Competencies of Extension Workers Promoting Agroforestry to Smallholders in the Global South

by

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ABSTRACT

Smallholder farmers in the Global South are confronted by a wide array of challenges. Challenges smallholders encounter range from a shifting climate to economic uncertainties. Agroforestry, the intentional integration of trees with crops and/or livestock, has been one strategy promoted by institutions to address some of the challenges realized by smallholder farmers. As an organization promotes this dynamic agricultural practice and natural resource management strategy, organizations must ensure that their extension staff is competent to promote agroforestry to smallholders in the Global South. To better understand the agroforestry knowledge, skills, and abilities (KSAs) of extension workers promoting agroforestry in the Global South, research for a three-article dissertation was conducted. The three unique but related studies included: (a) a modified Delphi study, (b) focus groups, and (c) a Ranked Discrepancy Model (RDM) needs assessment. Results from the first study provided a comprehensive list of technical and human relation KSAs that an agroforestry expert panel agreed was important. The identified list of KSAs was used for the next two studies. The second study produced an organizational agroforestry extension competency model for the Nongovernmental Organization (NGO), Plant with Purpose, using focus groups. Seven core competencies were identified, along with key actions staff must display. The final study was a needs assessment that used a snowball sample of global agroforestry extension workers to prioritize their top training needs based on their Ranked Discrepancy Score (RDS) of the KAS items. The top ranked training needs were in the areas of agribusiness and pests and disease. All three studies combined provide a fuller understanding of competencies required of extension workers promoting agroforestry in the Global South.

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LIST OF ABBREVIATIONS

FAO Food and Agriculture Organization

KSA Knowledge, Skill, and Ability

NGO Nongovernmental Organization

PWP Plant with Purpose

RDM Ranked Discrepancy Model

RDS Ranked Discrepancy Score

SDG Sustainable Development Goal

CHAPTER I

INTRODUCTION

Agroforestry, the deliberate integration of trees with crops and/or livestock (Nair, 2007), is receiving more attention from organizations as a method to help farmers address climate change through adaptation and mitigation (Bettles et al., 2021; Bezner Kerr et al., 2022), along with a wide range of other economic, social, and environmental benefits (Nair, 2007). This is especially true in the Global South (Latin America, Asia, Africa, and Oceania) when promoted as an agroecological practice on smallholder farms that are often family-operated on two or fewer hectares (Bezner Kerr et al., 2022; Food and Agriculture Organization of the United Nations [FAO], 2022). This innovative agricultural practice is estimated to be practiced by 1.2 billion farmers worldwide (Zomer et al., 2016). Davis and Sulaiman (2014) urge international agricultural education and extension researchers to advance knowledge in agricultural innovation. This research, through three individual studies, will explore competencies of extensionists promoting agroforestry innovation, providing insight into what makes a competent agroforestry extension worker and how organizations can use competencies to strengthen their programs.

Background

The term agroforestry was coined 40-plus years ago, and researchers started to study agroforestry through a scientific lens (Plieninger et al., 2020; Nair et al., 2017). This makes the study of agroforestry young, but the practice of agroforestry has been found worldwide for thousands of years (Nair, 1993). Leakey (2017) defines agroforestry

as “A dynamic, ecologically based, natural resource management system that, through the integration of trees in farm and rangeland, diversifies and sustains smallholder production for increased social, economic, and environmental benefits” (p. 6). Nair (2007) discusses how agroforestry in the Global South emphasizes poverty reduction, food security, and stopping land degradation. In the Global North, agroforestry's primary role has been providing ecosystem services, including carbon sequestration, water quality control, conserving biodiversity, and good land ethics and aesthetics.

Even with the wide range of benefits that agroforestry provides to farmers and the land (Bettles et al., 2021; Bezner Kerr et al., 2022; Plieninger et al., 2020), scaling up has been limited (Callo-Concha et al., 2017; Plieninger et al., 2020). Barriers to scaling up have included (a) insecure land and tree tenure (Bettles et al., 2021; Glover et al., 2013); (b) lack of access to capital (Bettles et al., 2021; Shennan-Farpón et al., 2022); (c) limited access to market (Muthee et al., 2022; Russell & Franzel, 2004); (d) complex farming systems (Andreotti et al., 2020); (e) farmers’ lack of agroforestry knowledge (Bettles et al., 2021; Shennan-Farpón et al., 2022; Chitakira & Torquebiau, 2010); and (f) not adapting agroforestry to the local context (Smith Dumont et al., 2017).

Overcoming barriers to adoption will require a workforce that understands complex biophysical and socio-economic factors and how to engage with the community. Agricultural extensionists often provide services that facilitate technology transfer, offer advice, conduct training, or facilitate empowerment (Sawnson & Rajalahti, 2010), often with extension workers having to provide all four services to farmers (Suvedi, 2019). Gliessman (2022) contends that for agroecology practices such as agroforestry to be

expanded, agriculture extension must encourage farmer-led and community-led extension programs promoting agroecology solutions. FAO (2022) finds that extension providers can play a crucial role in farmers deciding to transition to agroecology. This will require extension workers to make a personal transition. Staff require the necessary technical and functional skills to be effective. Providers also need to prioritize the knowledge and experiences of smallholders and agroecological sustainability (FAO, 2022).

Studies show that extension workers often need more training and expertise in agroforestry (Baig et al., 2021; Beyene et al., 2019; Place et al., 2012; Tolentino & Landicho, 2011; Wilson & Lovell, 2016). Extension workers tend to approach agroforestry from either a forestry perspective, which focuses on trees, or an agricultural perspective, which focuses on annual crops. Instead, there should be a combination of the two, highlighting the strength of agroforestry (Baig et al., 2021; Lassoie, 1990; Tolentino et al., 2010; van Noordwijk et al., 2019). In some situations, nongovernmental organizations (NGOs) use staff without training in forestry, agriculture, or agroforestry (Tolentino et al., 2010). Prescriptive agroforestry approaches are often promoted without accounting for the heterogeneity of communities and individual farmers (Smith Dumont et al., 2017; Jacobi et al., 2017; Reed, 2007).

Agricultural extension programs have used competencies to train and develop extension workers to be effective in their work (Stone, 1997). Competencies are the collective knowledge, skills, and abilities (KSAs) that a person needs to perform a position (Lindner et al., 2003), making competencies essential to organizational success (Harder et al., 2010). McClelland (1973), an early researcher on competencies, found that

organizations should train workers on technical outcomes and include social and interpersonal competencies. Extension workers need both technical and human relations competencies to be effective. Drawing on extension research methods, this study examines agroforestry competencies needed by extension workers engaging with smallholder farmers in the Global South, and how organizations' agroforestry extension programs can also use competency models and training needs assessments.

Statement of the Problem

As organizations continue to promote agroforestry in the Global South, competent extension workers must engage with smallholders (Amare & Darr, 2020; Baig et al., 2021; Bettles et al., 2021; Tolentino et al., 2010). Stone and Bieber (1997) discuss how applying proper knowledge, technical skills, and personal characteristics lead to outstanding performance for extension workers. Agroforestry extension workers and organizations need to use appropriate competencies in their work, necessitating more research on specific agroforestry competencies for agroforestry extension programs.

Prior research indicates that agroforestry extension workers often only have competencies in forestry, agriculture, or community development (Baig et al., 2021; Tolentino et al., 2010). Therefore, a need exists to determine KSAs required for agroforestry extension workers.

Statement of Purpose and Objectives

The purpose of this study was to gain insight into competencies required by extension workers who promote agroforestry to smallholders in the Global South. This research has three objectives: 1) determine the knowledge, skills, and abilities required

for extension workers who promote agroforestry in the Global South; 2) demonstrate how to design an agroforestry extension competency model for an organization; and 3) measure agroforestry extension workers' training needs using a needs assessment.

Theoretical and Conceptual Frameworks

The theory of Diffusion of Innovation and competency-based performance are overarching frameworks that inform the three individual studies in this dissertation.

Diffusion of Innovation

The theory of Diffusion of Innovation helped inform this study. **"**Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers, 2003, p 5). This research was interested in the change agents (i.e., extension workers) who promote agroforestry. A change agent is one communication link between a change agency promoting innovation and those they try to influence (Roger, 2003).

Rogers (2003) describes a change agent as someone "who influences clients' innovation decisions in a direction deemed desirable by a change agency" (p. 366). However, Rogers (2003) also describes change agents' role as being broader than diffusers of information, as agents act as linkers between clients' and the change agency, providing feedback from the client to the organization, ensuring the intervention programs fit the needs of clients. Extension workers in agroforestry enhance the effectiveness with which the innovation is communicated, reduce the perceived complexity, and improve the innovation's observability and adaptability (Reed, 2007).

Agroforestry extension workers also have a key role in identifying innovators and their innovations (Bettles et al., 2021; Reed, 2007).

Competencies

Staff competencies provide a conceptual framework for all the studies. Stone (1997) defined competencies as "the application of knowledge, technical skills, and personal characteristics leading to outstanding performance" (p. 53). McClelland (1973), an early researcher on competencies, was cautious of testing people in a specific trade solely on technical skills and not taking a more holistic approach to account for the technical, social, and interpersonal competencies approach of preparing people. Harder et al. (2010) discussed how organizations that identify the required competencies of staff and develop their staff in competencies, the organization will achieve increased capacity. The three studies will focus on both the technical and social KSAs required of extension workers promoting agroforestry.

Significance of the Study

These findings may guide governmental, nongovernmental, and tertiary educational institutions about KSAs required of agroforestry extension workers in the Global South. This research also provides insight into how organizations promoting agroforestry may use competencies in staff needs assessments or develop organizational competency models.

Structure of the Study

This individual but related three-journal article dissertation consists of five chapters, and the research articles are presented in Table 1.1. Chapter 1 introduces the

research and outlines the dissertation's organization. Chapter 2 provides findings from a modified Delphi study, where an expert panel described the KSAs of extension workers promoting agroforestry in the Global South to smallholders. The following two chapters show how organizations can use the agroforestry extension competencies. Chapter 3 presents a qualitative approach to developing an organizational competency model for an NGO agroforestry program using focus groups. Chapter 4 examines findings from the agroforestry extension worker quantitative needs assessment using a Ranked Discrepancy Model (RDM) needs assessment. Chapter 5 presents a summary of the studies, implications, future research recommendations, and future recommendations for practice.

Table 1.1

Summary of Research Design and Methods

Studies	**Method**	**Sample**	**Product**
Chapter II: Determine competencies extension workers need to promote agroforestry	Three-round modified Delphi	26 expert panelists	List of competencies identified by the expert panelist
Chapter III: Develop an organizational agroforestry extension competency model	Focus groups	50 agroforestry staff and partner members of an NGO	Competency model (list of core competencies with behavioral indicators)
Chapter IV: Conduct a needs assessment of extension workers promoting agroforestry	Needs assessment	107 people (extension workers, program managers, and directors) promoting agroforestry	A list of ranked training needs

Chapter II: Journal Manuscript 1

For the first study, a modified Delphi study (Dalkey & Helmer, 1963) to determine KSAs extension workers require to promote agroforestry to Global South's smallholders. In three rounds, a Delphi study panel of 26 agroforestry experts reached a consensus on the required technical and human relation KSA items. The panel identified (a) 22 knowledge items, (b) 18 skill items, and (c) 25 abilities required of extension workers promoting agroforestry to smallholders in the Global South.

Chapter III: Journal Manuscript 2

For the second study, focus groups were used (Krueger & Casey, 2015) to construct an organizational agroforestry competency model, starting with the competencies from the first study. In 10 focus groups, the global staff of the NGO, Plant with Purpose (PWP), developed an agroforestry competency model for their work, selecting seven core competencies and key actions that they wanted their agroforestry extension staff and partner staff to have. This study described the process of developing an organizational competency model for extension workers promoting agroforestry to smallholders in the Global South.

Chapter IV: Journal Manuscript 3

For the third study a quantitative approach was used to assess the training needs of extension workers promoting agroforestry in the Global South. This study administered a RDM needs assessment (Narine & Harder, 2021) to extension staff using the competencies identified in the first study. A snowball sample (Goodman, 1961) was used to recruit 107 respondents who represented those working in agroforestry

throughout the Global South. Respondents took an assessment scoring their perceived importance and their perceived proficiency for each KSA item. The study ranked each KSA item based on the group's Ranked Discrepancy Score (RDS), determining the top training needs for participants. Respondents' greatest training needs were in topics related to agribusiness and pest and disease management.

Chapter V: Conclusion

The three studies combined provide a deeper look at agroforestry extension competencies and provide tools to those promoting agroforestry to smallholders in the Global South. This chapter includes a summary of the research, implications, recommendations for future research, and recommendations for practice.

Scope of Investigation, Assumptions, and Limitations

This study focused on extension workers promoting agroforestry to smallholders in the Global South. The study is limited in scope as it does not address extension workers promoting agroforestry in the Global North. Nair (2007) documented that benefits of agroforestry are prioritized differently by farmers in the Global South than those in the Global North, leading the researcher to focus the scope specifically on extension workers in the Global South.

This study assumed that the expert panel selected for the Delphi represents the broader agroforestry community in the Global South, promoting agroforestry to smallholders. The same assumptions cannot be made for the focus groups and those participating in the needs assessment.

There was limited government-related extension professionals' participation in the studies. Also, there were limited or no agribusiness professionals who promote agroforestry involved in the study. Most participants in the three studies worked for NGOs.

Definitions of Key Terms

Ability: An observable behavior or a behavior that results in completing a task. The qualities required to do something. Behavior that results in completing a task (Lindner et al., 2003). For example, these are qualities extension workers in agroforestry must exhibit to promote agroforestry.

Agroforestry: Leakey's (2017) definition of agroforestry will be used for this study: "a dynamic, ecologically based, natural resource management system that, through the integration of trees in farm and rangeland, diversifies and sustains smallholder production for increased social, economic and environmental benefits" (p. 6)

Competencies: The KSAs required for an individual to reach an elevated level of work performance. Stone (1997) defined competencies as "the application of knowledge, technical skills, and personal characteristics leading to outstanding performance" (p. 53).

Competency model: The model may contain behavior or key actions that indicate what individuals need to know to perform their responsibilities in a job (Epley et al. 2017).

Extension workers: Government, nongovernmental staff who facilitate technology transfer, provide advisory services, support human resource development, and facilitate empowerment (Suvedi, 2019). These staff members can be called facilitators, trainers, extensionists, or extension agents. This study will focus on extension workers promoting

agroforestry to smallholders in the Global South but will draw from extension literature that discusses extension agents more broadly.

Global South: Refers broadly to the regions of Latin America/Caribbean, Asia, Africa, and Oceania (Dados & Raewyn, 2012).

Knowledge: An organized body of information supported by professionally acceptable theory and research (Lindner et al., 2003). For example, this is the information or principles that extension workers need to promote agroforestry.

Skill: Using knowledge effectively and readily in completing a task (Lindner et al., 2003). For example, these are the proficiencies developed through training or experience that extension workers need to promote agroforestry.

Smallholder: For this research, smallholders are farmers whose farms are usually family-operated on two or fewer hectares and are found in rural and peri-urban areas. They are often low-tech farming enterprises, although this is changing due to technological innovations, such as smartphones and apps (Terlau et al., 2018).

CHAPTER II

COMPETENCIES OF EXTENSION WORKERS PROMOTING AGROFORESTRY IN THE GLOBAL SOUTH: A DELPHI STUDY

Abstract

Smallholder farmers face increasing challenges threatening their livelihoods, food security, and nutrition. Extension workers can be essential in promoting agroforestry practices among smallholders in the Global South to address these challenges. With the appropriate competencies, extension workers help organizations achieve their goals of promoting agroforestry. This research determined the knowledge, skills, and abilities (KSAs) constituting the technical and human relation competencies required for extension workers who promote agroforestry to smallholders in the Global South. A three-round modified Delphi method was used to identify and determine the important KSAs among a panel of agroforestry experts. The panel of experts selected through a snowball sample, were from nongovernmental organizations (NGOs), academic institutions, and international agroforestry and agricultural agencies. The panel agreed that extension workers needed 22 knowledge items, 18 skill items, and 25 ability items to promote agroforestry to smallholders in the Global South. The KSAs were categorized into technical and human relation categories. The results should be used when developing, implementing, and assessing agroforestry extension programs for smallholders in the Global South.

