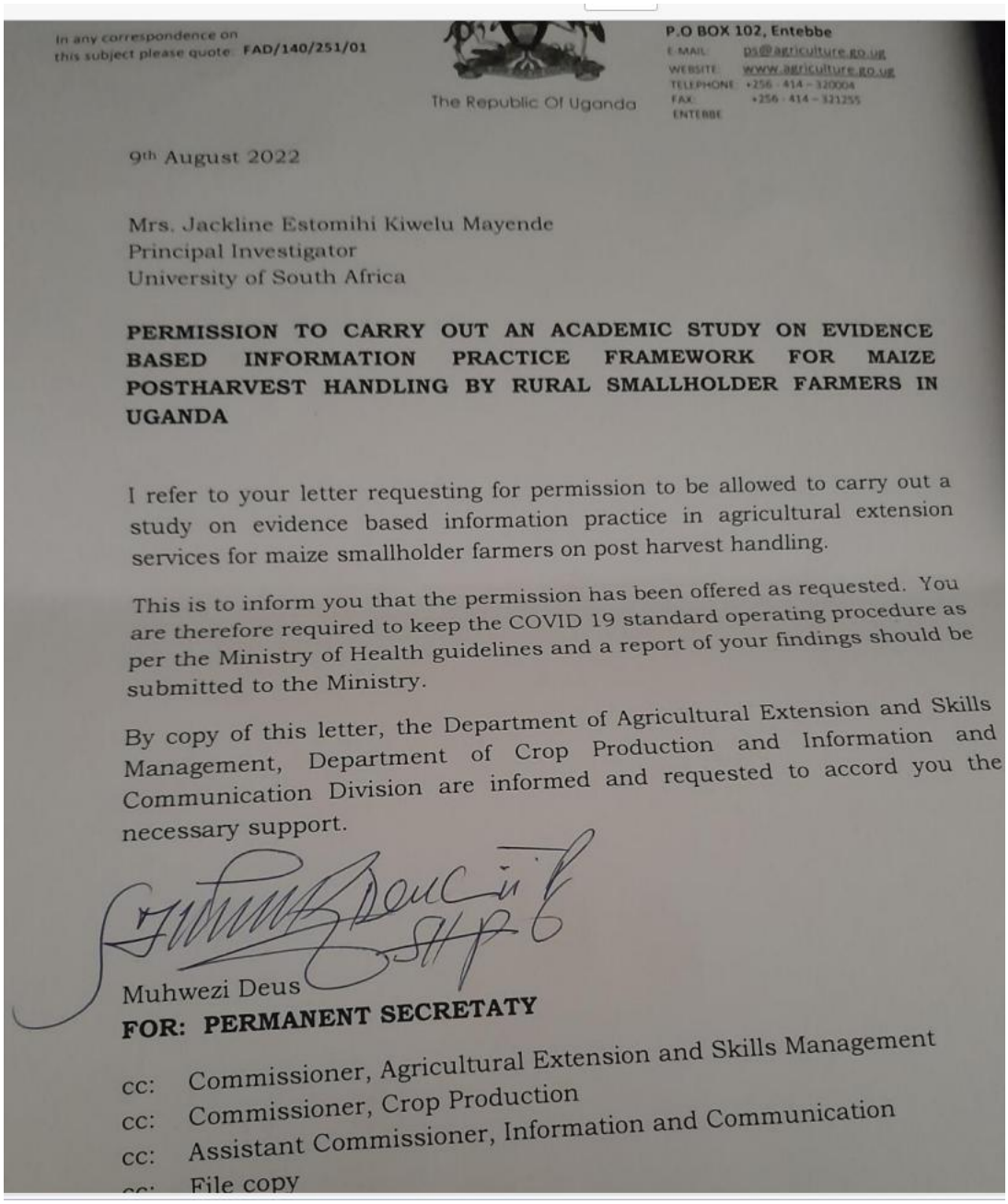
For: Chief Administrative Officer
Kabarole District

Kahunde Stella
For: CHIEF ADMINISTRATIVE OFFICER, KABAROLE.

Copy:

The District Chairperson, Kabarole
The Resident District Commissioner, Kabarole
The District Production Officer, Kabarole

Appendix 19: Permission to carry out the study in the Department of Agriculture Extension Services, in MAAIF, Entebbe Uganda



In any correspondence on this subject please quote: FAD/140/251/01

The Republic Of Uganda

P.O BOX 102, Entebbe
E-MAIL: ps@agriculture.go.ug
WEBSITE: www.agriculture.go.ug
TELEPHONE: +256 - 414 - 320004
FAX: +256 - 414 - 321255
ENTEBBE

9th August 2022

Mrs. Jackline Estomihi Kiwelu Mayende
Principal Investigator
University of South Africa

PERMISSION TO CARRY OUT AN ACADEMIC STUDY ON EVIDENCE BASED INFORMATION PRACTICE FRAMEWORK FOR MAIZE POSTHARVEST HANDLING BY RURAL SMALLHOLDER FARMERS IN UGANDA

I refer to your letter requesting for permission to be allowed to carry out a study on evidence based information practice in agricultural extension services for maize smallholder farmers on post harvest handling.

This is to inform you that the permission has been offered as requested. You are therefore required to keep the COVID 19 standard operating procedure as per the Ministry of Health guidelines and a report of your findings should be submitted to the Ministry.

By copy of this letter, the Department of Agricultural Extension and Skills Management, Department of Crop Production and Information and Communication Division are informed and requested to accord you the necessary support.

Muhwezi Deus
FOR: PERMANENT SECRETATY

cc: Commissioner, Agricultural Extension and Skills Management
cc: Commissioner, Crop Production
cc: Assistant Commissioner, Information and Communication
cc: File copy

Appendix 20: Ethical clearance letter from ECS in Uganda approved by UNSCT

Uganda National Council for Science and Technology

(Established by Act of Parliament of the Republic of Uganda)

Our Ref: SS1435ES **15 February 2023**

Jackline Kiwelu
Kampala International University
Kampala

Re: Research Approval: **Evidence-based information practice framework for maize postharvest handling by rural smallholder farmers in Uganda.**

I am pleased to inform you that on **15/02/2023**, the Uganda National Council for Science and Technology (UNCST) approved the above referenced research project. The Approval of the research project is for the period of **15/02/2023** to **15/02/2024**.