Keywords: agroforestry, competencies, extension, smallholders

Introduction

Smallholder farmers face increasing environmental and economic challenges that threaten their livelihoods, food security, and nutrition (Fan & Rue, 2020), with many smallholders in the Global South (Africa, Asia, Latin America/Caribbean, and Oceania) living in poverty (World Bank, 2015). Smallholder farms are often family-operated on two or fewer hectares in rural and peri-urban areas (Terlau et al., 2018). Goal 2 of the United Nations Sustainable Development Goals (SDGs) strives to promote sustainable agriculture, achieve food security, and improve nutrition (United Nations General Assembly, 2015). Supporting sustainable production among smallholders is one strategy promoted for reaching this worldwide goal (FAO, 2018).

Agroforestry is a sustainable production practice that governmental and nongovernmental organizations (NGOs) in the Global South are increasingly promoting to smallholders to address food insecurity and poor nutrition while meeting environmental objectives, such as soil conservation and climate change adaptation and mitigation (Amare & Darr, 2020; Bettles et al., 2021; Plieninger et al., 2020; Waldron et al., 2017). Agroforestry integrates trees with annual crops and/or livestock in a landscape, making it a complex system (Nair et al., 2017). Organizations must design agroforestry programs considering local and scientific knowledge (Jacobi et al., 2017), accounting for agroforestry's multiple economic, social, cultural, and environmental impacts (Plieninger et al., 2020).

Complexities of agricultural innovation require individual extension staff with the capacity to do the tasks asked of them (Davis & Sulaiman, 2014). Organizations need

extension workers who understand the community's needs (Suvedi, 2019) and can share agroforestry knowledge and techniques (Bettles et al., 2021; Glendinning et al., 2001). Often, agroforestry extension workers have inadequate training and experience to address these complexities (Tolentino et al., 2010; van Noordwijk et al., 2019; Wilson & Lovell, 2016). This includes extension workers without required technical expertise and functional capacities in agroforestry extension.

Since the study of agroforestry has evolved from the studies of forestry and agriculture (Lassoie, 1990; van Noordwijk et al., 2019), extension workers often are educated with an emphasis on one or the other, resulting in an agroforestry extension workforce not fully qualified (Baig et al., 2021; Tolentino & Landicho, 2011). An accurate agroforestry approach is holistic, emphasizing the ecosystem and integration of trees, crops, and/or animals for optimal environmental and production outcomes (Baig et al., 2021; Tolentino et al., 2010). Approaching agroforestry from an agriculture or forestry lens can diminish the benefits to those implementing agroforestry systems (van Noordwijk et al., 2018) and limit scaling up agroforestry at national and regional levels (Reij & Garrity, 2016). Scaling up agroforestry requires extension workers to have technical expertise specific to agroforestry practices being promoted in their service areas.

The lack of functional capacities can hinder extensionists when identifying local agroforestry innovators in communities (Baig et al., 2021; Reed, 2007) or lead to inadequate training for farmers (Sanou et al., 2017). Extension workers need to understand and share agroforestry knowledge and techniques (Baig et al., 2021; Bettles et

al., 2021; Glendinning et al., 2001) by facilitating training and on-the-ground technical assistance with farmers (Sanou et al., 2017). Agroforestry extension workers may lack the capacity to incorporate local and scientific knowledge into agroforestry programs (Jacobi et al., 2017). If extension services are not tailored for agroforestry and based on the local community, innovations are often not identified and poorly adopted (Reed, 2007; Rudebjer et al., 2005; Tolentino & Landicho, 2011; Wilson & Lovell, 2016).

The literature shows a gap in knowledge of competencies required for agroforestry extension workers. Lindner et al. (2003) described competencies as the collective knowledge, skills, and abilities (KSAs) that a person needs to perform a job. Governments, academic institutions, and NGOs need to know the competencies required of extension workers who promote agroforestry to smallholders (Tolentino et al., 2010). This study contributes to understanding competencies needed in agroforestry extension.

Conceptual Framework

The conceptual lens centered on staff competencies. Organizations have used competencies to train and develop practitioners who provide extension services (Stone, 1997). Staff need to be competent to effectively do their jobs and advance the organization's mission (Liles & Mustian, 2004). Organizations must identify the competencies required of staff to help achieve organizational goals (Harder et al., 2010).

This research considered McClelland's (1973) caution about testing people in a specific trade solely based on technical skills. McClelland (1973) proposed a more comprehensive approach that accounted for people's technical, social, and interpersonal competencies. Davis and Sulaiman (2014) discuss the need for individual international

extension workers with the proper technical knowledge and skills to manage social processes and organizational capacities in their 'new extensionist' framework. The new extensionist framework described how international extension workers need technical and functional capacities to help organizations address current agricultural challenges and contribute better to innovation. Ghimire et al. (2017) stated "that success of agricultural extension services is contingent on extension professionals' knowledge, skills, and abilities to perform their extension work effectively" (p. 138). This study used competency-based research as a framework to understand agroforestry extension workers' KSAs needed to perform their work effectively.

Purpose and Objectives

This study determined the competencies extension workers need to promote agroforestry to smallholders in the Global South. Specific research objectives included:

1. Identify knowledge, skill, and ability items agroforestry extension workers should obtain to promote agroforestry to smallholders in the Global South.
2. Develop consensus of the knowledge, skill, and ability items that agroforestry extension workers need to promote agroforestry to smallholders in the Global South.
3. Determine the importance of the knowledge, skill, and ability items agroforestry extension workers need to promote agroforestry to smallholders in the Global South.

Methods

This study used a modified Delphi technique, a descriptive research method, to achieve the research objectives. A Delphi study stimulates group communication amongst a panel of experts (Linstone & Turoff, 1979), facilitating reliable consensus among a series of questionnaires combined with the opportunity for controlled opinion feedback (Dalkey & Helmer, 1963). This study method provides anonymity to those participating (Linstone & Turoff, 1979). Previous Delphi studies have been used for determining extension workers' competencies in general (Conner et al., 2013; Diab & Abdel-Ghany, 2014; Harder et al., 2010) and in agroforestry research (Escribano et al., 2018; Flinzberger et al., 2020; Ndour et al., 1992).

Snowball sampling was used to generate a panel of experts (N = 30) in agroforestry extension to comprise the study group. The criteria were: (a) panelist must be currently involved in agroforestry by working for a governmental organization, NGO, or an academic institution, and (b) have at least five years of experience in promoting agroforestry to smallholders in the Global South. Nominations were solicited from 16 professionals in agroforestry or international extension. Ten experts met the criteria to participate in the first solicitation. The other 20 panelists were selected using the snowball sampling method (Goodman, 1961). The sampling method ensured that the 30 experts represented a broad range of institutions and the Global South. Twenty-six experts participated in the Delphi study by responding to at least one round. Dalkey (2002) recommended a panel of 13 representative experts, who engaged in the Delphi process, would provide reliability within a 0.90 correlation coefficient.

The researcher developed questionnaires for each round. The questionnaires and findings from each round were reviewed by (a) two experts in agricultural extension and education and (b) two experts in agroforestry for appropriateness and applicability. Three rounds were used for data collection because previous research indicated that more rounds resulted in only minimal changes in responses (Linstone & Turoff, 1979).

Three rounds of data were collected using the online survey platform, Qualtrics. Personalized invitations and follow-up reminders with links to instruments were sent to panelists every four days from October 12 to December 23, 2021. Dillman et al.'s (2014) recommendations for the timing of pre-notice, notice, and follow-up electronic correspondence were used in all three rounds.

Round 1

In Round 1, the expert panel identified the KSAs required for agroforestry extension workers in the Global South. The Round 1 questionnaire consisted of three open-ended questions: (a) What are the top 10 knowledge items that extension workers in the Global South need to effectively promote agroforestry to smallholders?; (b) What are the top 10 skills items that extension workers in the Global South need to effectively promote agroforestry to smallholders?; and (c) What are the top 10 ability items that extension workers in the Global South need to effectively promote agroforestry to smallholders? A definition and example for KSA were provided, and space for panelists to respond. The definitions were as follows:

1. Knowledge: an organized body of information supported by professionally acceptable theory and research. For example, this is the information or principles

that extension workers need to promote agroforestry. Some examples of knowledge items might be the water cycle, photosynthesis, adult learning theory, etc.

2. Skill: Using knowledge effectively and readily in completing a task. For example, these are the proficiencies developed through training or experience that extension workers need to promote agroforestry. Some examples of skill items might be oral communication skills, plant propagation skills, leadership skills, etc.
3. Ability: A behavior that results in completing a task. For example, these are the qualities extension workers in agroforestry need to promote agroforestry. Some examples of abilities might be working well with others, managing multiple tasks, adapting, and acquiring new things quickly, etc.

The qualitative information was analyzed using content analysis methods (Fraenkel et al., 2018; Keeney et al., 2011). Krippendorff (2004) defined content analysis as "a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use" (p. 18). Categories emerged through the analysis process (Fraenkel et al., 2018). Responses with the same meaning were combined into one answer, and the qualitative data produced individual competency statements (Conner et al., 2013; Harder et al., 2010). Competency items were categorized into their proper KSA grouping using knowledge, skill, and ability definitions. An item was discarded if it did not meet the definition of knowledge, skill, or ability. The researcher then divided the KSAs into technical and human relation KSA items based on if the items are technical or functional capacities (Davis & Sulaiman, 2014). The 2

experts in agroforestry and 2 experts in extension reviewed the technical and human relation KSAs providing feedback on the categorization of the items.

Round 2

The goal of Round 2 was to seek expert panel consensus on items identified in Round 1. An instrument was administered with the KSA items. Panelists rated their level of agreement on a six-point Likert scale for each item. The ratings include: 1 – strongly disagree, 2 – disagree, 3 – slightly disagree, 4 – slightly agree, 5 – agree, and 6 – strongly agree. It was determined a *priori* that the competencies rated by two-thirds of responding panelists (67%) as agree or strongly agree would advance to Round 3 (Harder et al., 2010; Shinn et al., 2009). Competencies that did not achieve consensus were removed from the list. Panelists also had the opportunity to re-word or suggest more competencies in this round.

Round 3

Round 3 was to determine the importance of the KSA items agreed upon or suggested in Round 2. Round 3 asked panelists to rate the importance of each item on a six-point Likert-type scale. The ratings include 1 – not at all important, 2 – unimportant, 3 – slightly unimportant, 4 – slightly important, 5 – important, and 6 – absolutely essential. It was determined a *priori* that competencies rated by two-thirds of responding panelists (67%) as important or absolutely essential would be kept for the final list of agroforestry competencies for extension workers promoting agroforestry to smallholders in the Global South; items below the threshold were removed.

Results

A global expert panel of 26 agroforestry practitioners and researchers agreed to participate in the three-round modified Delphi study by responding to at least one round. Seventeen panelists participated in all three rounds, seven participated in at least two rounds, and two people participated in one round. The panelists were from (a) NGOs, (b) academic institutions, (c) agroforestry research institutions, and (d) intergovernmental agencies throughout the Global South.

Round 1

The first Delphi round sought to identify the KSAs that extension workers need to promote agroforestry to smallholders in the Global South. Twenty-two panel members provided 620 statements. The researcher analyzed and categorized each statement proposed by the panel; non-KSA items were removed based on the predetermined definitions and similar or duplicated items were combined. The researcher categorized the KSAs as either technical KSA items or human relation KSA items. The researcher retained and restructured (a) 17 technical knowledge items, (b) nine human relation knowledge items, (c) 14 technical skill items, (d) 11 human relation skill items, (e) nine technical ability items, and (f) 23 human relation ability items.

Round 2

In Round 2, twenty-one panelists rated their level of consensus for each technical and human relation KSA item for agroforestry extension workers. Items with a two-thirds consensus (agree/strongly agree) were kept. The panel could suggest other items and reword or reorganize items across KSA categories. Through panel consensus and

recommendations, (a) 14 technical knowledge items, (b) nine human relation knowledge items, (c) 12 technical skill items, (d) seven human relation skill items, (e) five technical ability items, and (f) 20 human relation ability items were kept for Round 3. The panel added five items by restructuring items and recommending new ones. Based on not reaching a consensus, (a) five technical knowledge items, (b) one human relation knowledge item, (c) four technical skills, (d) five human relation skills, (e) three technical abilities, and (f) two human relation abilities were removed. It should be noted that the knowledge items in introductory soil science, basic crop science, and the skill item forestry management did not arrive at a consensus. Several KSA items related to program management also did not receive consensus.

Round 3

In the final Delphi round, items with a two-thirds consensus (important/strongly essential) were deemed important. Twenty-four panelists determined that (a) 15 technical knowledge items, (b) seven human relation knowledge items, (c) 12 technical skill items, (d) six human relation skill items, (e) five technical ability items, and (f) 20 human relation ability items are important for agroforestry extension workers to promote agroforestry to smallholders in the Global South. The KSAs cover a range of competencies in the domains of (a) trees, (b) agriculture, (c) agroforestry, (d) culture, (e) teaching and facilitation, (f) communication, (h) teamwork, and leadership, and (g) agribusiness.

Table 2.1 shows the results of the percent agreement on important technical knowledge items. The top three items were (a) *trees in agroforestry systems*, (b) *tree*

nursery management, and (c) *sustainable agricultural production systems and practices*. The item *climate change mitigation* did not reach a consensus, so it did not make the final list.

Table 2.1

Percent of Agreement on Importance of Agroforestry Extension Technical Knowledge Items for Delphi Round 3 (n = 24)

Technical Knowledge	**%**
Trees in agroforestry systems (species, planting, protection, pruning, harvesting, and uses)	100
Tree nursery management (seed collection, propagation, seedling care, protection, and transportation)	100
Sustainable agricultural production systems and practices	96
Cost and benefits of implementing agroforestry (socioeconomic, environmental, nutrition, and food security)	92
Land and tree tenure practices	92
Agroforestry systems, practices, and principles	92
Natural regenerations (Farmer Managed Natural Regeneration, assisted natural regenerations, etc.)	88
Drivers of agroforestry adoption by smallholders	88
Indigenous agroforestry practices	88
Climate and weather (regional climate, microclimates, and weather patterns)	83
Business management (agroforestry markets and value chains)	79
Climate change adaptation	75
Plant pests and diseases	71
Nutrient cycle process in agroforestry systems	71
Agriculture and natural resource ecology	67
Climate change mitigation	54

Table 2.2 provides the percent agreement on important human relation knowledge items. All items were considered important, reaching over 80% consensus from the panel, and making the final list of KSAs. The four highest-rated items were (a) *adult learning theory and extension methods*, (b) *community development practices*, (d) *local institutions and policies that impact agroforestry*, and (e) *communication***.**

Table 2.2

Percent of Agreement on Importance of Agroforestry Extension Human Relation Knowledge Items for Delphi Round 3 (n = 24)

Human Relation Knowledge	**%**
Adult learning theory and extension methods	96
Community development practices	88
Local institutions and policies that impact agroforestry	88
Communication	88
Gender roles in the community	84
Socioeconomic conditions and livelihoods of the local community	83
Local culture, history, language, and development efforts	83

Table 2.3 shows that the expert panel retained all the technical skill items, deeming them all as important. The top five technical skills were (a) *soil and water conservation*, (b) *seed collection and processing*, (c) *tree nursery management*, (d) *integration of livestock, crops, and trees*, and (e) *agroforestry design, implementation, and management*.

Table 2.3

Percent of Agreement on Importance of Agroforestry Extension Technical Skill Items for Delphi Round 3 (n = 24)

Technical Skills	**%**
Soil and water conservation	96
Seed collection and processing	96
Tree nursery management	96
Integration of livestock, crops, and trees	92
Agroforestry design, implementation, and management	92
Agroforestry value-added products	88
Assisted natural regeneration and Farmer Managed Natural Regeneration Management	83
Disease and insect prevention	83
Agroforestry entrepreneurship	79
Agricultural management	75
Plant identification	75
Making organic fertilizer	71

Table 2.4 shows that the panel unanimously agreed that *teaching and/or facilitation* was important. The panel determined the item *written communication* as the only human relation skill, not making panel consensus. This item was removed from the final list.

Table 2.4

Percent of Agreement on Importance of Agroforestry Extension Human Relation Skill Items for Delphi Round 3 (n = 24)

Human Relation Skills	**%**
Teaching and/or facilitation	100
Cultural competency	96
Active listening	96
Oral communication	96
Problem identification, analysis, and solving	92
Community-based development	88
Written communication	63

All the technical abilities reached a consensus and were considered important by the panel (Table 2.5). The highest percentage of agreement was on the *ability to adapt agroforestry practices based on local context and research*. The lowest-rated percentage of agreement was on *using tools safely*.

Table 2.5

Percent of Agreement on Importance of Agroforestry Extension Technical Ability Items for Delphi Round 3 (n = 24)

Technical Abilities	**%**
Adapt agroforestry practices based on local context and research	92
Identify markets for agroforestry products	83
Monitor and evaluate smallholder's adoption of agroforestry	83
Use digital tools for accessing information and communication	75
Use tools safely	71

Table 2.6 lists the percentage of agreement on the importance of specific agroforestry extension human relation ability items. All items were considered important. The item, *build strong, trusting relationships with diverse groups of stakeholders*, received 100% agreement as important from the panel.

Table 2.6

Percent of Agreement on Importance of Agroforestry Extension Human Relation Ability Items for Delphi Round 3 (n = 24)

Human Relation Abilities	%
Build strong, trusting relationships with diverse groups of stakeholders	100
Facilitate farmer learning	96
Cultural sensitivities	96
Use resources efficiently	96
Document and report successes, challenges, and lessons learned	96
Identify and diagnose problems objectively	92
Be a lifelong learner	92
Identify community champions and local expertise	92
Adapt quickly to unexpected events	88
Exercise emotional intelligence (self-awareness, motivation, empathy, and social skills)	88
Work independently	88
Be tolerant and open-minded	88
Reliable; follow directions and assume responsibilities	83
Facilitate the development of participatory action plans	83
Develop trainings	83
Display servant leadership with stakeholders	83
Disciplined, detailed, and timely	79
Plan and accomplish multiple tasks	79
Advocate for the adoption of agroforestry amongst critics	75
Promote transdisciplinary collaboration	71

Conclusions, Recommendations, and Implications

Agroforestry professionals who participated in the expert panel agreed with (a) 22 knowledge, (b) 18 skills, and (c) 25 ability items needed by extension workers promoting agroforestry to smallholders in the Global South. The extensive list of competencies produced suggests that extension workers need a combination of technical and human relations competencies when promoting agroforestry, which reaffirms the McClelland

(1973) call for organizations to have staff with the required technical and social competencies.

The Delphi study validates Tolentino and Landicho (2011), who found agroforestry draws from agriculture and forestry while addressing the need for environmental stability and economic productivity, often on environmentally susceptible lands. Agroforestry extensionists must have subject matter expertise in forestry and agriculture. The lack of addressing these interdisciplinary competencies or only focusing on agriculture or forestry competencies limits the adoption of agroforestry (Jacobi et al., 2017; Plieninger et al., 2020; Tolentino et al., 2010). Also, the general competencies in areas of agriculture and forestry may be too broad for extension workers. The panel, in Round 2, did not reach a consensus on basic crop science, introduction to soil science, and forestry management. It may be that the panel considered these KSAs addressed in other related competencies.

The agroforestry field should draw competencies from agriculture and forestry but should continue to develop into its own distinct field of study (Plieninger et al., 2020). In many cases where countries have limited tertiary educational agroforestry programs, government and nongovernmental organizations promoting agroforestry may need to ensure that their extensionists are given training within the organization.

Extension workers need subject matter expertise and functional capacity (Davis & Sulaiman, 2014), such as (a) cultural, (b) training and facilitation, (c) communication, and (d) leadership domains. The Delphi panel identified culture related KSAs, including local knowledge about the community and its situation and skills and abilities to engage

actively with community members. These cultural competencies provide agroforestry extension workers the aptitude to understand and engage with communities and individual farmers (Smith Dumont et al., 2017; Reed, 2007). The identified cultural competencies are essential because local knowledge plays a vital role in agroforestry design and implementation (Jacobi et al., 2017), and the local context needs consideration (Amare & Darr, 2020). Cultural competencies are important for extension workers promoting agroforestry as it gives them the KSA to incorporate local knowledge with scientific knowledge. Also, the panel agreed on teaching and facilitation KSA items. Innovative systems such as agroforestry require extension workers to have teaching and facilitation competencies to engage with the community (Davis & Sulaiman, 2014). Organizations should ensure extension workers understand adult learning and are skilled facilitators and trainers facilitating learning among farmers.

Increasingly, agroforestry systems and practices are being promoted worldwide as climate change mitigation and adaptation strategies, including the Global South (van Noordwijk et al., 2021; Bezner Kerr et al., 2022). Still, the panel did not agree that climate change mitigation is a vital knowledge item for extension workers promoting agroforestry to smallholders in the Global South. This may be because the panel believes climate mitigation is not a driver of farmers' decisions when implementing agroforestry (Mbow et al., 2014). Suppose climate mitigation payment systems become more common in agroforestry. In that case, extension workers will play a role in encouraging smallholders to adopt agroforestry for climate change mitigation reasons requiring competencies in this topic.

Program management skills such as (a) project planning, management, and evaluation; and (b) human resource management were not considered past the first round. The ability items (a) monitor and evaluate smallholder's adoption of agroforestry and (b) use resources efficiently did reach a consensus. The lack of consensus on program management-related skills contradicts the core competencies from Ghimire et al.'s (2017) research on governmental extension workers in Nepal. The difference may be that this study focused on extension workers promoting directly to smallholders. Ghimire et al. (2017) focused on a range of extension professionals, including extensionists in the field and administrators. These project management KSA items should be further studied in future agroforestry extension research to explore if the Delphi study findings are consistent.

This study had limitations. The study did not determine the competency level of importance based on the extension workers' years of experience. Do extension workers with more experience need to be more competent in specific competencies and less in others? Future research could address this question by assessing extension workers' training needs based on years of experience. The competencies could be prioritized based on extension workers' years of experience and level of importance. These competencies are also limited to smallholder agroforestry in the Global South. How do these competencies compare to competencies required by extension workers promoting agroforestry in the Global North? A valid question that may be included in future research. Furthermore, future research should be performed to discover whether the needs

of international agroforestry extensionists vary depending on the region in which agroforestry is being promoted.

The identified agroforestry extension workers' KSA items are the starting point. These items should be used to develop organizational agroforestry extension competency models based on organizational goals (Harder et al., 2010). Organizations and staff should use the KSA items relevant to their organizational goals, developing competency models with key actions and behaviors expected of exemplary staff for each item (Epley et al., 2017). The KSAs can be used to evaluate current agroforestry extension staff, used prepare staff development, and select new staff.

The study findings have relevance in international agroforestry extension. This study provides a deeper understanding of what KSAs are required of agroforestry extensionists. However, as it is a relatively young and complex field of study, the competencies will continue to need to be re-evaluated over time and adapted to specific organizational needs.

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CHAPTER III

DEVELOPING AN ORGANIZATIONAL COMPETENCY MODEL: AN NGO AGROFORESTRY EXAMPLE

Abstract

Agroforestry is well suited for smallholder farmers because of its role in poverty alleviation, food security, and addressing deforestation. Nongovernmental organizations (NGOs) are important in promoting agroforestry in the Global South to smallholders. However, NGOs require extension staff who are competent in promoting agroforestry. This study demonstrates how NGO staff in a participatory approach can create agroforestry competency models for their organization. Through multiple focus groups, NGO staff identified seven core competencies that extension workers need to be effective in their agroforestry work, along with key actions they must display. This research shows the process of developing a competency model and provides insight into agroforestry competencies required of NGO staff promoting agroforestry in the Global South to smallholders.

Keywords: knowledge, skills, and abilities (KSA), competencies, focus groups, agroforestry, nongovernmental organizations (NGOs) staff

Introduction

In the Global South (Africa, Asia, Latin America/Caribbean, and Oceania), organizations have promoted agroforestry, the integration of trees with crops and/or livestock in landscapes, to smallholders because of its role in poverty alleviation, increasing food security, and addressing deforestation (Nair, 2007). Non-state actors, such as NGOs, often work directly with smallholders to promote the agroecological practice of agroforestry (Bettles et al., 2021). This requires NGOs to have staff that are competent in agroforestry. Organizations need methods to evaluate performance and assess staff needs to perform their jobs (Harder et al., 2010). Staff also need to know what is expected of them within the organization (Liles & Mustian, 2004). Organizational competency models can provide a system to improve the organization's staff capacity to serve the community better (Liles & Mustian, 2004). This research studies the process of developing an organizational agroforestry competency model and the implications of the research for other organizations promoting agroforestry.

Agroforestry

Agroforestry is defined by Leakey (2017) as "a dynamic, ecologically based, natural resource management system that, through the integration of trees in farm- and rangeland, diversifies and sustains smallholder production for increased social, economic, and environmental benefits" (p. 6). Agroforestry is complex, drawing from the fields of forestry and agriculture, while including many specific biophysical and socioeconomic subjects (Lassoie, 1990). Agroforestry practices and systems will vary by context (Bettles et al., 2021), often needing to be adapted to the individual farmer's situation (Kalanzi et

al., 2022). Though institutions may have various goals for promoting agroforestry, the proposed agroforestry system must address farmers' needs (Gassner & Dobie, 2022). This requires organizations and staff working closely with farmers to understand their needs (Amare & Darr, 2020).

NGOs' Promotion of Agroforestry

Many organizations spend considerable funding on projects to enhance the productivity and sustainability of smallholder agroforestry practices (Montagnini, 2017). Non-state actors, such as NGOs, are central in reaching smallholders with agroforestry because of their proximity to the community (Bettles et al., 2021) and their ability to disseminate agroforestry innovation (Martini et al., 2017). NGOs can promote agroforestry in communities by promoting skill development, creating opportunities for training, and fostering local collaboration among those in the communities (Amare & Darr, 2020). Extensionists can also play an essential role in promoting agroforestry by identifying innovative local practices and enhancing the efficacy with which the innovations are communicated (Reed, 2007). Gassner and Dobie (2022) discuss that the process of finding the optimal agroforestry system for a community or farmer is not a straight line from knowledge, through analysis, to the formulation of interventions. The process required is a participatory process. Ideas and knowledge should be discovered and shared among the organization and community (Bettles et al., 2021). As ideas develop, they will be informed by local and scientific knowledge, with an understanding that the community and organization might not agree in the end (Gassner & Dobie, 2022).

Even with the promotion of validated agroforestry practices, agroforestry adoption has been slow (Buck et al., 2020; Callo-Concha et al., 2017). Organizational capacities are one of the common bottlenecks. The lack of organizational capacities causes organizations, individuals, and networks not to achieve impact (Callo-Concha et al., 2017). Competency approaches can be a helpful framework for building the required organizational capacity (Scheer et al., 2011).

Competencies

Davis and Sulaiman (2014) state that extension staff needs the capacity both in technical knowledge and in managing social processes. This requires extension workers with both technical and human relation competencies at the individual level. Competencies are essential to organizational success (Harder et al., 2010), and competency models allow staff to understand, discuss, and utilize competencies to employee performance (Marrelli et al., 2005). Liles and Mustian (2004) define core competencies as the basic knowledge, skills, attitudes, and observable behaviors that lead to excellence in the workplace. A competency model is an organizing framework of the core competencies required for exemplary performance in a job (Marrelli et al., 2005). Competency models can include a list of competencies, definitions, and key actions (Epley et al., 2017).

Research has found that competency models are most effective when created specific to an organization, considering organizational culture, programming, and staff (Rothwell & Lindholm, 1999). There are many approaches used in developing competency models. Rothwell and Kazanas (1998) classified the approaches into three

broad methods: (1) the borrowed approach, (2) the borrowed-and-tailored approach, and (3) the tailored approach.

Borrowed Approach

The borrowed approach implements a developed competency model in an organization and is the easiest and least expensive method of competency modeling. However, the disadvantage is that it is also the least rigorous approach because it does not require an investigation to identify the unique competencies of a target group in an organization (Rothwell & Lindholm, 1999).

Often organizations use this approach by purchasing an assessment instrument and administering it without tailoring it to account for the organization's uniqueness (Rothwell & Lindholm, 1999).

Borrowed-and-Tailored Approach

The borrowed-and-tailored approach uses previous competency research to build a model. Tailoring in the borrowed-and-tailored approach involves modifying the model to be suitable for use in an organizational culture and validating competencies with the input of employees (Rothwell & Lindholm, 1999). The borrowed-and-tailored approach is not considered as rigorous as the tailored approach, but it allows for staff input in the process and is an appropriate method to develop competency models used for staff development purposes (Epley et al., 2017). The tailoring may include surveying members of the targeted group, steering focus group meetings with exemplary and successful performers, or conducting a study using behavioral event interviewing (Rothwell & Lindholm, 1999).

Tailored Approach

The tailored approach builds a competency model from the ground up (Rothwell & Lindholm, 1999). This approach requires the most significant research rigor but can take more time to validate. The tailored approach is often used because its rigor can provide legal defensibility to organizations when making hiring and firing decisions (Rothwell & Lindholm, 1999).

All the competency model approaches for organizations have their criticisms or limitations. Rigor is often influenced by available time and other resources. Conducting and validating a study can take many years in large organizations and be quite labor-intensive. The process can move quicker but usually at the expense of rigor (Epley et al., 2017). In the case of organizations creating models for staff development, the borrowed-and-tailored approach provides a viable option, as it is not time-consuming, but also provides an opportunity for staff buy-in.

Purpose and Objectives

This study's purpose was to develop and validate a competency model for the agroforestry extension workers of the NGO Plant with Purpose (PWP) using the borrowed-and-tailored approach. The specific objectives were to:

1. Identify KSA required of Plant with Purpose agroforestry extension staff and partner staff to be successful.
2. Generate key actions for each competency.
3. Construct a competency model that reflects the organization by including the identified competencies, their definitions, and the competency key actions.

Methods

This study used a qualitative action research approach, as it is an appropriate approach to develop an intervention with participant engagement that describes the process (Merriam & Tisdell, 2015). Continuous participant involvement in competency development encourages ownership of competencies (Liles & Mustian, 2004). The borrowed-and-tailored method of competency modeling was used for this study. This competency modeling approach used previous agroforestry competency research to build a model. The tailoring used in the competency modeling was conducted by holding focus group meetings with PWP staff (Rothwell & Lindholm, 1999). The research design included data gathering, analysis, integration, member checking, and peer reviewing. Table 3.1 outlines the three phases used to accomplish this study's objectives.

Table 3.1

Summary of Focus Group Research Design and Methods

Phases	Method	Participants	Products
Phase 1 Knowledge, skills, and ability item identification	1 focus group	5 PWP program directors	Prioritizing the knowledge, skills, and abilities
Phase 2 Identifying core competencies and key actions	6 focus groups and analysis	33 PWP program staff and partners	Draft #1 of a PWP competency model
Phase 3 Verify core competencies and key actions	3 focus groups	42 PWP program staff and partners	Final PWP competency model

A purposive sample was used for this study. Merriam and Tisdell (2015) recommend that purposeful sampling include participants who are most knowledgeable about a topic. The sample included PWP senior program managers, country program managers, and field staff. The staff was selected based on their agroforestry knowledge and the organization's training and extension efforts. Senior program managers' support was solicited throughout the process as previous research identified a lack of top management buy-in as a barrier to the success of competency modeling (Stone et al., 2013). The senior program managers invited the country program managers and field staff to participate. Participants were staff from the U.S.-based headquarters and the regional offices in East Africa, Central Africa, Latin America/Caribbean, and Southeast Asia.

Multiple focus groups were conducted for this study. Focus groups allow issues to be explored more deeply (Krueger & Casey, 2015) exploring people's experiences, and views (Kitzinger & Barbour, 1998). According to Merriam and Tisdell (2015), focus groups allow those with knowledge of a subject to interact and discuss with one another. Rothwell and Lindholm (1999) find focus groups an effective method of tailoring a competency model by meeting with exemplary and successful performers.