Your research registration number with the UNCST is **SS1435ES**. Please, cite this number in all your future correspondences with UNCST in respect of the above research project. As the Principal Investigator of the research project, you are responsible for fulfilling the following requirements of approval:

1. Keeping all co-investigators informed of the status of the research.
2. Submitting all changes, amendments, and addenda to the research protocol or the consent form (where applicable) to the designated Research Ethics Committee (REC) or Lead Agency for re-review and approval **prior** to the activation of the changes. UNCST must be notified of the approved changes within five working days.
3. For clinical trials, all serious adverse events must be reported promptly to the designated local REC for review with copies to the National Drug Authority and a notification to the UNCST.
4. Unanticipated problems involving risks to research participants or other must be reported promptly to the UNCST. New information that becomes available which could change the risk/benefit ratio must be submitted promptly for UNCST notification after review by the REC.
5. Only approved study procedures are to be implemented. The UNCST may conduct impromptu audits of all study records.
6. An annual progress report and approval letter of continuation from the REC must be submitted electronically to UNCST. Failure to do so may result in termination of the research project.

Please note that this approval includes all study related tools submitted as part of the application as shown below:

No.	Document Title	Language	Version Number	Version Date
1	Data collection tools	English	PDF	23 December 2022
2	Questionnaire	English	PDF	23 December 2022
3	Project Proposal	English	FINAL	
4	Approval Letter	English		
5	Administrative Clearance	English		
5	Luganda Participant consent and information sheet	Luganda	04	06 January 2023
6	Lusoga participant consent and information sheet	Lusoga	04	06 January 2023
7	Rutooro-Runyoro Participant consent and information sheet	Rutooro-Runyoro	04	06 January 2023
8	Luganda questionnaire	Luganda	04	06 January 2023
9	Rutooro-Runyoro questionnaire for smallholder farmers	Rutooro-Runyoro	04	06 January 2023
10	Madi questionnaire for smallholder farmers	madi	04	06 January 2023
11	Participant consent and information sheet	English	04	06 January 2023
12	COVID 19 an EBOLA Approved Mitigation plan	English	04	06 January 2023
13	Lusoga questionnaire for smallholder farmers	Lusoga	04	06 January 2023
14	In-depth interview guide for agric extension workers	English	04	06 January 2023
15	FGD Guide	English	04	06 January 2023
16	FGD Participant consent and information sheet	English	04	06 January 2023
17	Observation checklist	English	pdf	06 January 2023
18	Madi participants consent and information sheet	madi	04	06 January 2023
19	In-depth interview participants consent and information sheet	English	04	06 January 2023
20	In-depth interview participants consent and information sheet	English	06	11 January 2023

Yours sincerely,

Hellen Opolot
For: Executive Secretary
UGANDA NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

Appendix 21: Ethical clearance letter approved by UNISA REC

UNISA university of south africa

COLLEGE OF HUMAN SCIENCES RESEARCH ETHICS REVIEW COMMITTEE

25 April 2022

Dear Mrs Jackline Estomihi Kiwelu Mayende

Decision:
Ethics Approval from 25 April 2022 to 25 April 2027

NHREC Registration # :
Rec-240816-052
CREC Reference # :
12788279 _CREC_CHS_2022

Researcher(s): Name: Mrs Jackline Estomihi Kiwelu Mayende
Contact details: 12788279@mylife.unisa.ac.za
Supervisor(s): Name: Prof. P. Ngulube
Contact details: Ngulup@unisa.ac.za

Title: Evidence-based information practice framework for maize postharvest handling by rural smallholder farmers in Uganda

Degree Purpose: PhD

Thank you for the application for research ethics clearance by the Unisa College of Human Science Ethics Committee. Ethics approval is granted for five years.

The ***low risk application*** *was reviewed by* College of Human Sciences Research Ethics Committee, in compliance with the Unisa Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.

The proposed research may now commence with the provisions that:

1. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.
2. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the College Ethics Review Committee.
3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
4. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the

University of South Africa
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PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
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confidentiality of the data, should be reported to the Committee in writing, accompanied by a progress report.

5. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
6. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data require additional ethics clearance.
7. No fieldwork activities may continue after the expiry date **(25 April 2027).** Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:
*The reference number **12788279_CREC_CHS_2022** should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Yours sincerely,

Signature: Khan

Prof. KB Khan
CHS Research Ethics Committee Chairperson
Email: khankb@unisa.ac.za
Tel: (012) 429 8210

Signature: PP

Prof K. Masemola
Executive Dean: CHS
E-mail: masemk@unisa.ac.za
Tel: (012) 429 2298

Appendix 22: Questionnaire /survey codebook

QN. NO.	CODE	CATEGORY	DESCRIPTION
1.	Gen	1= Male 2= Female	Gender
2.	Literacy	1= I can read and write 2= I cannot read and write	Literacy levels
3.	Age_brac	1=18-20 2=21-40 3=41-60 4=61-80 581 and above	Age
4.	SACCO	1=Yes 2=No	Am a member of a financial Group or SACCO
5.	District	1=Adjumani 2=Iganga 3=Kabarole 4=Mubende	Name the district
6.	Acred_land	1=less than 1acre 2=One to 5acres	total acreage of land
7.	qnmaizeharv	1=less than1000 kgs 2=1000-5000kgs 3=5000kgs and above	quantity of maize harvested
8.	qnmaizelost	1=less than1000 kgs 2=1000-5000kgs 3=5000kgs and above	quantity of maize lost

9.	Access_storage _evidence	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5-=Strongly disagree	Access to storage evidence- based information for better maize storage practices.
10.	Uses_storage _evidence	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5=Strongly disagree	Use of storage evidence- based information for better maize storage practices.
11.	Access_drying _evidence	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5=Strongly disagree	Access to drying evidence-based information for better maize drying practices.
12.	Use_drying_evidence	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5=Strongly disagree	Use of drying evidence-based information for better maize drying practices.
13.	Access_valueadd_evidenc e	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5-=Strongly disagree	Access to value addition evidence-based information for better maize selling practices.
14.	Use_value_addevidence	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5-=Strongly disagree	Use of value addition evidence-based information for better maize selling practices.