To ensure trustworthiness, the researcher took steps to establish credibility, transferability, dependability, and confirmability within the study (Lincoln & Guba, 1986). To establish credibility, the researcher had prolonged engagement with participants, triangulated the data, and conducted member checks. The researcher conducted a total of 10 focus groups to ensure that all the country office staff had an

opportunity to share their perspective on required competencies and actions. Though done remotely, the researcher engaged for a long time with partners and staff from all the PWP countries. Data were triangulated by using diverse sources. Conducting numerous focus groups with staff and partners from various countries allowed the researcher to hear multiple perspectives. The researcher also reviewed PWP reports, and research articles found online to cross-check the focus group findings with the literature. Finally, member checks were conducted to ensure credibility (Merriam & Tisdell, 2015). Participants provided feedback on findings after each study phase. To establish transferability, a thick description was provided of the research process and data gathered. To establish dependability and confirmability, one expert in competency research and two agroforestry experts were used to peer review the findings and confirm that the findings were plausible (Marrelli et al., 2005).

The steps outlined for conducting the focus groups are adapted from Epley et al. (2017). Using Zoom's online meeting technology, focus groups began with an introduction to the process, explained the procedure for the meeting, and provided background information. Based on Tuttas' (2015) recommendation, a mock focus group was previously held to ensure the software worked, providing the researcher an opportunity to gain experience coordinating and moderating Web conference focus groups and data management. Focus groups were recorded, and notes were taken during the focus groups to facilitate transcription and coding.

In Phase 1, the five senior program staff were presented with agroforestry extension knowledge, skills, and abilities (KSA) items identified from a previous Delphi

study conducted by the researcher. The leadership team was asked to consider the KSA items and confirm or explain their perspectives if they differed from their colleagues (Marrelli et al., 2005). Staff as a group rated KSA items from high, medium, to low based on their importance to PWP's agroforestry work with communities worldwide. The list was compiled from high to low and presented to participants individually for further review (via email). The researcher kept the KSA items considered highly important for the next phase.

In Phase 2, the researcher conducted six focus groups with a total of 33 program staff and partners representing the organization's work in the Democratic Republic of Congo (n = 2), Burundi (n = 9), Tanzania (n = 6), the Dominican Republic (n = 5), Thailand (n = 6), and Haiti (n = 5). Participants of the focus groups were asked to review high-priority KSA items senior program staff selected in previous focus group. Staff members from the offices were asked to ponder the following statements based on the items provided to them:

- Consider actions or statements that illustrate specific competencies.
- Provide specific examples of how you or others have demonstrated this competency.
- Think of a story highlighting the key actions or behaviors describing the competency.

Participants were given time to reflect and then were asked to share in the group, generating ideas for the key actions for each KSA item. Focus group interviews were coded using open, axial, and selective coding techniques (Merriam & Tisdell, 2015). The

researcher listened to and read the interviews, identified themes that emerged through coding (i.e., core competencies). The agroforestry extension KSA items were all categorized into the following eight themes: (a) trees, (b) agriculture, (c) agroforestry, (d) agribusiness, (e) culture, (f) teaching and facilitation, (g) communication, and (h) teamwork and leadership. The researcher assigned the KSA items and key action indicators to the themes and wrote definitions. The findings of six focus groups combined to generate a competency model representing the organization's priorities.

In Phase 3, the competency model was presented to PWP staff for feedback; this included senior staff and PWP country staff leaders and training staff. These sessions were conducted in three regional focus groups with 42 focus group members. This included PWP staff and partners from Latin America/the Caribbean (n = 12), Asia (n = 9), and Africa (n = 21), all countries where PWP works were represented. Participants provided minor feedback on core competency key actions. Agroforestry and extension peer reviewers had the opportunity to comment on the document before the final draft was membered checked by senior managers of PWP.

Results and Discussion

This study was undertaken to develop and validate a competency model for PWP's extension staff, who promote agroforestry to smallholders in the Global South. Three data collection and analysis phases were conducted, each building on the preceding one. This participatory approach allowed many involved in PWP agroforestry programs to participate in the process, including staff and partner organizations. The organization's

list of high-rated KSAs and the organizational competency model represent the study's results.

Rating the KSAs and Developing the Competency Model

Senior program managers rated the KSAs of the agroforestry extension KSA items from high to low based on PWP's agroforestry program organizational focus and the role and responsibilities of the agroforestry extension staff. Table 3.2 shows the high-rated technical or human relation KSAs items categorized. Agroforestry extension KSA items were categorized into one of the following eight categories: (a) trees, (b) agriculture, (c) agroforestry, (d) agribusiness, (e) culture, (f) teaching and facilitation, (g) communication, and (h) teamwork and leadership. PWP staff rated 39 KSA items as a high priority in all the domains except agribusiness.

Table 3.2

Prioritized Plant with Purpose Agroforestry Extension Workers' Knowledge, Skills, and Abilities Items and their Domain

Domain	Item	KSA
Tree	Trees in agroforestry systems (species, planting, protection, pruning, harvesting, uses, and interactions with crops)	Technical Knowledge
	Tree nursery management (seed collection, propagation, seedling care, protection, and transportation)	Technical Knowledge
	Natural regenerations (Farmer Managed Natural Regeneration, assisted natural regenerations, etc.)	Technical Knowledge

Table 3.2. Continued

Domain	Item	KSA
Agriculture	Sustainable agricultural production systems and practices	Technical Knowledge
	Agriculture and natural resource ecology	Technical Knowledge
	Soil and water conservation	Technical Skill
	Agricultural management	Technical Skill
	Making organic fertilizer	Technical Skill
Agroforestry	Agroforestry systems, practices, and principles	Technical Knowledge
	Drivers of agroforestry adoption by smallholders	Technical Knowledge
	Integration of livestock, crops, and trees	Technical Skill
	Agroforestry design, implementation, and management	Technical Skill
	Adapt agroforestry practices based on local context and research	Technical Ability
Cultural	Local culture, history, language, and development efforts	Human Relation Knowledge
	Gender roles in the community	Human Relation Knowledge
	Socioeconomic conditions and livelihoods of the local community	Human Relation Knowledge
	Cultural competency	Human Relation Skill
	Cultural sensitivities	Human Relation Ability

Table 3.2 Continued

Domain	**Item**	**KSA**
Teaching and Facilitation	Adult learning theory and extension methods	Human Relation Knowledge
	Teaching and/or facilitation	Human Relation Skill
	Develop trainings	Human Relation Ability
	Facilitate farmer learning	Human Relation Ability
	Facilitate the development of participatory action plans	Human Relation Ability
Communication	Communication	Human Relation Knowledge
	Oral communication	Human Relation Skill
	Advocate for the adoption of agroforestry amongst critics	Technical Ability
Teamwork and Leadership	Build strong, trusting relationships with diverse groups of stakeholders	Human Relation Ability
	Active listening	Human Relation Skill
	Problem identification, analysis, and solving	Human Relation Skill
	Identify and diagnose problems objectively	Human Relation Ability
	Be a lifelong learner	Human Relation Ability
	Be tolerant and open-minded	Human Relation Ability
	Work independently	Human Relation Ability
	Adapt quickly to unexpected events	Human Relation Ability

Table 3.2 Continued

Domain	Item	KSA
	Exercise emotional intelligence (self-awareness, motivation, empathy, and social skills)	Human Relation Ability
	Reliable; follow directions and assume responsibilities	Human Relation Ability
	Display servant leadership with stakeholders	Human Relation Ability
	Disciplined, detailed, and timely	Human Relation Ability
	Plan and accomplish multiple tasks	Human Relation Ability

Staff prioritized the KSAs representing both technical and human relation capacities required of the agroforestry extensionist working with the organization. As found in other extension research, PWP extension staff needs both subject matter knowledge and skills and the KSAs to manage social processes (Davis & Sulaiman, 2014).

A PWP Agroforestry Extension Competency Model was developed with the list of PWP prioritized agroforestry KSA items. Two drafts of the PWP Agroforestry Extension Competency Model were created before the definitive version, with each draft being presented to participants for member-checking. The final competency model contained seven core competencies with a definition for each competency and three to seven key actions per competency. The final developed model is presented in Table 3.3.

Table 3.3

Plant with Purpose Agroforestry Competency Model for Extension Staff

Competency	Description
Tree	Demonstrates knowledge of trees and their uses in agroforestry systems and at a watershed level. Understands nursery management and on-farm natural regeneration of trees. Delivers this information to those in the community.
	Key Actions: Recognizes the positive and negative effects of trees in agroforestry and conveys both to farmers. Demonstrates to farmers the proper spacing of trees with crops based on farmer, crop, and tree needs. Champions local tree nurseries in the community and transfers tree nursery management knowledge to the community. Promotes native trees, improved fruit trees, and locally appropriate exotic trees to communities. Promotes the concept of natural regeneration to communities. This may include assisted natural regeneration and/or FMNR, depending on the region. Recognizes local policies surrounding tree tenure and understands the impact on agroforestry efforts.
Agriculture	Demonstrates knowledge of local agriculture and natural resource ecology at the watershed level. Has knowledge and skills in sustainable agriculture and soil and water conservation. Recognizes and understands the local crops and traditional agricultural practices. Prioritizes food security through backyard gardening and smallholder family farms. Key Actions: Demonstrates experience in agricultural management. Understands the role of farms in the local community and region (how the farm fits in the more extensive system).

Table 3.3 Continued

Competency	Description
	Respects local and traditional farming practices. Understands how food security and nutrition are tied to rural families' objectives. Uses local crops that grow in the region and knows how they interact in an integrated farming system. Creates organic fertilizer (compost and liquid fertilizer) and teaches the skill to others. Uses and shares knowledge of soil and water conservation practices. Builds and uses an A-frame, teaching it to others. Demonstrates the construction of contour barriers, ditches, or other appropriate soil conservation methods in the region.
Agroforestry	Has knowledge and skills in agroforestry design, implementation, and management. Knows appropriate agroforestry systems and practices for the region based on research and local practices. Understands the needs of the individual farmer and watershed level.
	Key Actions: Understands the basic principles and desired outcomes behind agroforestry systems and practices, including agroforestry's spatial arrangement and/or temporal sequence. Observes and listens to those in the community to learn what influences and limits agroforestry adoption. Recognizes how livestock, crops, and trees relate to one another and identifies beneficial local knowledge and practices for integrating livestock, crops, and trees. Modifies and promotes locally appropriate researched systems and practices to farmers' specific context, demonstrating agroforestry design and management to individual farmers that address food security and nutrition, economics, and environmental needs.

Table 3.3 Continued

Competency	**Description**
Cultural	Understand cultural differences and similarities. Demonstrates effectiveness in using that understanding to develop organizational mission, communication strategies, and services. Works closely with community members to develop programs and activities that affirm and reflect the value of diverse cultures.
	Key Actions: Engage with the community to learn about their socioeconomic and livelihood condition. Respects those in the culture where they work. Understands the local culture, history, and local development efforts and how that impacts the work. Speaks and engages in the local language, clarifies what is being said, and exchanges ideas. Lives in the culture and takes part in cultural activities. Understands the different gender roles in a community and how both genders engage in agroforestry. Facilitates broader gender inclusion in agroforestry programs by building relationships in the community and challenging gender norms.
Teaching and Facilitation	Teaches and facilitates activities with ease and builds trust and relationships with participants. Engages and motivates farmers using participatory approaches. Facilitates a hands-on experience allowing farmers to actively apply what they are learning.
	Key Actions: Approaches and relates to participants building trust with those being trained. Generates a collaborative environment that creates an engaging learning atmosphere between them and participants. Employs a variety of adult learning methods that allow for participation, such as demonstrations, group discussions, hands-on experiences, and group exchanges, and highlights successful farmers.

Table 3.3 Continued

Competency	**Description**
	Describes complex subject matter in simple and relevant terms tying it to local knowledge.
Communication	Communicates effectively with those in the community through verbal and non-verbal communication. Actively engages in dialogue with the community to understand the local context and those in the community. Delivers communications humbly and is approachable.
	Key Actions: Designs training and acquires materials in local language whenever possible. Delivers clear messages when speaking, providing key information that addresses communities' needs. Speaks directly to individuals on their level using local terms and limiting technical terms that might be foreign, sharing complex topics. Introduces topics and asks questions to evaluate others' level of understanding. Demonstrates active listening. Allows time for people to express themselves in a culturally appropriate manner, paraphrase, and repeats back to ensure proper understanding.
Teamwork and Leadership	Effectively participates and works as a member of a team but works independently as required. Has the confidence to manage and a willingness to collaborate with others.
	Key Actions: Develops constructive working relationships with co-workers and identifies goals that need to be achieved. Takes responsibility for plans and accomplishes multiple tasks. Builds strong and trusting relationships with those in the community, making the communities’ problems their problems. Identifies community members that will be good community promotors. Develops the capacity of others, willing to work oneself out of a job.

PWP staff identified the need for their extension workers to have subject matter expertise in the domains of trees, agriculture, and agroforestry. This includes knowledge and skills related to the fields of forestry and agriculture but also provides knowledge and skills specific to agroforestry. Previous research has discussed how agroforestry needs to develop into a distinctive research area (Plieninger et al., 2020) with the fields of agriculture and forestry interweaving to provide the scientific underpinnings of agroforestry (Lassoie, 1990; Nair, 2007). PWP extensionists need to be competent in basic science of forestry and agriculture that relates to agroforestry (Lassoie, 1990) while understanding what influences the adoption or rejection of agroforestry (Amare & Darr, 2020). Knowledge of how trees, crops, and livestock interact in agroforestry systems and practices is also required (Mbow et al., 2014). These understandings allow extensionists to help farmers adapt to specific situations as the agroforestry system is designed, implemented, and managed on the land (Gassner & Dobie, 2022).

The competencies identified in trees, agriculture, and agroforestry indicate that the organization prioritizes extension staff with the capacity to improve landscapes and encourage environmentally sustainable agricultural production. Previous research finds comparable results, where international institutions promoting agroforestry often focus on agroforestry practices that maintain landscape integrity and provide ecosystem services while promoting smallholder agricultural production (Montagnini, 2017).

PWP's focus on increased agricultural production is based on their desire to diversify the production of home gardens and smallholder farms (Ollinaho & Kröger, 2021) and help improve food security and nutrition of smallholder farmers and their

families (Gitz et al., 2021). The PWP competency model illustrates that the organization wants extensionists with a broad knowledge of agricultural management and an understanding of local agricultural practices while having specific skills related to sustainable agriculture, such as making organic fertilizer and practicing soil and water conservation. This finding is in concurrence with previous research (Tolentino et al., 2010). Though the specific skills in organic fertilizer and soil and water conservation may or may not be relevant to other organizations depending on their agroforestry program interventions. Furthermore, the specific agriculture skills required of extension workers will be based on farmers' needs and organizational agroforestry interventions.

Similarly, the PWP competency model highlights the need for extension workers to know a broad range of trees used in farmer's agroforestry systems. This includes knowledge about quality seedlings that can survive and grow while yielding products that farmers require (Gassner & Dobie, 2022). The extension workers require knowledge of natural regeneration (assisted natural regeneration and farmer-managed natural regeneration) through seeds and existing trees in the field (Reij & Garrity, 2016). Additionally, PWP extensionists must have knowledge of tree species that farmers desire based on their needs and conditions (Smith Dumont et al., 2017). Smith Dumont et al. (2017) found that this requires engaging with various stakeholders to identify potential local and suitable options.

However, staff did not prioritize KSAs in extension staff related to business management, agroforestry entrepreneurship, or identifying markets, all categorized under the domain of agribusiness. Though agribusiness subject matter is not the focus of PWP,

many other NGOs do help remove market barriers to smallholders' agroforestry products, along with identifying potential economic outcomes (Montagnini, 2017). The findings in this study were not representative of NGOs that prioritize agribusiness subject matter in their organizational mission. NGOs that prioritize using agroforestry extension to help smallholders overcome economic barriers may find competencies in agribusiness relevant for their extensionists to help increase adoption (Amare & Darr, 2020).

The PWP staff identified competencies and key actions in domains of (a) culture, (b) teaching and facilitation, (c) communication, and (d) teamwork and leadership. Extensionists who work with farmers to develop agroforestry systems need to be well-versed in local conditions, able to elicit information from other knowledge holders, receptive to local views, and able to facilitate the sharing of information between stakeholders (Gassner & Dobie, 2022).

PWP staff prioritized competencies of staff that allow the extensionists to use participatory approaches to engage with communities, facilitate training, and communicate with stakeholders. Using participatory methods, extensionist can learn from the community, identifying local knowledge and community needs, developing tailored support (van Noordwijk, 2019). Reed (2007) discusses that agroforestry extensionists not only disseminate information but are well-placed to identify innovations if they are willing to learn from farmers.

While developing the competency model, PWP identified an area of concern they recognize they need to improve. The lack of speaking the same local native languages as the community can be a barrier to adoption (Gikunda et al., 2022), which is a challenge

that some PWP staff face. Though all PWP extension staff are nationals of the countries where they work, some of the countries speak several languages, making it difficult for staff or partners to speak all the native languages in each country. PWP prioritizes training farmers in their local native language, so translation is often needed. Still, it was noted that it could be challenging in some cases, especially as they expand into regions where their current staff does not reside. The focus group provided an opportunity for country staff to share this challenge. PWP staff identified having extensionists belonging to and living in the local culture where they work as a key action that could be taken, but this will require additional resources from the organization. Other research has found that using local farmers can effectively address having extensionists who do not speak the local languages (Martini et al., 2017), which is a strategy employed by PWP and should be considered by others.

A common theme found throughout the PWP competency model is the desire of the PWP staff to have extension workers that understand the local context. An understanding of the local context is relevant in many of the prioritized PWP technical and human relation KSAs. Related to the technical items, the key actions identified by staff agree with the literature, including understanding local tree preferences (Kalanzi et al., 2022), local crop selection, and local farming practices (Gassner & Dobie, 2022). Key actions related to human relation competencies involve understanding the local context and the broad need to understand the community's economic, social, and cultural factors, as discussed by Smith Dumont et al. (2017). This requires that PWP staff use technical and human relation competencies that allow the extensionist to engage with the

community thoughtfully, showing respect for the local community but addressing challenges. One example addressed in the competency model is having competent staff that understand and respects local gender norms and encourages broader gender inclusion in agroforestry programs. Duffy et al. (2021) found this required that the extension delivery focus on the end-user, allowing them to be involved in designing the delivery to construct an enabling environment.

When developing the PWP Agroforestry Competency Model, the PWP staff emphasized the need for extension workers to develop constructive, strong, and collaborative relationships with their coworkers and the local community making the community's problems their problems. Similarly, Jacobi et al. (2017) believe that collaborative learning is constructed on respect, equity, and empowerment; helping identify potential barriers and creating solutions.

Implications, Limitations, and Conclusions

This study provides insight into the competencies that agroforestry extension workers at PWP need and demonstrates how a competency model can be developed with organization-wide involvement. The following recommendations are based on this study's findings and the researcher's insight. Recommendations are offered for future research and to inform practice.

Implications for Research

There is a need for continued research on the agroforestry competencies of NGO extension workers. The study considered views of agroforestry extensionist because they work directly with smallholders in the Global South. Further research should be done

from the smallholders' perspective concerning their perception of high-performing agroforestry extension workers. The smallholders might have a different opinion on which competencies are most important, or they may confirm the competencies included in the model, giving it added credibility.

The research specifically focused on PWP agroforestry programs, but competency models could be created for other organizations doing similar work. This would allow organizations to customize the competency model to their needs with staff buy-in and involvement in the process. This would also provide more research on competencies in agroforestry extension, including those working in the Global North.

Implications for Practice

Developing a competency model is not the end goal for an organization. The next step is to integrate the model into staff evaluation, hire new staff using the model, and provide focus on staff development (Epley et al., 2017). One specific way the model can be used is to develop a checklist to assess agroforestry extension candidates' applications and interviews or to conduct staff performance reviews. The competence model can also be used to conduct training needs assessments and used as the foundation for designing staff development programs.

Future research could develop descriptions of different proficiency levels, such as novice, master, and expert. Also, competencies could be developed using the same methodology for other staff members at PWP, not just agroforestry trainers, so there is an organization-wide competency model that could be tailored for different staff.

Limitations

It is important to mention the limitations of this study. The study provides insight into developing organizational competency models which can be used broadly, but the specific competencies have been identified with a particular organization in mind. The competency model may also need to be reconsidered over time as the communities where the organization works change or the organization itself changes, requiring new programming and staff needing to be updated in new competencies.

The effort was made so that a broad range of staff could participate in developing the model. Still, there is potential that some staff was not as involved, which could limit the engagement and staff buy-in; not all competencies may be as important as thought, or something meaningful could be missing.

Conclusions

The adoption of agroforestry in the Global South has been limited, requiring capable NGO extension workers promoting agroforestry to effectively promote agroforestry to smallholders in the Global South. This requires NGO extension workers to have the proper technical and human relation competencies to meet the organizational mission and community needs. PWP staff were involved in creating the competency model so that the model was in line with the organization's mission and to encourage staff buy-in. The organization plans to conduct a needs assessment of staff using the competency model to evaluate the organization's strengths and weaknesses. This assessment will give the organization a baseline of staff strengths and weaknesses as they continue strengthening their agroforestry extension.

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CHAPTER IV

EVALUATING AGROFORESTRY EXTENSION WORKERS' TECHNICAL AND HUMAN RELATION COMPETENCIES: A RANKED DISCREPANCY MODEL NEEDS ASSESSMENT

Abstract

Increasingly, agroforestry is being promoted to smallholders as a method to adapt to climate change. Promoting agroforestry requires organizations to have competent staff with requisite knowledge, skills, and abilities (KSAs) for their roles. This study used a Ranked Discrepancy Model (RDM) to determine and prioritize KSA training needs of agroforestry professionals promoting agroforestry in the Global South. The study was conducted with a snowball sample of 107 agroforestry professionals who promote agroforestry to smallholder farmers in the Global South. Agroforestry extension professionals deemed all items either average or important, and training gaps existed in all agroforestry KSAs. However, the most significant training gaps were in (a) agribusiness and (b) pests and disease. The research provides insight into training gap needs of agroforestry personnel promoting agroforestry to smallholders in the Global South.

Keywords: knowledge, skills, and abilities (KSA), need assessments, agroforestry, staff development, Ranked Discrepancy Model (RDM)

Introduction

The impacts of climate change have a global effect on agricultural practices (Arora, 2019). Climate change significantly impacts vulnerable groups such as smallholder farmers in the Global South (Bezner Kerr et al., 2022; El Bilali et al., 2020). Smallholders are at greater risk of food insecurity and lack of economic access (El Bilali et al., 2020). Many international institutions call for more sustainable agriculture practices, such as promoting agroforestry for farms to address climate change (Bettles et al., 2021). Agroforestry intentionally integrates crops and trees into landscapes (Nair, 2007). Agroforestry provides many biophysical and socioeconomic benefits, including (a) food security, (b) household income, (c) increased biodiversity, and (d) carbon dioxide capture (Bettles et al., 2021; Bezner Kerr et al., 2022).

Even with the well-documented benefits of agroforestry, there have been barriers to the scaling-up adoption of the innovation. Many of the barriers to adoption from smallholders in the Global South have included economic, policy, biophysical, and cultural barriers. Economic barriers can include a lack of access to financial support (Shennan-Farpón et al., 2021), and inadequate market access (Muthee et al., 2022). Policy barriers may involve insecure land and tree tenure (Bettles et al., 2021; Glover et al., 2013). Biophysical barriers for farmers include complex farming systems with multiple components (Andreotti et al., 2020), and farmers' lack of agroforestry knowledge (Chitakira & Torquebiau, 2010). Finally, cultural barriers may involve the inability to adopt agroforestry in the local context and farmers' needs (Callo-Concha et al., 2017; Sanou et al., 2017).

Organizations promoting agroforestry require staff with competencies in complex biophysical and socioeconomic factors to address these barriers (Smith Dumont et al., 2019; Tolentino et al., 2010). Staff must also possess the ability to (a) transfer technology and innovation, (b) provide advisory services, (c) support human resource development, and (d) empower others (Suvedi, 2019). However, past research has found that organizations often need better trained extensionists with the required competencies (Baig et al., 2021; Beyene et al., 2019; Masambuka-Kanchewa et al., 2020). This lack of competencies requires organizations to train their staff to be competent in the required tasks.

As organizations continue to expand the promotion of agroforestry to smallholders in the Global South, an agroforestry workforce is needed that is competent in biophysical and socioeconomic competencies and able to engage with the community. For this study, an agroforestry extension competency needs assessment will be tested to understand better the extension workforce's training needs and how those competencies are perceived by the extension workers. The research will also demonstrate how this tool can be used by organizations promoting agroforestry to identify and prioritize the training needs of their staff.

Conceptual Framework

Stone and Bieber (1997) define competencies as the "application of knowledge, technical skills, and personal characteristics leading to outstanding performance" (p. 1). McClelland (1973) advised that competencies should address work's occupational and social aspects. Furthermore, McClelland (1973) contended that academic institutions and

employers should use competencies to assess students and employees. Ghimire et al.'s (2017) proposed conceptual framework for competency assessment informed this study. The framework is based on the following steps: (a) identify competency areas, (b) examine the importance of competencies, (c) examine levels of competency, (d) identify gaps in competencies, (e) identify ways to acquire competencies, (f) revise/update curricula, and (g) provide education and training. Through these activities, extension services are strengthened. This research will address three steps of this framework: (a) examine importance of competencies, (b) examine competency levels, and (c) identify gaps in the competencies of agroforestry professionals using a training needs assessment.

Borich (1980) proposed a self-evaluation training needs assessment model called the Borich model, explaining that it was an effective method for assessing the training needs of a group. Training need is identified as the gap or discrepancy between 'what is' and 'what should be.' The discrepancy can identify competencies requiring professional development (Borich, 1980).

In agricultural education and extension research, needs assessment models are an accepted method for assessing training needs (Edwards & Briers, 1999; Harder & Narine, 2019; Harder & Wingenbach, 2008; Narine & Harder, 2021; Seitz et al., 2022). Competency needs assessments identify discrepancies between respondents' perceived levels of importance and proficiency for individual competency items.

Narine and Harder (2021) proposed the RDM as an alternative to the Borich model, providing a more intuitive approach to assess the training needs of a sample. Similar to the Borich model, the RDM is an appropriate method when the following

conditions exist: (a) cross-sectional data is gathered at one point in time from a sample or census of a target population, (b) data for each item is paired on two ordinal scales with an equal number of response anchors, and (c) discrepancies are being assessed between two clearly identified conditions for each item (Narine & Harder, 2021). Unlike the Borich model, the RDM does not use the means of individual competency items, and it provides a standardized discrepancy score of the competencies based on the identified conditions of equilibrium. Items that score below zero represent a more significant training gap, and items above zero represent no training gap (Narine & Harder, 2021). The RDM is an intuitive approach to understanding the severity of a training need. It allows for direct comparison and priority ranking between competencies, indicating the needs of the sample, making it a tool that organizations can use to understand the training needs of their staff and prioritize professional development that addresses these needs.

Purpose and Objectives

This study examined perceived competency training needs among international workers promoting agroforestry. The specific objectives were to:

1. Describe differences between perceived proficiency and importance of agroforestry extension competencies.
2. Prioritize agroforestry professionals' training needs based on gaps identified using the Rank Discrepancy Model (RDM).

Methods

A cross-sectional research design was used for this study. This design allowed survey data to be collected from different individuals at a single point in time (Fraenkel,

2014). Using a self-training needs assessment, the study sought to assess the perception of agroforestry extension competencies from a sample of agroforestry extension professionals in the Global South who work with smallholders.

The study population was comprised of global agroforestry extension professionals: (a) directors, (b) managers, and (b) extension field staff. A non-probability snowball sampling technique (Goodman, 1961) was used for this study. A snowball method of sampling was used to identify a hard-to-reach population that is geographically dispersed (Mack et al., 2005). The researcher invited (via email) 65 program directors and managers from organizations that work in extension or agroforestry in the Global South; this group was identified during the selection process of an agroforestry extension Delphi study. These participants invited others from their organization or network to participate. The survey was also shared on extension and agroforestry listservs and social media sites based on the suggestion of participants. Those that completed the assessment became part of the sample.

The researcher developed a 65-item split matrix instrument using the agroforestry extension knowledge, skills, and abilities (KSAs) determined by a Delphi study (Dalkey & Helmer, 1963). A four-member panel of extension and agroforestry experts reviewed the instrument to ensure content validity. The split matrix instrument had two columns; the first was for respondents to rate the perceived importance, and the second was to rate the perceived proficiency for each item. Using a 4-point ordinal scale with the following options: 1 = None, 2 = Low, 3 = Average, and 4 = High (Narine & Harder, 2021), respondents identified their perceived importance and personal proficiency in technical

and human relation KSA items. The survey concluded with five additional demographic questions to better understand participants. The survey was translated into Thai, French, and Spanish by native-speaking translators with agriculture translation experience. Another native-speaking translator checked each translation. Cronbach's alpha coefficients were not calculated because agroforestry KSA items were not considered as a set of scaled items that could be summed to measure the dimensionality of an overall concept. As such, Cronbach's alpha was unnecessary because dimensionality and/or unidimensionality were not of concern in this study (Davenport et al., 2015).

The researcher administered the questionnaire through Qualtrics via a survey link. Participants could select their preferred language (English, French, Spanish, or Thai) within the survey. The survey was open from March 1, 2022, to April 30, 2022.

The study utilized three data analysis methods: (a) descriptive statistics, (b) paired *t*-tests, and (c) an RDM. Data were analyzed using SPSS and Excel software. Descriptive statistics were used to describe the sample and explain respondents' levels of importance and proficiency on the agroforestry extension KSA items. To address objective one, a paired *t*-test was conducted for each item to determine whether there was a significant mean difference between the item's perceived importance and perceived proficiency (Choi & Park, 2022). The study's statistically significant mean difference between importance and performance on KSA items was tested at $p < 0.05$. Cohen's *d* was then calculated to determine the effect size on statistically significant items (Narine & Ali, 2020). Cohen's *d* effect size measures the magnitude of the difference between two means and identifies the practical significance. The larger the effect size, the larger the

difference between the items (i.e., larger practical significance). According to Cohen (2013), a value of $d = 0.2$ represents a small effect size, $d = 0.5$ represents a medium effect size, and $d = 0.8$ is a large effect size.

A Ranked Discrepancy Score (RDS) was calculated for each competency statement to address objective two (Narine & Harder, 2021). This analysis allows for the gaps between perceived levels of competency and perceived importance to be prioritized. The RDM has been used previously in competency research to identify training gaps (Choi & Park, 2022; Narine & Harder, 2021; Seitz et al., 2022). Narine and Harder (2021) outline three steps in the RDM. First, calculate the number of occurrences in the sample when respondents' ability ratings are: (a) less than respondents' importance ratings (Negative Ranks = NR), (b) more than respondents' importance ratings (Positive Ranks = PR), or (c) equal to respondents' importance ratings (Tied Ranks = TR). This analysis was conducted in SPSS (version 27) by running a Wilcoxon rank test between paired responses (Field, 2017). Data were then exported to Microsoft Excel. After finding the number of NR, PR, and TR occurrences for each item, the Wilcoxon ranked scores were converted into percentages. The last step was to assign relative weights (W) to NR% (WNR = -1), PR (WPR = 1), and TR (WTR = 0) and calculate the RDS for each item. The formula for calculating the RDS was as follows; RDS = NR% (-1) + PR% (1) + TR% (0). The RDS is a standardized score ranging between -100 to 100. The RDS has an equilibrium of zero, with negative scores indicating a priority need or discrepancy and positive scores indicating the absence of a need. The RDS represents the overall capacity of the sample to perform a competency (Narine & Harder, 2021), providing insight into

the training needs of this broad sample of professionals promoting agroforestry in the Global South.

Findings

The assessment was completed by 107 agroforestry professionals, with 76% being male. More than one-half of respondents had a graduate degree (55%), followed by a bachelor's degree (41%), and then a technical degree (4%). Most respondents (65%) worked for nongovernmental organizations (NGOs). Thirteen percent of respondents worked for governmental organizations, 9% for universities, and 13% listed *other* for organization type. Their work experience ranged from 0–5 years (41%), 6–10 years (23%), and 11 or more years (36%). Sixty-eight agroforestry professionals had work experience in Africa, 18 in Asia, and 12 in Latin America and the Caribbean. Nine respondents did not provide enough information to be categorized into a Global South region. These demographics are displayed in Table 4.1.