15.	Access_finance_evidence	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5-=Strongly disagree	Access to financial evidence-based information for improved financial practices.
16.	Use_financial_evidence	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5-=Strongly disagree	Use of financial evidence-based information for better financial practices.
17.	Continuous_training	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5-=Strongly disagree	Participation in continuous training to gain knowledge on how to handle maize effectively.
18.	Awareness_EBIP		Awareness of Evidence-based Information Practices on maize postharvest handling.
19.	Asking_evidence_needs	0=No 1=Yes	Asking for information needs on maize postharvest handling
20.	Acquisition_evidence	0=No 1=Yes	Acquisition of maize postharvest information
21.	Appraising_evidence	0=No 1=Yes	Appraising maize postharvest handling information for credibility and quality.
22.	Aggregating_evidence	0=No 1=Yes	Aggregating maize postharvest handling information for easy access and use.
23.	Applying_evidence	0=No 1=Yes	Applying maize postharvest handling information for better decisions and practice.
24.	Assess_evidence	0=No 1=Yes	Assess maize post-harvest handling information application for improvement.

25.	No_EBIP	0=No 1=Yes	No evidence-based information practices are available
26.	Source of evidence		Source of maize evidence-based information practices
27.	Meetings	0=No 1=Yes	Village meetings/church meetings
28.	Agricultural_Extension_Off	0=No 1=Yes	Agricultural Extension Office
29.	NGOs	0=No 1=Yes	Through Nongovernmental Organizations
30.	Exp_offline or online	0=No 1=Yes	Through personal experience/learning offline or online means
31.	Info_Officers	0=No 1=Yes	Through District/Village/Subcounty Information Officers
32.	Comm_Lib	0=No 1=Yes	Community Libraries
33.	Friends	0=No 1=Yes	Friends
34.	Media	0=No 1=Yes	Media (Radio/Tv/Newspapers)
35.	Stakeholders		Stakeholders who support evidence-based information practices
36.	NAADS	0=No 1=Yes	National Agricultural Advisory Services
37.	District_Extension_Officers	0=No 1=Yes	District Extension Officers
38.	WFP	0=No 1=Yes	World Food Programme
39.	FAO	0=No 1=Yes	Food and Agricultural Organization

40.	NARO	0=No 1=Yes	National Agricultural Research Organisation
41.	ACDP	0=No 1=Yes	Agriculture Cluster Development Project
42.	Comm_ Librarians	0=No 1=Yes	Community Librarians
43.	Specific EBI		Specific Evidence based information needs
44.	Drying	0=No 1=Yes	Drying
45.	Storage	0=No 1=Yes	Storage
46.	Value_add	0=No 1=Yes	Value addition
47.	Credit	0=No 1=Yes	Credit support
48.	Training	0=No 1=Yes	Continuous training
49.	Any other need (specify	0=No 1=Yes	Various needs not mentioned above
50.	Current_MPHHEBIP	0=No 1=Yes	whether the current maize postharvest evidence-based information practices influence farmers practices
51.	difficulties_1	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5-=Strongly disagree	Current evidence-based practice not adequate.
52.	difficulties_2	1=Strongly agree 2=Agree 3=Not sure 4=Disagree	Sources of evidence not convenient

		5-=Strongly disagree	
53.	difficulties_3	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5-=Strongly disagree	Lack of awareness of better postharvest handling practices like hermetic bags, etc.
54.	difficulties_4	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5-=Strongly disagree	Lack of knowledge on technological value addition methods
55.	difficulties_5	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5-=Strongly disagree	Lack of awareness on credit/financial facilities available to support postharvest handling
56.	difficulties_6	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5-=Strongly disagree	Ad hoc nature of trainings provided
57.	difficulties_7	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5-=Strongly disagree	Lack of evidence-based information practice framework
58.	difficulties_8	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5-=Strongly disagree	Unknown source of maize postharvest handling evidenced information

59.	difficulties_9	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5-=Strongly disagree	Various difficulties not mentioned
60.	difficulties_10	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5-=Strongly disagree	Unfavorable transport terrain
61.	Difficulties_11	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5-=Strongly disagree	Unawareness of difficulties
62.	To_be_included_1	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5-=Strongly disagree	Farmers recommend the framework to include specific evidence-based information needs such drying, storage, value addition, credit access, and trainings
63.	To_be_included_2	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5-=Strongly disagree	A mechanism that provides access to adequate and convenient maize postharvest evidence-based information
64.	To_be_included_3	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5-=Strongly disagree	The framework should include the evidence-based information practices (Ask, Acquire, Appraise, Aggregate, Apply and Assess)

65.	To_be_included_4	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5-=Strongly disagree	Continuous training should be done for maize smallholder farmers
66.	To_be_included_5	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5-=Strongly disagree	Access to information on financial/credit support is important
67.	To_be_included_6	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5-=Strongly disagree	The framework should be evaluated from time to time as technology changes
68.	To_be_included_7	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5-=Strongly disagree	Retooling of Evidenced information providers
69.	why_include_1	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5-=Strongly disagree	Reason for recommending the framework to include specific evidence-based information needs such drying, storage, value addition, credit access, and trainings
70.	why_include_2	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5-=Strongly disagree	Reason for recommending a mechanism that provides access to adequate and convenient maize postharvest evidence-based information

71.	why_include_3	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5-=Strongly disagree	Reason for continuous training should be done for maize smallholder farmers
72.	Why_include_4	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5-=Strongly disagree	Reason for recommending access to information on financial/credit support
73.	Why-include_5	1=Strongly agree 2=Agree 3=Not sure 4=Disagree 5-=Strongly disagree	Reason for recommending a framework should be evaluated from time to time as technology changes