Table 4.1

Demographics of Agroforestry Extension Study Participants

Characteristic	*f*	%
Sex		
Male	81	76
Female	26	24
Education		
Technical degree	4	4
Bachelor's degree	44	41
Graduate degree	59	55
Organization		
Nongovernmental organization	69	65
Government	14	13
University	10	9
Other	14	13
Experience in agroforestry		
0–5 years	44	41
6–10 years	25	23
11 or more years	38	36
Region		
Africa	68	64
Asia	18	17
Latin America and Caribbean	12	11
Other	9	8

Objective one was to describe the differences between perceived proficiency and the importance of agroforestry extension competencies. Descriptive statistics were used to analyze the means of perceived importance and perceived proficiency. Table 4.2 reveals that the agroforestry staff perceived 13 knowledge items as important; the rest were considered of average importance. The importance level of *sustainable agricultural production systems and practices* (M = 3.8, SD = 0.42) ranked most important, followed by *trees in agroforestry systems* (M = 3.72, SD = 0.59). The panel's two least important knowledge items were *business management* (M = 3.43, SD = 0.69) and *natural*

regeneration (*M* = 3.44, *SD* = 0.66), though both are still considered of average importance.

Table 4.2

Ranked Perceived Importance of Agroforestry Extension Knowledge Items (n = 107)

Items	Type	*M* [b] (*SD*) Importance	Proficiency	*t**	*d*[c]
Sustainable agricultural production systems and practices	TK	3.80 (.42)	3.44 (.66)	5.45	0.53
Trees in agroforestry systems	TK	3.72 (.59)	3.18 (.78)	6.69	0.65
Communication	HRK	3.68 (.61)	3.34 (.68)	5.42	0.53
Drivers of agroforestry adoption by smallholders	TK	3.65 (.61)	3.07 (.81)	7.61	0.74
Costs and benefits of implementing agroforestry	TK	3.64 (.66)	3.07 (.73)	6.83	0.66
Community development practices	HRK	3.63 (.65)	3.25 (.77)	5.18	0.50
Tree nursery management	TK	3.63 (.70)	3.34 (.74)	3.92	0.38
Socioeconomic conditions and livelihoods of the local community	HRK	3.62 (.56)	3.24 (.72)	5.27	0.51
Agroforestry systems, practices, and principles	TK	3.61 (.58)	3.19 (.77)	5.60	0.54
Adult learning theory and extension methods	HRK	3.56 (.75)	3.10 (.84)	6.60	0.64
Climate change adaptation	TK	3.56 (.73)	3.14 (.75)	4.83	0.47
Local culture, history, language, and development efforts	HRK	3.51 (.67)	3.06 (.72)	6.86	0.66
Gender roles in the community	HRK	3.51 (.73)	3.19 (.74)	4.06	0.39
Land and tree tenure practices	TK	3.50 (.69)	2.83 (.82)	7.81	0.76
Nutrient cycle process in agroforestry systems	TK	3.50 (.59)	2.90 (.75)	8.53	0.83
Plant pests and diseases	TK	3.48 (.59)	2.80 (.74)	8.72	0.84
Local institutions and policies that impact agroforestry	HRK	3.48 (.69)	2.82 (.79)	8.10	0.78
Climate and weather	TK	3.47 (.66)	2.79 (.77)	9.30	0.90
Agriculture and natural resource ecology	TK	3.47 (.70)	3.12 (.76)	4.22	0.41
Indigenous agroforestry practices	TK	3.46 (.74)	3.03 (.80)	5.46	0.53
Natural regeneration	TK	3.44 (.63)	2.93 (.81)	5.52	0.53
Business management	TK	3.43 (.69)	2.71 (.71)	7.92	0.77

Note. [a]TK = Technical Knowledge, HRK = Human Relation Knowledge. [b] 1.0 = None, 2.0 = low, 3.0 = average, 4.0 = high. [c] Effect sizes were based on Cohen's *d* (small = 0.2, medium = 0.5, and large = 0.8).
*p < 0.001

Participants perceived themselves as having average proficiency in all knowledge items. The most proficient knowledge items were (a) *sustainable agricultural production systems and practices* (M = 3.44, SD = 0.66), (b) *tree nursery management* (M = 3.34, SD = 0.74), and (c) *communication* (M = 3.34, SD = 0.68). *Business management* (M = 2.71, SD = 0.71) had the least proficiency, though still considered average proficiency based on means, followed by *climate and weather* (M = 2.79, SD = 0.77). Respondents' perceived importance of knowledge items was more than their perceived proficiency of those items, indicating a training gap exists because of lesser proficiency than importance in all items. Table 4.2 is sorted by the ranked perceived importance from most to least.

To describe the differences between perceived proficiency and importance of agroforestry extension knowledge items, a paired *t*-test was conducted on each item. Table 4.2 shows a statistically significant mean difference between perceived importance and perceived proficiency across all knowledge items tested at the $p < 0.05$ level. Participants perceived proficiency in the knowledge items was significantly lower than the perceived importance. The finding signifies that respondents as a group have a training need in all the knowledge items. However, because the items were statistically significant, Cohen's d was calculated in SPSS for each item to determine the effect size of the difference between perceived importance and proficiency. The larger the effect size of an item, the larger the discrepancy between importance and proficiency, pointing to a greater training gap. Respondents' perceived importance is greater than their perceived proficiency in the top three knowledge items: (a) *climate and weather* (d = 0.90), (b) *plant pests and disease* (d = 0.84), and (c) *nutrient cycle process in*

agroforestry systems (*d* = 0.82). All three items have a large effect size pointing to the need for prioritizing training on these items for this sample, as there is practical significance between the perceived importance and proficiency.

The descriptive statistics of skill items in Table 4.3 displays that the most perceived important skill item was *active listening* (*M* = 3.80, *SD* = 0.42), followed by *oral communication* (*M* = 3.78, *SD* = 0.46) and *teaching and/or facilitation* (*M* = 3.78, *SD* = 0.46). The least perceived importance skill item was *agroforestry entrepreneurship* (*M* = 3.41, *SD* = 0.71), followed by *disease and insect prevention* (*M* = 3.45, *SD* = 0.70). Both are still considered of average importance for respondents.

Table 4.3

Ranked Perceived Importance of Agroforestry Extension Skill Items (n = 107)

		M [b](*SD*)			
Items	Type	Importance	Proficiency	*t**	*d*[c]
Active listening	HRS	3.80 (.42)	3.50 (.60)	5.01	0.48
Oral communication	HRS	3.78 (.46)	3.41 (.58)	5.68	0.55
Teaching and/or facilitation	TS	3.78 (.46)	3.51 (.63)	4.27	0.41
Problem identification, analysis, and solving	HRS	3.77 (.50)	3.36 (.66)	6.61	0.63
Soil and water conservation	TS	3.70 (.64)	3.34 (.82)	5.34	0.52
Community-based development	HRS	3.68 (.57)	3.27 (.78)	6.33	0.61
Integration of livestock, crops, and trees	TS	3.64 (.69)	3.11 (.81)	6.85	0.66
Cultural competency	HRS	3.62 (.61)	3.23 (.69)	5.93	0.57
Agroforestry design, implementation, and management	TS	3.58 (.75)	3.02 (.86)	7.02	0.68
Tree nursery management	TS	3.54 (.74)	3.17 (.83)	4.94	0.48
Agricultural management	TS	3.51 (.70)	3.10 (.71)	6.20	0.60
Making organic fertilizer	TS	3.50 (.77)	3.15 (.79)	4.50	0.44
Seed collection and processing	TS	3.49 (.73)	2.93 (.82)	7.69	0.74
Agroforestry value-added products	TS	3.46 (.70)	2.78 (.81)	7.37	0.71
Disease and insect prevention	TS	3.45 (.70)	2.77 (.76)	8.86	0.86
Assisted natural regeneration and FMNR (Farmer Managed Natural Regeneration)	TS	3.42 (.77)	2.83 (.87)	6.34	0.61
Agroforestry entrepreneurship	TS	3.41 (.71)	2.67 (.82)	9.10	0.88
Plant identification	TS	3.33 (.73)	2.81 (.80)	6.25	0.60

Note. [a]TS = Technical Skills, HRS = Human Relation Skills. [b] 1.0 = None, 2.0 = low, 3.0 = average, 4.0 = high. [c] Effect sizes were based on Cohen's *d* (small = 0.2, medium = 0.5, and large = 0.8).
*p < 0.001

Participants perceived themselves to have average proficiency or more proficiency in all the skill items. The most perceived proficiency skill items were *teaching and/or facilitation* (M = 3.51, SD = 0.63) followed by average perceived proficiency in *active listening* (M = 3.50, SD = 0.60). The least perceived proficiency skill items were *agroforestry entrepreneurship* (M = 2.67, SD = 0.82) and *disease and insect prevention* (M = 2.77, SD = 0.76). Again, the agroforestry professionals in this study's perceived importance for the items was more than their perceived proficiency, showing a gap.

Table 4.3 also shows the results of the paired *t*-tests conducted on each skill item to describe the difference between perceived proficiency and importance of agroforestry extension skill items. The paired *t*-test found a statistically significant difference between the mean perceived importance of the skill items and the participants' perceived proficiency in the items at the $p < 0.05$ level. Cohen's *d* was conducted to determine the effect size on all the items because they were statistically significant. Respondents' perceived importance compared to proficiency is greater with the skill item *agroforestry entrepreneurship* (d = 0.88) followed by *disease and insect prevention* (d = 0.86). The large effect sizes for these items' perceived importance and proficiency differences indicate a large training gap, requiring training in these areas. Respondents' effect size was the least for the item, *teaching and/or facilitation* (d = 0.41). *Teaching and/or facilitation's* medium effect size demonstrates that it is not a priority training topic for this specific sample of agroforestry professionals.

Descriptive statistics of ability items found that respondents' perceived importance ranked important for 20 items as shown in Table 4.4. The most important ability item was *be a lifelong learner* (*M* = 3.83, *SD* = 0.40), followed by *plan and accomplish multiple tasks* (*M* = 3.80, *SD* = 0.42). The least perceived importance ability item was *use digital tools for accessing information and communication* (*M* = 3.38, *SD* = 0.74). However, the item is still considered average importance by respondents.

Table 4.4

Ranked Perceived Importance of Agroforestry Extension Ability Items (n = 107)

Items	Type	*M* [b] (*SD*) Importance	Proficiency	*t*	*d*
Be a lifelong learner	HRA	3.83 (.40)	3.57 (.63)	4.73*	0.46
Plan and accomplish multiple tasks	HRA	3.80 (.42)	3.50 (.65)	5.02*	0.49
Be tolerant and open-minded	HRA	3.79 (.40)	3.55 (.57)	4.46*	0.43
Identify and diagnose problems objectively	HRA	3.79 (.45)	3.44 (.60)	6.12*	0.59
Facilitate farmer learning	HRA	3.79 (.47)	3.46 (.65)	5.69*	0.55
Build strong, trusting relationships with diverse groups of stakeholders	HRA	3.74 (.55)	3.36 (.70)	7.07*	0.68
Develop trainings	HRA	3.74 (.52)	3.36 (.71)	5.81*	0.56
Use resources efficiently	HRA	3.73 (.54)	3.46 (.63)	4.20*	0.41
Exercise emotional intelligence	HRA	3.72 (.51)	3.47 (.65)	3.87*	0.37
Display servant leadership with stakeholders	HRA	3.70 (.57)	3.43 (.61)	4.74*	0.46
Document and report successes, challenges, and lessons learned	TA	3.68 (.62)	3.09 (.83)	7.50*	0.73
Cultural sensitivities	HRA	3.67 (.61)	3.4 (.71)	4.50*	0.44
Adapt agroforestry practices based on local context and research	TA	3.65 (.61)	3.04 (.82)	8.26*	0.80
Adapt quickly to unexpected events	HRA	3.65 (.57)	3.28 (.77)	4.94*	0.48
Disciplined, detailed, and timely	HRA	3.65 (.57)	3.47 (.69)	2.65*	0.26
Reliable; follow directions and assume responsibilities	HRA	3.64 (.57)	3.44 (.69)	3.05*	0.30
Work independently	HRA	3.58 (.72)	3.50 (.73)	1.24	
Monitor and evaluate smallholder's adoption of agroforestry	TA	3.57 (.67)	3.07 (.81)	6.56*	0.63
Identify markets for agroforestry products	TA	3.56 (.76)	2.58 (.83)	10.67*	1.03
Facilitate the development of participatory action plans	HRA	3.55 (.73)	3.21 (.77)	4.75*	0.46
Identify community champions and local expertise	HRA	3.50 (.74)	3.09 (.81)	5.86*	0.57
Promote transdisciplinary collaboration	HRA	3.50 (.67)	3.09 (.78)	5.54*	0.54
Advocate for the adoption of agroforestry amongst critics	HRA	3.49 (.80)	3.02 (.86)	5.35*	0.52
Use tools safely	TA	3.49 (.74)	3.21 (.69)	3.53*	0.34
Use digital tools for accessing information and communication	TA	3.38 (.74)	2.86 (.80)	5.92*	0.57

Note. [a]TA = Technical Ability, HRA = Human Relation Ability. [b] 1.0 = None, 2.0 = low, 3.0 = average, 4.0 = high. [c] Effect sizes were based on Cohen's *d* (small = 0.2, medium = 0.5, and large = 0.8). *p < 0.001

Participants perceived themselves as having moderate to highly proficient levels in the ability items. The most perceived proficiency ability item was *be a lifelong learner* (*M* = 3.57, *SD* = 0.63), followed by *be tolerant and open-minded* (*M* = 3.55, *SD* = 0.57).

The least perceived proficiency ability item was *use digital tools for accessing information and communication* (M = 2.86, SD = 0.80), an average proficiency level for respondents.

Table 4.4 shows paired *t*-tests ($p < 0.05$) performed on each ability item to describe the difference between perceived proficiency and importance of agroforestry extension ability items. A statistically significant mean difference was observed between perceived importance and participants' perceived proficiency in all ability items except *work independently* (p = 0.219).

A Cohen's *d* was conducted on the statistically significant ability items. The ability item, *identify markets for agroforestry products,* had a large Cohen's *d* score of 1.02, representing a large effect size between perceived importance and proficiency, bringing attention to a noticeable training gap. The next item based on Cohen's d score was *adapt agroforestry practices based on local context and research* (d = 0.80), which also had a noticeable training gap.

For the second objective, RDM was used to prioritize agroforestry professionals' training needs based on the level of discrepancy between perceived importance and perceived proficiency. This method provides the severity of a need and allows for direct comparison and ranking between items (Seitz et al., 2022). Table 4.5 lists unweighted rank responses and RDS for each knowledge item surveyed. The RDS is a standardized score ranging between -100 to 100, with zero equilibrium. The lower the negative number, the greater the training need. Based on the RDS, there is a performance gap in all the knowledge items, meaning the sample population needs training in all knowledge

items. The three top discrepancies in the technical knowledge items were (a) *business management* (RDS = -54), (b) *plant pests and disease* (RDS = -54), and (c) *climate and weather* (RDS = -53), indicating the items requiring the most important training needed for this group of respondents. The least priority items are *tree nursery management* (RDS = -26) and *gender roles in the community* (RDS = -23).