Appendix 23: Code book for personal interview participants

Participants	Districts	Code
Participant 1	Iganga	P1-IGA
Participant 2	Kabarole	P2-KAB
Participant 3	Kabarole	P3-KAB
Participant 4	Kabarole	P4-KAB
Participant 5	Kabarole	P5-KAB
Participant 6	Kabarole	P6-KAB
Participant 7	Kabarole	P7-KAB
Participant 8	ADJUMANI	P8-ADJ
Participant 9	ADJUMANI	P9-ADJ
Participant 10	ADJUMANI	P10-ADJ
Participant 11	ADJUMANI	P11-ADJ
Participant 12	ADJUMANI	P12-ADJ
Participant 13	ADJUMANI	P13-ADJ
Participant 14	ADJUMANI	P14-ADJ
Participant 15	IGANGA	P15-IGA
Participant 16	IGANGA	P16-IGA
Participant 17	IGANGA	P17-IGA
Participant 18	MUBENDE	P18-MUB
Participant 19	MUBENDE	P19-MUB
Participant 20	MUBENDE	P20-MUB
Participant 21	IGANGA	P21-IGA
Participant 22	MAAIF-ENTEBBE	P22-EBB
Participant 23	KABAROLE	P23-KAB
Participant 24	KABAROLE	P24-KAB
Participant 25	KABAROLE	P25-KAB
Participant 26	MAAIF-ENTEBBE	P26-EBB

Appendix 24: Code groups for the qualitative study

Code Group	Code
Access and use of Information	Access through agriculture officers Access through chairman of the villages Access through saccos Area LC1s Community libraries community meetings Farm demonstrations. Farmer trainings Reference service in the library one farmer after another Farm visits Internet Meetings radio talk shows
Difficulties	Fake seeds Frequency of dissemination -20% field and 80%office High costs of Fertilizer High costs of seeds No convenient information centres No high quality maize products for international markets Ignorance of maize farming and postharvest handling Illiterate farmers The extension workers are few.. Inadequate funding Inadequate trainings Lack of awareness Lack of farm supplies Lack of harmonised evidence. lack of ICTs knowledge and skills Lack of Internet Lack of loans

	Lack of maize PHH evidenced information in the community libraries Lack of MPHHEBI lack of reliable transport lack of stores Lack of unifying mechanism Language problem Limited funding and resources Low prices maize loss 40 % mechanism not available negative attitude toward learning No checklist for evaluating evidence No convenient information centres Convenient information centres: districts head office, Farm exhibitions farm demonstrations No convenient source of MPHHEBI No mechanism for monitoring implementation No MPHHEBI Pests and diseases poor attitude to new technology Poor attitude toward trainings Poor roads postharvest loss Price fluctuation Extension workers not accounTable to MAAIF Sensitisation is lacking Soils degraded Technology: not accessible to farmers Theft of maize Transportation is difficult contributes to loss Unanswered MPHHEBI needs unpredicTable facilitation Unreliable rainfall, Floods,

	Pests and diseases High costs of Fertilizer High costs of seeds Lack of maize market lack of reliable transport Lack of loans lack of stores and proper storage Maize Price fluctuation Lack of tarpaulin
EBIP Implementation	Ask: assessing the farmers information or technology needs Acquire: looking for the needed information Appraise: assess for the quality Aggregate: repackage the information to manuals and leaflets Coordinate with stakeholders Disseminate the information through trainings Evaluate the implementation There is a checklist EBIP inadequate Lack of skills for EBIP EBIP is ineffective EBIP is not properly implemented EBIP not effective Lack of evidence and knowledge EBIP not implemented always Farmers were tired of “bafere” (con people) Feedback documentation not there. Monitoring and evaluation not done Monitoring the application of evidence: sometimes No checklist for evaluating evidence No mechanism for monitoring implementation

Frequencies of Dissemination	When funds are available. twice a year Seasonally Depend on Internet availability According to work schedule weekly monthly quarterly
Libraries/Information centres	Provide Information centres near to the farmers to ease access Farmers do not have time to use libraries Libraries and District Information officers can work with extension workers to disseminate information. No convenient information centres No convenient information centres: districts head office. Farm exhibitions farm demonstrations partners with Librarians Provide MPHHEBI to community libraries and information offices reading literature Internet in the library working with libraries: no
Means of dissemination	: Farmers trainings, lectures, experience sharing, practical demonstra Access through chairman of the villages Access through saccos Burial ceremonies Dissemination Dissemination is done in a chain Disseminators of evidence not there Dissemination is effective Farm demonstrations. Farmer trainings Reference service in the library one on one farmer. Sensitisation meetings Farmers Explore

	Farmer Exhibitions podcast radio talk shows Burial ceremonies when people gather.
Mechanism for EBIP	Mechanism available mechanism not available Monitor through leaders Monitoring and evaluation not done Monitoring the application of evidence is done through farms interaction Monitoring the application of evidence: sometimes monitoring through observations No checklist or mechanism for monitoring and evaluating implementation of EBI.
MPHHEBI Disseminated	Drying evidence turpline, proper drying, hullers, storage facilities Evidence disseminated Drying, Storage and Packaging or value addition evidence: materials used in Postharvest handling evidence: pile on stacks evidence: postharvest handling Harvesting on time, threshing, cleaning, drying, transportation, storage Harvesting on turpline, proper drying, use of appropriate hullers, pro Important postharvest handling information. machinery is on value addition Marketing methods of postharvest handling.

	postharvest handling materials technology traditional methods for PHH
Partnerships	A network of experts, researchers and farmers can use video mediated lnformation Village leadership. Area LC1s Community based facilitators Community libraries District leaders District Production office Extension office Ministry of Agriculture, Animal industry and Fisheries (MAAIF NARO FAO WFP Farmer groups NGOs Research stations

Sources of MPHHEBI	AGORA Research databases Brochure from MAAIF Community libraries Extension books Internet MAAIF NARO
Specific MPHHEBIP Needs	Drying information materials used in Postharvest handling information Marketing information methods of postharvest handling. Pests and diseases Provide agricultural loans information. Provide relevant and quality information. Provide water for production information. technological information. Threshing information Best and cheaper storage technological information

Suggested ways of improvement	A network of experts, researchers and farmers can use video mediated l Adequate facilitation for extension work AGORA (2): Awareness Apply bottom to top approach Build postharvest handling facilities. Capacity building and skilling farmers to access online information Continuous trainings. fit international markets as this might influence export market and tr Government needs to continuously support all the relevant stakeholders Government should subsidize on the postharvest handling technologies. Implementations need resources. Improve on farmers training schedules and more sensitisation. Improve on farmers training sensitization, reduce political influence improve on road network. Improve roads and transportation system Improve standards of maize farming Inadequate (2): Technology advancement and innovation information needed Information centres near to the farmers to ease access Markets information should be communicated to farmers who live in the Provide agricultural loans. provide cheap and affordable chemicals, Provide MPHHEBI to community libraries and information offices Provide relevant and quality evidence Recruit more extension officer at least every parish should have one. Refresher and retool trainings Translate and package MPHHEBI
Translation and Repackaging Evidence	A network of experts to repackage the information Illiterate farmers need translation. Repackaging and translation-brochures, audio visual and videos visual aids. Translation and packaging expensive not easy.

Appendix 25: Syntheses matrix Evidence-based information practice for LIS

	Author and year	Purpose/objective	Methodology	Major findings	Recc
1.	Aynalem, et al 2021.	Evaluate the use of EBIP in information literacy for nurses	Qualitative Nurses	Applied in Information literacy, decision making and quality service. EBLIP research is minimal	EBIP Part
2.	Ayoubian, 2020	Systematically review the major relevant articles in case of barriers and facilitators to implementing evidence-based practice in health services.	Systematic review	Healthcare providers have less knowledge about proprietary evidence-based terminology, and reference books are the most important source of information for EBP There are barriers to EBP, such as lack of awareness, time and commitment from the administrators.	iden to fa and
3.	Azami et al2020.	Evaluates the relationship between IL and evidence-based nursing	Quantitative survey study. 164 nurses Kerman University	Increased information literacy is associated with increased evidence-based nursing.	Inco EBLI
4.	Bell 2022	Examines how values and a values-based practice framework are positioned as significant to evidence based practice in libraries.	narrative reviews were conducted in library and information science databases	The literature emphasizes the role of values when practitioners engage with critical reflective practice or invite user voices in evidence. An explicit values-based practice approach was evident in the library assessment literature, though not explicitly addressed in the EBLIP literature or EBLIP models.	The valu deci base
5.	Breckons, 2014	Identify cultural factors that affect evidence-based information services.	Soft system and action research, qualitative means Cancer organisations	-lack of time -Lack of a clear system to produce and disseminate information -Lack of information resources	Prop Accr
6.	De Brún, 2015.	propose a model to facilitate access to high-quality consumer health information	Qualitative General Public in England	-Poor quality online health information -The public in England needs information literacy skills and a tool for accessing evidence - The public uses mobile technology	Prop facili Qual
7.	Diekema, et al 2019	Seeking information is a key element of evidence-based practice and successful healthcare delivery. S	A quantitively descriptive study nursing alumni	Nurses seek practical information primarily to provide informed patient care and medical solutions, clarify medical situations, and expand their healthcare knowledge. Consultation is done in e-health records. The was a need for IL on specific clinical information and open-access resources	IL is shou
8.	Dongardive 2013	Define information repackaging, its usefulness and how it is done and its contribution to library services in Ethiopia and beyond.	Literature review	Information repackaging is a way of improving library services and coping with the explosion while providing quality service.	-Libr repa
9.	Eldredge 2016.	To find out why health librarians are not integrating research evidence in their practices	Qualitative, Ground theory, Focus group discussions Health Science Librarians UK	-Health Librarians provide EBIP and training support. Few studies have been done on integrating research into practice. Unavailability of evidence, lack of expertise and time	Keep
10.	Elueze, IN. 2016	investigated the knowledge translation practices and the utilization of research knowledge by policy actors in Nigeria	Mixed methods research 600 respondents in Nigeria	Knowledge translation is an occasional activity, The policy actors do not use reports to guide decisions. There is a lack of awareness of their use.	Crea evid
11.	Esmaeilzad et al 2022	To determine the effect of evidence-based information management and practice (EBIMP) training courses on the promotion of medical librarians' critical thinking.	Quantitative methods 60 librarians	The findings showed that the Participants' critical thinking skills after training in information management and evidence-based practice (EBIMP) significantly improved. -Virtual evidence based information management and practice (EBIMP) training is effective in improving the critical thinking of librarians.	sugg prac curri the r level

12. Etomaru, et al. 2021	to explain mechanisms the university has put in place to enhance Translation of research to inform policy and practice.	Qualitative research approach, Case study, Makerere University Staff	-system optimization, innovation, Researchers to work more close to the knowledge users. Funding not covering knowledge translation. Only focus on graduating the researchers. -weak linkage mechanisms	Estal trans rese know
13. Franzen & Bannon 2016	To map the EBP curriculum map. In class, the librarian and subject faculty taught evidence-based practice, using the language of the EBP steps.	Participatory approach and observation -Qualitative study	Instruction of information literacy in the health sciences classroom necessitates a strong partnership between librarians and health sciences faculty.	The desc libra
14. Gillespie,2014	to investigate the experiences of teacherlibrarians as evidence-based practice. A	Qualitative through interviews of 15 Australian teacher-librarians.	An empirically derived model for evidence-based practice was devised and associated critical findings identified. The results demonstrate that evidencebased practice for teacher-librarians is a holistic practice. It is not a linear, stepby-step process.	This and info unde prac
15. Granikov, et al 2020	The present methodological review assesses the current state of mixed methods research in LIS	Review of 84 articles published between 2017 and 2018.	LIS journals may adapt the reporting guidelines proposed by O'Cathain et al. (2008) for appraising the methodological quality of mixed methods research using existing tools such as the Mixed Methods Appraisal. -high-quality mixed methods studies reported in an explicit and transparent manner would benefit LIS MMR.	Adop MMI
16. Hayman & Smith 2020	Evaluate methodological trends in EBLIP	Systematic review Librarians	-Less that 0.5% studies are I MMR - Librarians need skills on EBLIP	Libra and
17. Kania, & Zmija 2016	Analyse and evaluated the existing relationship between science and education, advisory services and agricultural practice in Poland.	-literature review -Focus group famers, researchers and advisors	-Very strong links exist between agricultural advisors and farmers, between advisory, and research & education, between advisory and agricultural policy, and between farmers and companies selling Agricultural inputs and purchasing agricultural products.	Linka advis
18. Koufogianna kis, 2013	Evaluate how EBLIP influences librarians decision making	Qualitative Academic Librarians Canada	Librarians use EBLIP to improve service quality through the process of articulating the evidence need, assemble the evidence, agree and adapt the practice. Sources of evidence for librarians include statistics, expert knowledge, reports, empirical studies and experience.	Tests fram it ar prob
19. Kumar, GHK. 2017	Assess the importance of information literacy among the farming community in the context of strengthening agricultural productivity.	Qualitative, Farmers in Jorhat District	-The need to blend Indigenous and scientific information Sources of evidence are journals, books,	Use to di infor
20. Luo, L. 2018	Evaluated to application of EBIP in LIS	FGD-Qualitative Academic Librarians	-Applicable in decision making -Considers "Know-what (works)" - Addresses a specific problem. -Use wide source of evidence . Difficulties are lack of time, mentorship, training, un-available evidence and organizational culture - Sources of evidence include tangible and intangible knowledge	-help evid deep Und -Enr - Mo
21. Marshall, 2014	The review explored the origins of evidence-based practice (EBP) in health sciences librarianship, beginning with examples from the work of Janet Doe and past Doe lecturers.	Review- Four sources of evidence are used to examine the rise of EBP.	These sources of evidence confirm the rise of EBP in health sciences librarianship. International initiatives sparked the rise of evidence-based librarianship. This review shows the emergence of a unique form of EBP that, although inspired by evidence-based medicine (EBM), has developed its view of evidence and its application in library and information practice.	Heal in in othe obse appr evid the c