Table 4.5

Ranks/Ranked Discrepancy Scores for Agroforestry Extension Knowledge Items (n = 107)

		Ranks (%)			
Item	Type	NR	PR	TR	RDS
Business management	TK	64	9	27	-54
Plant pests and diseases	TK	61	7	33	-54
Climate and weather	TK	55	2	43	-53
Nutrient cycle process in agroforestry systems	TK	54	4	42	-50
Land and tree tenure practices	TK	54	6	40	-49
Local institutions & policies that impact agroforestry	HRK	50	3	47	-48
Drivers of agroforestry adoption by smallholders	TK	49	4	48	-45
Costs and benefits of implementing agroforestry	TK	54	10	36	-44
Trees in agroforestry systems	TK	50	7	44	-43
Local culture, history, language, and development efforts	HRK	41	3	56	-38
Adult learning theory and extension methods	HRK	42	5	53	-37
Indigenous agroforestry practices	TK	42	7	51	-36
Natural regeneration	TK	47	11	42	-36
Agroforestry systems, practices, and principles	TK	40	6	54	-35
Climate change adaptation	TK	39	7	53	-32
Socioeconomic conditions and livelihoods of the local community	HRK	36	6	58	-31
Community development practices	HRK	37	7	56	-31
Sustainable agricultural production systems and practices	TK	36	6	59	-30
Communication	HRK	36	6	59	-30
Agroforestry and natural resource ecology	TK	39	11	50	-28
Tree nursery management	TK	36	9	55	-26
Gender roles in the community	HRK	36	12	51	-24

Note. TK = Technical Knowledge, HRK = Human Relation Knowledge, RDS = Ranked Discrepancy Score.

Table 4.6 shows unweighted rank responses and RDS for each technical and human relation skill item. The scores signify a training gap in all the skill items. The top two priority technical skill items requiring training are *agroforestry entrepreneurship*

(RDS = -55) and *disease and insect prevention* (RDS = -54). The two least-rated items are *active listening* (RDS = -25) and *teaching and/or facilitation* (RDS = -23).

Table 4.6

Ranks/Ranked Discrepancy Scores for Agroforestry Extension Skill Items (n = 107)

		Ranks (%)			
Item	Type	NR	PR	TR	RDS
Agroforestry entrepreneurship	TS	58	3	39	-55
Disease and insect prevention	TS	57	3	40	-54
Agroforestry value-added products	TS	56	8	36	-48
Seed collection and processing	TS	50	5	45	-46
Agroforestry design, implementation, and management	TS	47	5	49	-42
Plant identification	TS	50	8	41	-42
Integration of livestock, crops, and trees	TS	50	8	41	-42
Assisted natural regeneration and FMNR	TS	50	8	41	-42
Agricultural management	TS	40	4	56	-36
Problem identification, analysis, and solving	HRS	40	4	56	-36
Community-based development	HRS	40	5	55	-36
Oral communication	HRS	42	7	51	-36
Cultural competency	HRS	39	6	55	-34
Soil and water conservation	TS	36	6	59	-30
Tree nursery management	TS	36	8	55	-28
Making organic fertilizer	TS	36	9	54	-27
Active listening	HRS	29	4	67	-25
Teaching and/or facilitation	HRS	31	7	62	-23

Note. TS = Technical Skill, Human Relation Skills, RDS = Ranked Discrepancy Score.

Table 4.7 lists unweighted rank responses and RDS for each ability item. The top priority item was *identifying markets for agroforestry products* (RDS = -62). The least priority item was *work independently* (RDS = -7). This finding demonstrates the need for training in *identifying markets for agroforestry products*. However, there is little need for training in the item *work independently* for those that participated in the need assessment.

Table 4.7
Ranks/Ranked Discrepancy Scores for Agroforestry Extension Ability Items (n = 107)

		Ranks (%)			
Item	Type	NR	PR	TR	RDS
Identify markets for agroforestry products	TA	66	4	30	-63
Adapt agroforestry practices based on local context and research	TA	50	2	49	-48
Document and report successes, challenges, and lessons learned	TA	51	4	45	-48
M&E smallholder's adoption of agroforestry	TA	44	4	52	-40
Use digital tools for accessing information and communication	TA	47	11	42	-36
Build strong, trusting relationships with diverse groups of stakeholders	HRA	36	1	63	-36
Identify community champions and local expertise	HRA	37	3	60	-35
Promote transdisciplinary collaboration	HRA	41	7	52	-35
Advocate for the adoption of agroforestry among critics	HRA	42	9	49	-33
Develop trainings	HRA	38	6	56	-33
Identify and diagnose problems objectively	HRA	33	2	65	-31
Facilitate farmer learning	HRA	33	3	64	-30
Adapt quickly to unexpected events	HRA	35	7	58	-27
Facilitate the development of participatory action plans	HRA	36	8	56	-27
Use resources efficiently	HRA	33	7	60	-25
Use tools safely	TA	37	12	50	-25
Display servant leadership with stakeholders	HRA	30	5	65	-25
Plan and accomplish multiple tasks	HRA	27	3	70	-24
Cultural sensitivities	HRA	28	5	67	-23
Be a lifelong learner	HRA	26	3	71	-23
Be tolerant and open-minded	HRA	24	3	73	-21
Exercise emotional intelligence	HRA	30	8	62	-21
Reliable; follow directions and assume responsibilities	HRA	24	7	69	-18
Disciplined, detailed, and timely	HRA	26	9	64	-17
Work independently	HRA	19	12	69	-7

Note. TA = Technical Ability, HRA = Human Relation Ability, RDS = Ranked Discrepancy Score.

Two subject areas emerged as priority training for this group of respondents. All agribusiness KSA items and the pest and disease knowledge and skill items had top ranking RDS. Respondents had an elevated RDS in all the agribusiness KSA items (-63 to -48) relative to the other items. Participants only rated one item as important (*identify markets for agroforestry products*), while the other items rated as average. However, the effect size between proficiency and importance ranged from $d = 0.71$ to $d = 1.03$ for all the agribusiness items, showing an above medium to large effect size. The *pest and disease* knowledge item had an RDS of -54, and the *disease and insect prevention* had an RDS of -48. Again, items had average importance to participants but had a large effect size, highlighting a large training discrepancy.

Conclusions, Discussion, and Recommendations

The study aimed to examine participants' perceived importance and proficiency of agroforestry extension competencies and prioritize training needs. The overall findings found training discrepancies in all technical and human relation agroforestry KSA items.

The RDM provides an intuitive method to prioritize training needs of groups. Though the RDM scores of this study are limited to this specific sample, the study shows how organizations with staff promoting agroforestry globally could use this needs assessment. Organizations that use the RDM to assess agroforestry extension competencies are strongly recommended to use technical and human relations KSAs. Based on findings, organizations can prioritize a mix of the technical and human relations KSA training needs to base professional development, ensuring staff has both technical and social competencies (McClelland, 1973).

This study's findings prioritized the training needs of the respondent group in areas related to agribusiness and pests and diseases. Plieninger et al. (2020) stated that for agroforestry to be viable, market and business development must be supported. Agroforestry extension can play an active role in this. Amare and Darr (2020) discussed how extension services have been shown to increase agroforestry adoption through training farmers in business development skills. Also, organizations developing value-added agroforestry goods and services can increase farmers' income while having ecosystem benefits (Muthee et al., 2022) when extension services link farmers to markets (Ros-Tonen et al., 2019; Russell & Franzel, 2004). However, as this needs assessment found, and Muthee et al. (2022) discussed, there is often a need for more expertise in agroforestry organizations related to agribusiness topics. Agroforestry professionals often work with a wide range of trees and agricultural crops (van Noordwijk et al., 2019), with farmers with access to various markets and entrepreneurial possibilities, making it dynamic and innovative (Gumucio et al., 2018). Extensionists with KSAs that can be adapted to specific farmers' needs should be considered. Though there are opportunities for organizations to provide agroforestry business-related training and services through competent staff, care should be taken not to focus on initiatives that bypass the smallholder (Ros-Tonen et al., 2019; Russell & Franzel, 2004) and lead away from the broader socioeconomic and biophysical benefits agroforestry can provide if done using agroecological principles (Ollinaho & Kröger, 2021).

The research found training needs in the knowledge and skill items related to pests and disease. One benefit touted by agroforestry advocates has been its role in

decreasing pest and disease issues often associated with monoculture crops (Cerda et al., 2020; Lasco et al., 2014). Agroforestry's species diversity is the leading reason for its ability to control pests and diseases (Lasco et al., 2014). However, complex agroforestry systems requiring knowledge of multiple trees and agricultural crops make agroforestry knowledge-intensive for researchers, extension workers, and farmers when pests and diseases are an issue (Schroth et al., 2000). Because of the complexity of agroforestry, extensionists should have general knowledge and skills related to pest and disease management that draws from local and outside sources (Gassner & Dobie, 2022). Previous research has suggested implementing a central database of pests and diseases associated with agroforestry systems (Schroth et al., 2000). A database would allow organizations to develop appropriate training materials for field staff and farmers on specific pest and disease issues they face. Even without access to a central database, organizations should inventory the pest and disease issues related to agroforestry systems.

Interestingly, respondents did not have as large a training gap in *gender roles in the community* as other knowledge items. This finding is surprising because previous research has shown that female farmers face more significant challenges to agroforestry knowledge acquisition than male farmers, even in the presence of extension services (Duffy et al., 2021; Kiptot & Franzel, 2012), demonstrating that agroforestry extension can be ineffective in reaching females farmers. Martini et al. (2017) found this to be the case in their research, where female farmers were less receptive to information presented by male extension workers. Duffy et al. (2021) also discuss that female farmers often have increased social and economic barriers that limit their knowledge acquisition

compared to male farmers. It is important for organizations promoting agroforestry to understand intrahousehold decision-making (Crossland et al., 2021; Sanou et al., 2017) and for extension services to be developed based on this analysis (Suvedi, 2019). This knowledge item should be investigated more, as the findings from this study are different from the literature.

This study had some limitations, such as a snowball sample and restricted generalizations about the international agroforestry extension population's specific training needs. The sample was also not representative of the Global South, with more respondents with experience in Africa and few from Latin America/Caribbean and Asia. There was also a greater proportion of NGO professionals that responded.

Future studies should target agroforestry extension efforts in specific regions of the Global South (such as coffee production in Latin America or home gardens in Southeast Asia). The RDM also provides a chance to identify training needs of extension staff at distinct experience levels, allowing organizations to target training.

Organizations promoting agroforestry should use needs assessments for their staff to prioritize training needs. Prioritized training needs will allow the institution to provide targeted training to their staff and use their resources and time more effectively.

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CHAPTER V

SUMMARY IMPLICATIONS, AND RECOMMENDATIONS

Chapter V summarizes the three individual but related studies, providing implications, and recommendations for future research and practice.

Summary

This research investigates the competencies (knowledge, skills, and abilities) required by extension workers who promote agroforestry to smallholders in the Global South. The first study determines the knowledge, skills, and abilities (KSAs) required of extension workers promoting agroforestry in the Global South. The following two studies demonstrate the KSA's potential in agroforestry extension, with all three providing insight into global agroforestry extension competencies.

Summary of Chapter II: Journal Manuscript 1

Chapter II describes the process and findings of research conducted to determine the competencies extension workers need to promote agroforestry to smallholders in the Global South. The research was comprised of three objectives:

RO_1: Identify KSA items agroforestry extension workers should obtain.

RO_2: Develop consensus on the KSA items that agroforestry extension workers need.

RO_3: Determine the importance of the knowledge, skill, and ability items agroforestry extension workers need to promote agroforestry to smallholders in the Global South.

A three-round modified Delphi method was used to determine the important KSAs among a panel of 26 agroforestry experts. The panel agreed on the importance of 22 knowledge items, 18 skill items, and 25 ability items to promote agroforestry to

smallholders in the Global South. The KSAs were a combination of technical and human relations items. These KSA items were utilized and studied further in the following dissertation studies.

Summary of Chapter III: Journal Manuscript 2

In Chapter III, the study aimed to develop and validate a competency model for the agroforestry extension workers of the NGO Plant with Purpose (PWP). There were three specific objectives:

> **RO$_1$**: Identify the core competencies required of PWP agroforestry extension staff.
>
> **RO$_2$**: Generate key actions for each core competency.
>
> **RO$_3$**: Construct a competency model that reflects the organization by including the identified core competencies, their definitions, and the competency key actions.

The study in Chapter III used the borrowed-and-tailored method of competency modeling. The tailoring used in the competency modeling was conducted by holding ten focus group meetings with PWP staff. This approach used the agroforestry extension KSAs determined by the Delphi panel, as discussed in Chapter II. The PWP leadership team determined thirty-two KSA items as high priority based on their organizational priorities and agroforestry strategy. The PWP agroforestry extension KSA items were categorized into the following seven core competencies: (a) trees, (b) agriculture, (c) agroforestry, (d) culture, (e) teaching and facilitation, (f) communication, and (g) teamwork and leadership. Key actions and definitions were developed for all the items based on the focus group findings and member feedback.

Summary of Chapter IV: Journal Manuscript 3

Chapter IV examined perceived competency training needs among international workers promoting agroforestry. There were two specific objectives for this study:

> **RO$_1$**: Describe the differences between perceived proficiency and the importance of agroforestry extension competencies.
>
> **RO$_2$**: Prioritize agroforestry professionals' training needs based on gaps identified using the Rank Discrepancy Model (RDM).

Using a non-probability snowball sample, 107 global agroforestry extension professionals responded to a split matrix instrument rating their perceived importance and proficiency for each agroforestry extension KSA item identified in the Delphi study discussed in Chapter II. The data were analyzed using descriptive statistics, a t-paired test, and a Ranked Discrepancy Score (RDS). The KSA items were prioritized in their KSA categories. Agribusiness and pest and disease management topics had the most significant training needs, but it was found that the respondents had training gaps in all the KSA items.

Implications

Implications of Chapter II: Journal Manuscript 1

The first study was driven by the need to understand the competencies required of extension workers promoting agroforestry in the Global South to smallholders. The Delphi study identified an extensive list of technical and human relation competencies required of extension workers promoting agroforestry.

The Delphi study validates previous research that recognized that agroforestry extensionists must have subject matter expertise in both forestry and agriculture but must

not rely solely on one or the other (Plieninger et al., 2020; Jacobi et al., 2017; Tolentino et al., 2010). There is a need for technical competencies in agriculture and forestry, with agroforestry education programs and training drawing from these fields of study. However, extension workers must have knowledge and skills in the complexity of integrating trees with crops and/or livestock, which stand-alone agriculture and forestry educational programs do not address.

Increasingly, agroforestry is promoted globally as a climate mitigation strategy (Bezner Kerr et al., 2022; Lasco et al., 2014; Reppin et al., 2020). The expert panel did not consider the proposed climate change mitigation knowledge item essential for extension workers. Previous research has shown that smallholders are not driven to adopt agroforestry because of climate mitigation potential (Mbow et al., 2014), so this may be why the panel did not prioritize it. This finding is an example that organizations' factors for promoting an innovation may often differ from why farmers adopt it.

Program management skills such as *project planning, management, and evaluation*, and *human resource management*, along with the ability items *monitor and evaluate smallholder's adoption of agroforestry,* and *use resources efficiently*, did not reach a consensus in this study. The lack of consensus on program management-related skills contradicts the core competencies from Ghimire et al.'s (2017) research on governmental extension workers in Nepal. The lack of consensus on program management KSAs may be because the panel did not prioritize these skills and abilities for extension workers promoting agroforestry directly to smallholders. Still, the results may have been different if the research was not explicitly focused on extension workers

who directly promote agroforestry to smallholders, excluding program managers and administrators.

Finally, the Delphi study draws attention to the need for agroforestry extension workers to have the capacity in human relation domains such as cultural competencies. Cultural competencies provide agroforestry extension workers the aptitude to understand and engage with communities and individual farmers. This engagement is essential because, throughout agroforestry literature, integrating local knowledge and scientific knowledge into agroforestry design and implementation is vital for adoption (Bettles et al., 2021; Nair et al., 2017). An extension worker competent in cultural competencies is better positioned within the community to learn the local practices of the community.

Implications of Chapter III: Journal Manuscript 2

The second study described the findings and process for developing an organizational competency model for PWP agroforestry extension staff. The competency model describes the core competencies, their definitions, and key actions prioritized by PWP.

As the Delphi study found, PWP staff identified the need for their extension workers to have subject matter expertise in the domains of trees, agriculture, and agroforestry. This subject matter expertise includes knowledge and skills related to forestry and agriculture but also provides knowledge and skills specific to agroforestry. The findings from this study and similar studies (Bettles et al., 2021; Tolentino et al., 2010) suggest that organizations that promote agroforestry need extensionists with knowledge of agriculture who are willing to learn about local agricultural practices from

farmers. The specific agriculture skills required of extension workers will be based on farmers' needs and organizational interventions. The PWP competency model also highlights the need for extension workers to understand how trees are used in farmer's agroforestry systems. This knowledge of trees includes knowledge of seedlings, natural regeneration, and an understanding of tree species farmers' desire.