22.	McGowan 2019	Evaluate the results of incorporating EBIP in Librarians' curriculum	quantitative survey, 79 students	improved student engagement throughout the course and post-course assessments. Students preferred EBIP training through class activities, lectures, readings, videos, and self-paced modules.	- su conf infor
23.	Nabyonga et al 2014	to increase understanding of the utilization of evidence in health policy making and programming in Uganda, and to conceptualization of KT KT activities.	Cross-sectional qualitative study and in-depth interviews. 17 health policy makers and Researchers in Uganda.	-Awareness of the use of evidence in health policy making and practice was high. -The access and use of evidence for health policy making was not frequent. -lack of conceptual clarity about KT and what constitutes evidence. -There were unclear partnerships and platforms for knowledge sharing between researchers and end users.	-con strat
24.	Ochoa & Pinto 2020	Develop a framework for evaluating LIS sustainability, competence, and impact in SDGs.	Exploration of literature Librarians	EBLIP pre-planning, implementing and use of evidence - Useful in LIS performance evaluation	Use
25.	Oyadongha et al 2016				Libra seric
26.	Parmar, 2018	Evaluate areas for EBLIP application	Qualitative Academic Libraries	Applicable in improving quality of library practice like patrons service, collection development and administration -Few EBIP studies are carried out in developing countries	Mor espe
27.	Rehfuess, et al 2016.	To identify priority EBP research areas medical field and questions relevant to the African context,	Mixed Methods – Pragmatism approach -Quantitative Online survey and participatory approach	-The pragmatic approach outlined facilitates research that is unique, relevant, context-sensitive, feasible and of high-quality in the context of an international research consortium. -Setting evidence-based and stakeholder-informed research priorities emerged as a useful method of strengthening research collaboration within and across continents.	Colla cour
28.	Ruchon, & Grad 2018.	Evaluate the awareness of evidence reversal	Qualitative Librarians	Few Librarians were aware of evidence reversal	Mor reco
29.	Sutton P. 2013	Examine the aspects of the question-answering process in an evidence based library and information practice (EBLIP)	Literature review and analysis Librarians New Zealand	Questions fell within the six EBLIP domains, with management being the most common. Timeliness, relevance, and accessibility were stronger determinants of article selection than rigour or study design. The key determinants in selecting a checklist were relevance, domain, and applicability.	-
30.	Thorpe, & Howlett 2020	Evaluate organisational management	Qualitative University libraries in Australia and New Zealand	-Levels of awareness of the need to apply EBIP is important. -Experience and understanding of EBLIP helps application -EBIP is an ad hoc activity. - Librarians lack EBIP expertise.	EBIP servi Ther

Appendix 26 Synthesis Matrix- Maize Postharvest Handling Information by Rural smallholder farmers

Author & Year	Study objective	Methodology	Main findings	Recommer
1. Abdoulaye et al 2016.	Postharvest losses of maize and grain legumes in Sub-Saharan Africa.	Survey of smallholder farmers in Sub-Saharan Africa (Quantitative)	There is a need for smallholder farmers to have greater access to effective storage technologies. Awareness is one step in that process.	Create m technologi
2. Achora C. 2020	Creating ICT for Agriculture (ICT4A) solutions for smallholder farmers: A case study from Uganda.	Case study (Qualitative)	Limited awareness of ICT4A resources; Uganda urgently needs farming information.	Exploit I disseminat
3. Affognon, et al 2015.	Analyzing postharvest losses in Sub-Saharan Africa: A meta-analysis.	Review: meta analysis	Limited information of Phh methods in Sub Saharan Africa	Technologi

4. Akumu, et al 2020	Evaluating the effectiveness of enhanced postharvest maize handling on reducing grain losses, mold infection, and aflatoxin contamination in rural Uganda.	Quantitative methods 108 smallholder farmers in Kamuli and Apac districts, Uganda.	lack of information, knowledge and skills for postharvest loss -Lack of credit support -improper postharvest handling	-improve improved t
5. Anderson,et al. 2016.	National survey and categorization of smallholder households in Uganda: assessing their needs for financial, agricultural, and digital solutions.	Survey on smallholder farmers in Uganda (Quantitative)	No access to formal financial support like credit and insurance information for smallholder farmers to handble PHH. Only informal financial services are easily accessed by smallholder farmers.	Improve disseminat mobile tec
6. Antwin-Agyei, &Abadoo 2021	Assessed the opportunities and challenges smallholder farmers face in accessing climate information, ranging from short-term weather forecasts to long-term climate change data, in the Sudan savannah agro-ecological zone of Ghana.	survey with 555 farmers, workshops, key informant interviews, and focus groups across six communities.	- Few farmers received climate information, primarily through radio. Challenges included inadequate seasonal forecasts, low accessibility, high illiteracy, and unclear communication.	- Climate agricultura effective d
7. Arias, et al 2012	Smallholder integration in changing food markets	Participatory research and reviews	Lack of clear evidence based policies to provide marketing information to smallholder farmers	-Put polici informatio -Create aw
8. Asasira 2019	How video attributes influence farmer learning about maize postharvest handling practices and technologies in Kakumiro District, Uganda	Interview, observation six key informant and 50 exit individual interviews were conducted in February 2019	Videos influence farmer learning through demonstration, attractiveness, clarity, and engaging content, fostering viewer interaction and enhancing understanding and applicability.	Use vide informatio
9. Atube, et al. 2021	Dominants' of smallholder farmers' adaptation strategies to the effects of climate change: Evidence from northern Uganda.	cross-sectional survey research design was employed to collect data from 395 randomly selected smallholder farmers'	Unreliable climatic information systems for smallholder farmers.	governmer agricultura climate inf
10.Btibutsa Et al. 2020.	Performance of five postharvest storage methods for maize preservation in Northern Benin	Quantitative -experiments of four hermetic storage bags	Maize can be stored safely in hermetic bags at 14% moisture or less; 13% is recommended to ensure seed viability.	Create awa Make the the market
11.Balungi, B. 2016	Post-Harvest Handling Technologies And Maize Farmers ' Income In Mid-West Uganda , Masindi And Kiryandongo Districts	Quantitative methods survey of maize farmers in Uganda	Lack of awareness of the technologies Lack of finances to acquire the technology	Improve a technologi Governme technologi
12.Campenhout 2021	Information's impact on agricultural technology adoption among Ugandan rice farmers.	An experimental design utilized a crossed treatment approach to observe rice farmers in Eastern Uganda.	Technological agriculture is vital, but increasing awareness and affordability are essential for access. Videos can raise awareness, while social networks and peer interactions effectively share information with rural smallholder farmers in Uganda..	-Use videos
13.Cruz et at 2021	Examine the agricultural interactive knowledge models: researchers' views on farmers' knowledge and information sources in Spain.	Quantitative, survey 156 Agricultural researchers and public institutions in Spain.	Farmers depend on pertinent knowledge and information sources, but personal experiences have the greatest impact on their practices..	Provide rel
14.Darfour, et al 2020	Cost evaluation of five maize grain handling methods to minimize postharvest losses due to insect contamination.	Quantitative methods,	High costs of handling maize grain require farmers to form cooperatives, improving their access to bank credits and helping them build necessary equity capital.	Ghana's go + accesso agricultura
15.Deinchma, et al 2016	Can digital technologies transform agriculture in developing countries?	Quantitative methods	Pathways for information include formal channels like mass media and village meetings, and informal ones like family and personal experience.	-

16. Elueze, 2016	Advancing evidence-informed agriculture policy: examining researchers' knowledge translation practices in Nigeria's National Agriculture Research Institutes.	Questionnaires and interviews. 600 agriculture researchers and the policy actors Nigeria Mixed Methods	finding show that knowledge translation mainly occurs for annual reports. Policymakers often neglect these reports due to unawareness.	Create awa evidence fo
17.Essougong, & Degrande 2018.	Are community-based organizations able to provide sufficient agricultural information to farmers? Insights from rural resource centers in Cameroon.	Qualitative-Interviews of 29 CBOs in Cameroon, 118 participants	armers require postharvest technological information, skills, and knowledge, sourced from extension offices, rural resource centers, and peers, while facing funding challenges.	-Governme
18.FAO & Nuwagaba 2019	The governments of Uganda, FAO, WFP, and IFAD are advancing efforts to create a comprehensive strategy to reduce post-harvest losses in grains.	Quantitative methods	Information for value addition, storage, credit to smallholder farmers is limited	Improve di
19.FAO, WFP & IFAD 2019	Food loss analysis: causes and solutions – The Republic of Uganda. Beans, maize, and sunflower studies Rome. 212 pp.	Quantitative methods	Helmets -lack of information, knowledge and skills -Postharvest loss -Lack of credit support -	- improper p
20.Kadjo, et al 2018	Storage losses, liquidity constraints, and maize storage decisions in Benin	Survey of 309 smallholders in Benin	The services are adhoc in form of projects, inadequate, few numbers of extension workers. Technology	Policies en storage households storage tec to storage
21.Kato, & Musoke 2021	Easy way to improve storage harvests. Harvest Money Guide Uganda	Qualitative/review	Repackaging the information in postharvest technologies for easy access in the newspaper magazines	Improve information
22. Manandhar, et al. 2018	This review aims to evaluate both traditional and emerging grain storage practices for smallholder farmers in developing countries, highlighting their most advantageous aspects and limitations.	Review	Smallholder farmers in developing countries rely on traditional grain storage methods like woven bags, which are ineffective against mold and insects. Hermetic bags appear to be a better option.	Disseminat use of herm for Posthar
23.Mbagwu & Benson 2018.	Identify the different challenges related to fulfilling the information needs of rural farmers through internet-based services, referencing experiences from developing countries.	Literature review	Challenges in meeting rural farmers' information needs via internet services include poor ICT infrastructure, low interest in agricultural information, inadequate knowledge, and lack of information agencies.	The findin discussion researching repackagin solutions to
24. Mendoza, et al 2017.	To examine existing grain handling practices in Huehuetenango, Guatemala, in order to identify techniques and factors that lead to post-harvest losses in maize.	Survey 280 families representing 14 rural communities	88% use traditional means of drying and stores for maize 14% use metal silos.	Create awa to rural ma
25. Mondal, et al 2021	This paper seeks to assess the performance of a mixed flow dryer by conducting energy and exergy analysis for drying freshly harvested maize grain..	Quantitative observation experiment	Exergy inflow, outflow, and loss increased with drying temperature. Exergy efficiency ranged from 8.54% to 20.87%, and potential for improvement varied from 0.81 to 11.12 kJ/s for mixed flow maize drying	Technologi
26. Muhanguzi & Ngubiri 2022	This study explores the obstacles preventing smallholder farmers from benefiting from agricultural information, even with the availability of information services.	A mixed-method research approach was employed to gather data from 200 farmers	Low education levels, inadequate quality information, poorly designed communication channels, and high access costs hinder effective information utilization.	Strategies communica translation information
27. Mutambuki, & Likhayo2021.	Effectiveness of various hermetic bag storage technologies in controlling insect pests and aflatoxin contamination in stored maize grain	Experiment of storage technological equipment	Evaluation results indicate that hermetic PICS, ZeroFly® bags, and Actellic Gold-treated woven PP	Implement widespread

			bags effectively protect stored maize from insect damage and weight loss.	technology food securi
28. Mutambuki, et al 2019	Assessment of the Purdue improved triple-layer hermetic storage bag in comparison to Prostephanus truncatus (Horn).	Evaluation of improved crop storage technologies (Quantitative)	Results indicated that PICS bags outperformed treated and untreated polypropylene and jute bags in preventing insect damage and weight loss in stored maize. This information is unknown to farmers.	Create awa to farmers.
29. Mwatima 2018	Utilization of mobile phones to enhance access to and use of socioeconomic information in rural communities in Tanzania.	The study used qualitative methods to interview 69 agro-pastoralists from two districts..	Key findings indicate that mobile phone use improved socioeconomic information services in rural Tanzania's selected districts.	Rural deve mobile te accessibilit
30. Nampijja & Birevu 2016	The use and adoption of mobile technologies for learning within smallholder farming communities in Uganda.	Qualitative study on 60 smallholder farmers	-inadequate, few numbers of extension workers 1:25,000 ratio. -Mobile learning can greatly benefit non-formal contexts, helping marginalized groups like smallholder farmers access vital information for resilience and livelihood security.	Exploit m postharves farmers.
31. Ogundeji, Danso-Abbeam & Jooste 2022	Access to relevant climate information is essential for addressing the adaptation needs of smallholder farmers in Africa	Using cross-sectional data obtained from farming households in South Africa(Quantitative)	TV, radio, extension agents, and farmer-to-farmer services are vital information sources, influencing farmers' adaptive behavior. Developing rural agricultural information systems is essential.	The study agricultura farmers' ac sources for
32. Omotilewa, 2019	To assess the impact of subsidizing improved grain storage bags on commercial purchases of the technology, determining whether it crowds out or crowds in sales.	Quantitative Randomised field 1,200 smallholders in Uganda	Lack of awareness and information of technology and where to buy was prevalent.	Create awa
33. Sam et al 2017	Assessment of the information requirements of agricultural extension agents in Ghana.	The study employed a structured survey with 472 agricultural extension agents from 40 districts in Ghana.)	- Extension agents preferred visual information from books and reports, facing infrastructure, awareness and training challenges.	The study and datab access to d
34. Sangbuapuan & Guha 2016	This paper proposes a method for providing information to Community Rice Centers in Thailand through the use of information kiosks.	The survey included 150 rice farmers divided into three groups: smart, professional, and seed producers.)	Information kiosks were identified as effective ICTs for sharing farming information, expert advice, and government updates on seed distribution and disaster management.	this study improving informatio to rice farm
35. Saweda, 2023	Investigate the connections between medium-scale farmers (MSFs) and small-scale farmers (SSFs), particularly the mechanisms that may lead to spillover effects..	APRA 2018 Nigeria survey from Kaduna and Ogun states.	Purchasing inputs from MSFs lowers access costs and increases inorganic fertilizer use among small-scale farmers, especially those with less than one hectare.	Effective m and larger enhancing
36. Shee, et al. 2019	Evaluates the factors contributing to postharvest losses at each stage of the maize and sweet potato (both white and orange fleshed) value chains for smallholder farmers.	using our cross-sectional field survey data from two districts in Uganda.(Quantitative)	Significant food crop losses occur along complex value chains, hindered by insufficient understanding of loss locations and contributing factors.	Knowledge
37.Sobalaje 2020.	The role of libraries for agricultural extension workers in Osun State, Nigeria.	Data were collected via structured questionnaires from 160 extension workers; 149 responded	Extension workers frequently use public libraries for farmer information, appreciating their role in knowledge enhancement. However, challenges include poor information repackaging, untrained staff, low ICT skills, and outdated resources.	Train librar workers for disseminat
38. Stathers et al 2020	A systematic review was conducted on post-harvest loss reduction interventions for 22 crops in 57 countries across sub-Saharan Africa and South Asia from the 1970s to 2019.	Scoping review	This analysis highlights the urgent need for systematic assessments of interventions across the value chain, focusing on training, finance, and policy beyond farmers.	-

39. Thiri, et al 2019	Examine the information requirements and obstacles faced by rural smallholder farmers in Mzimba North, Malawi.	The study used a mixed methods approach, guided by Wilson's Model, collecting data from 202 farmers via questionnaires and focus groups..	The primary information need of rural smallholder farmers was crop husbandry, personal experiences as source information was by the majority (185, 96%). Lack of mobility to information sources (147, 76.6%).	The study r Agriculture rural famili
40. Tibaingana et al	To explore smallholder farmers' views on household maize storage	Data were collected from nine focus groups with 108 participants in eastern Uganda.	Results indicate that smallholder maize farmers utilize eight storage types, obtained through purchase, construction, or contribution, varying by district and influenced by cost, accessibility, and tradition.	Agricultura maize pric governmer policies, a household essential.
41. Tibagonzeka, et al 2018.	To explore smallholder farmers' views on household maize storage.	Farmer interviews, focus group discussions and key informant interviews were used (Qualitative).	Results reveal widespread use of inadequate postharvest handling methods, leading to significant losses: 41% for maize, 33% for millet, and more. The highest losses occurred during storage, with aflatoxin contamination rates of 44% for maize and 91% for sorghum.	This study evidence-b enhance fo
42. Viller et al 2023	Gather evidence on the impact of five key interventions designed to enhance farmers' market access and participation in low- and middle-income countries.	Systematic review	Rural farmers in low- and middle-income countries require interventions for market output information.	Establish informatio technologi

Appendix 27: Confirmation of English Language Editing

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Confirmation of English language editing

This document confirms that a draft of the below manuscript has been edited for proper English language, grammar, punctuation, spelling, and overall style by Audrey Holmes, MA, an expert English language editor.

Title: Evidence-based information practice framework for maize postharvest handling by rural smallholder farmers in selected districts in Uganda

Author: Jackline Estomihi Kiwelu Mayende

Date language editing completed: 18 September 2024

Editor: Audrey Holmes

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EVIDENCE-BASED INFORMATION PRACTICE FRAMEWORK FOR MAIZE POSTHARVEST HANDLING BY RURAL SMALLHOLDER FARMERS IN SELECTED DISTRICTS IN UGANDA

by

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submitted in accordance with the requirements for the degree of

Doctor of Literature and Philosophy

in the subject of

Information Science

at the

UNIVERSITY OF SOUTH AFRICA

SUPERVISOR: Prof. Patrick Ngulube

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