Like the Delphi study, the focus groups prioritized the need for agroforestry extension workers to understand the community's local context of where they work. The organization wanted extension workers well-versed in local conditions, able to elicit information from other knowledge holders, receptive to local views, and able to facilitate information sharing between stakeholders. Understanding the local context requires that extension workers have both technical and human relation KSAs that allow them to engage with the community thoughtfully, showing respect for the local community but addressing challenges. Jacobi et al. (2017) discussed how collaborative learning among stakeholders is built on respect, equity, and empowerment, forming the basis for identifying barriers and developing solutions. The PWP staff, both in headquarters and the field, emphasized the need for the extension workers to develop constructive, strong, and collaborative relationships with their coworkers and the local community, making the community's problems their problems.

Related to this idea of building a relationship with the community and understanding the local context, the focus group participants continuously highlighted the importance of having extension staff that can speak the native language of the farmers. The groups discussed the importance and the challenge of having competent staff in

agroforestry who can speak the languages spoken in one country. This challenge is also a resource issue for PWP as it is costly to have the required staff speak all the languages; in some cases, they must rely on translation to train farmers. To address this issue, PWP has used local farmers to be agroforestry trainers, making it vital that PWP identify the agroforestry competencies that the farmers need and have a system in place to train farmers as local agroforestry extension workers. The organization has also emphasized trying to ensure training materials are in the native language of the farmers.

The senior leadership of PWP did not prioritize KSAs in business management, agroforestry entrepreneurship, or identifying markets for their extension staff. Agribusiness-related items also were not discussed in the conversation with the field staff and country directors. However, many NGOs prioritize agribusiness in agroforestry (Bettles et al., 2021; Montagnini, 2017). NGOs prioritizing agroforestry extension to help smallholders overcome economic barriers found increased adoption (Amare & Darr, 2020). Though this organization did not prioritize training for their extension workers in agribusiness-related competencies, it may be a priority in other situations, as found in the research discussed in Chapter IV.

Implications of Chapter IV: Journal Manuscript 3

The third study aimed to examine agroforestry professionals' differences between the importance of agroforestry extension competencies and levels of perceived proficiency, prioritizing training needs among respondents using their RDM score. The overall findings show that the group had training discrepancies in all the technical and human relation agroforestry KSA items.

This study's findings prioritized the training needs of the respondent group in the areas of agribusiness. A snowball sample was used, so generalizations cannot be made. However, it is worth exploring more, as research has discussed how markets and business development must be supported to make agroforestry viable. Extension services in these areas are essential for increased adoption (Amare & Darr, 2020; Ros-Tonen et al., 2019; Russell & Franzel, 2004). There is a concern in the literature (Ollinaho & Kröger, 2021) and found in the focus group research that focusing solely on agroforestry economics can direct people and the practices of agroforestry away from the socioeconomic and biophysical benefits of agroforestry if care is not taken.

Also, the research identified that the group needed training in pests and disease knowledge and skill items. This finding was interesting as advocates often tout agroforestry's role in decreasing pest and disease issues associated with monoculture crops (Cerda et al., 2020; Lasco et al., 2014), with agroforestry's species diversity is the leading reason for its ability to control pests and diseases (Lasco et al., 2014). However, this finding is a reminder that agroforestry is complex, requiring knowledge of multiple trees and agricultural crops, making it knowledge-intensive for researchers, extension workers, and farmers when pests and diseases are an issue (Schroth et al., 2000). Because of the complexity of agroforestry, extensionists should have local and outside knowledge and skills related to pest and disease management that can help solve problems that arise in communities (Gassner & Dobie, 2022).

As discussed previously, a snowball sample was used, so a generalization cannot be made about the international agroforestry extension population's specific training

needs. However, this study provided some insight into the overall agroforestry extension KSAs. This research found that respondents perceived all the KSA items as important to average importance. The agreement of importance from both this study and the Delphi study demonstrates that the KSA items have relevance in international agroforestry extension and should continue to be explored.

Finally, organizations promoting agroforestry should use needs assessments for their staff to prioritize training needs. Prioritized training needs will allow the institution to provide targeted training to their staff and use their resources and time more effectively.

Recommendations for Future Research

There has been limited research specific to competencies in agroforestry extension in the Global South; this provides a wide range of future research opportunities in this field of study. A future study should consider using a random sample of international agroforestry extension professionals to validate the agroforestry extension KSA items. Also, with a random and larger sample size, future research could address whether training needs vary based on the extension workers' demographics, exploring prioritized competencies based on years of experience, role within the organization, or regional location. For example, do extension workers with more experience need more competency in specific competencies and less in others? Addressing this question would allow for competency needs to be based on extension workers' years of experience. Also, competencies have the potential to be prioritized differently or even change as

agroforestry evolves as a field of study. So, revisiting the overall KSAs will be an important research opportunity in the future.

Furthermore, there are opportunities for continued applied research within agroforestry organizations. Agroforestry extension competency models and needs assessments must be tailored and implemented at the organizational level, providing researchers with opportunities to conduct applied research.

Agroforestry is a growing practice both in the Global South and Global North. It is recommended that similar research be conducted on agroforestry extensionists in North America to see how the results compare to this study, identifying if the competencies are similar or vary.

Finally, the studies considered agroforestry professionals' perspectives because they work directly with smallholders in the Global South. Further research should be done from the smallholders' perspective concerning their perception of high-performing agroforestry extension workers. Smallholders might have a different opinion on the competencies identified in this study or how they prioritize the agroforestry competencies.

Recommendations for Practice

These three studies provide a range of recommendations for the agroforestry extension field of practice. These studies provide insight into governmental, non-governmental, and tertiary educational institutions that want to incorporate staff competencies into their agroforestry extension programs for smallholders in the Global South. The identified agroforestry extension workers' KSA items provide a starting point

for organizations interested in building agroforestry extension staff capacity. The studies conducted for this research show how the agroforestry extension KSAs can be utilized to develop organizational competency models and conduct staff needs assessments.

The KSA items should be used to develop organizational agroforestry extension competency models based on organizational goals (Harder et al., 2010). As mentioned earlier in recommendations for research, the competency model may also need to be reconsidered over time as the community needs and/or organization's work changes, requiring new programming and updated staff competencies. Developing a competency model is not the end goal for an organization. One specific way the model can be used is to create a checklist to evaluate agroforestry extension candidates' applications and interviews or to conduct staff performance reviews. The competence model can also be used to conduct training needs assessments.

Organizations can use need assessments for their staff to prioritize training needs. Prioritized training for specific identified needs will allow the institution to provide targeted training to their staff and use their resources and time more effectively. The RDM provides an intuitive method to prioritize the training needs of groups. Organizations that use the RDM to assess agroforestry extension competencies are strongly recommended to use technical and human relations KSAs to prioritize a mix of the technical and human relations KSA training needs. However, the work should not stop there; once the competencies are identified, and competency gaps are detected, organizations must aid staff in acquiring staff development in the required competencies to strengthen the extension services provided.

Finally, organizations promoting agroforestry must realize that agroforestry is a distinct field of study and not rely on staff that only focuses on forestry or agricultural knowledge and skills but has the knowledge and skills that bridge forestry and agriculture while drawing on specific agroforestry and socioeconomic knowledge, skills, and abilities.

The study findings have relevance in international agroforestry extension. This study provides a deeper understanding of what knowledge, skills, and abilities are required of agroforestry extensionists. However, as it is a young and complex field of study, the competencies will continue to be re-evaluated over time and adapted to specific organizational needs.

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APPENDICES

APPENDIX A

TEXAS TECH UNIVERSITY IRB APPROVAL

TEXAS TECH UNIVERSITY
Human Research Protection Program

Sep 27, 2021 1:48:59 PM CDT

Amy Boren Alpizar
Ag Education and Communication

Re: IRB2021-713 Competencies of Extension Workers Promoting Agroforestry to Smallholders in the Global South

Findings: *This project involves the use of surveys, focus groups, and interviews with subjects representing professionals within a particular field of expertise. The protocol gives no suggestion of concern for coercion and the investigators have made proper assurances regarding recruitment, obtaining informed consent, the protection of participant privacy, and appropriate safekeeping of identifiable data.*

Good luck with the study!

Dear Dr. Amy Boren Alpizar, Brian Flanagan:

A Texas Tech University IRB reviewer has approved the proposal referenced above within the limited review category of: Category 2.(iii). Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) if at least one of the following criteria is met:
The information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subjects, and an IRB conducts a limited IRB review to make the determination required by §46.111(a)(7).

The determination was made on September 27, 2021. Annual review is not required, and no expiration date will be listed on your letter.

The research must follow Texas Tech University's Operating Procedures, the Belmont Report, and 45 CFR 46. If changes to the approved protocol occur, a **Modification Submission** must be reviewed and approved by the IRB before implementation. Please be aware that changes to the research protocol may prevent the research from qualifying for exempt review and require submission of a new IRB application or other materials to the Texas Tech University IRB.

A goal of the IRB is to prevent negative occurrences during any research study. However, despite our best intent, unforeseen circumstances or events may arise during the research. If a deviation, unanticipated problem or adverse event happens during your research, please notify the Texas Tech University, Human Research Protection Program as soon as possible (45 CFR 46). We will ask for a complete explanation of the event and for you to submit an **Incident Submission** in Cayuse IRB.

Your study may be selected for a Post-Approval Monitoring (PAM). You will be notified if your study has been chosen for a PAM. A PAM investigator may request to observe your data collection procedures, including the consent process.

Once your research is complete and no identifiable data remains, please use a **Closure Submission** to archive this study. IRBs that remain active are subject to audit by the IRB.
Sincerely,

Martin Binks, Ph.D.
Chair, Texas Tech University Institutional Review Board

APPENDIX B

TEXAS TECH UNIVERSITY IRB MODIFICATION

TEXAS TECH UNIVERSITY
Human Research Protection Program

Feb 1, 2022 11:12:06 AM CST

Amy Boren Alpizar
Ag Education and Communication

Re: IRB2021-713 Competencies of Extension Workers Promoting Agroforestry to Smallholders in the Global South

Findings:
The modification is approved.

Dear Dr. Amy Boren Alpizar, Brian Flanagan:

A Texas Tech University IRB reviewer has approved your proposed modification to the protocol referenced above within the limited review category of:
Category 2.(iii). Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) if at least one of the following criteria is met:
The information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subjects, and an IRB conducts a limited IRB review to make the determination required by §46.111(a)(7).

The modification approval date is effective as of February 1, 2022. Annual review is not required, and no expiration date will be listed on your letter.

The research must follow Texas Tech University's Operating Procedures, the Belmont Report, and 45 CFR 46. If changes to the approved protocol occur, a **Modification Submission** must be reviewed and approved by the IRB before implementation.

A goal of the IRB is to prevent negative occurrences during any research study. However, despite our best intent, unforeseen circumstances or events may arise during the research. If a deviation, unanticipated problem or adverse event happens during your research, please notify the Texas Tech University, Human Research Protection Program as soon as possible (45 CFR 46). We will ask for a complete explanation of the event and for you to submit an **Incident Submission** in Cayuse IRB.

Your study may be selected for a Post-Approval Monitoring (PAM). You will be notified if your study has been chosen for a PAM. A PAM investigator may request to observe your data collection procedures, including the consent process.

Once your research is complete and no identifiable data remains, please use a **Closure Submission** to archive this study. IRBs that remain active are subject to audit by the IRB.
Sincerely,

Martin Binks, Ph.D.
Chair, Texas Tech University Institutional Review Board
Director, Nutrition & Metabolic Health Initiative (NMHI)
Professor, Department of Nutritional Sciences, College of Human Sciences

APPENDIX C

TEXAS A&M UNIVERSITY IRB EXEMPTION

DIVISION OF RESEARCH

Exemption Determination
(Common Rule – Effective January 2018)

September 29, 2021

Title: Competencies of Extension Workers Promoting Agroforestry to Smallholders in the Global South
Investigator: Gary Wingenbach
IRB: IRB2021-1226M
Submission Type: Initial Review Submission Form
Funding: N/A
Reference Number: 130609

Dear Gary Wingenbach:

The HRPP determined on September 29, 2021 that this research meets the criteria for Exemption in accordance with 45 CFR 46.104.

This determination applies only to the activities described in this IRB submission and does not apply should any changes be made. Please use the reviewed, stamped study documents (available in iRIS and outlined below in the Appendix) for applicable study procedures (e.g. recruitment, consent, data collection, etc…). If changes are needed to stamped study documents or study procedures, you must immediately contact the IRB. You may be required to submit a new request to the IRB.

Your exemption is good for three (3) years from the Approval Start Date (09/29/2021). Thirty days prior to that time, you will be sent an Administrative Check-In Notice to provide an update on the status of your study.

Of note, since this work qualifies for an exempt category of human subjects research (Exemption Category 2), no IRB reliance agreement is needed. Since the overall approval lies with TTU IRB, all recruitment, consent documents and procedures, and data collection and analysis should be conducted under TTU IRB's approval. If changes are made to the study, please submit them to TAMU IRB via an IRB Amendment after TTU IRB has reviewed and approved them.

APPENDIX D

TEXAS A&M UNIVERSITY IRB MODIFICATION

DIVISION OF RESEARCH

Exemption Determination
(Common Rule – Effective January 2018)

February 08, 2022

Title: Competencies of Extension Workers Promoting Agroforestry to Smallholders in the Global South
Investigator: Gary Wingenbach
IRB: IRB2021-1226M
Submission Type: Submission Response for IRB Amendment
Funding: N/A
Reference Number: 137592

Dear Gary Wingenbach:

The HRPP determined on February 08, 2022 that this research continues to meet the criteria for Exemption in accordance with 45 CFR 46.104.

This determination applies only to the activities described in this IRB submission and does not apply should any changes be made. Please use the reviewed, stamped study documents (available in iRIS and outlined below in the Appendix) for applicable study procedures (e.g. recruitment, consent, data collection, etc…). If changes are needed to stamped study documents or study procedures, you must immediately contact the IRB. You may be required to submit a new request to the IRB.

Your exemption is good for three (3) years from the Approval Start Date (09/29/2021). Thirty days prior to that time, you will be sent an Administrative Check-In Notice to provide an update on the status of your study.

Of note, since this work qualifies for an exempt category of human subjects research (Exemption Category 2), no IRB reliance agreement is needed. Since the overall approval lies with TTU IRB, all recruitment, consent documents and procedures, and data collection and analysis should be conducted under TTU IRB's approval. If changes are made to the study, please submit them to TAMU IRB via an IRB Amendment after TTU IRB has reviewed and approved them.

If you have any questions, please contact the IRB Administrative Office at 1-979-458-4067, toll free at 1-855-795-8636.

APPENDIX E

CONSENT AND INFORMATION FORM

Delphi Study Round One Survey

Title: Competencies of Extension Workers Promoting Agroforestry to Smallholders in the Global South

What knowledge, skills, and abilities (KSA) do extension workers need in promoting agroforestry to smallholders in the Global South? Your experience as an active and effective contributor to agroforestry qualifies you as an expert in identifying the KSA for extension workers promoting agroforestry. This study concerns identifying agroforestry extension workers' competencies to build competency models that direct training needs of extension workers in the Global South.

This study uses the Delphi technique, consisting of 3 rounds of expert input from a panel of ~15 members such as yourself. All rounds will be completed online and at your own pace within a given period (two weeks for each round). In **Round 1**, panel members are asked to describe the top 10 knowledge, skills, and abilities needed by extension workers in the Global South. Round 1 may take about 10-15 minutes to complete. Round 2 requests panelists' ratings of importance for each KSA identified in Round 1; it should take about 10-15 minutes to complete. Round 3 requests panelists' agreement with the KSAs prioritized in Round 2, which may take another 10-15 minutes to complete.

Your participation in this study is voluntary. You can leave the study at any time. There are no sensitive questions that should cause discomfort. However, you can skip any question you do not wish to answer or exit the survey at any point.

All responses identifying you as a participant will be kept confidential. All identifiable information will be collected using the online program (Qualtrics) and stored in encrypted files on external flash drives, being only accessible by the research team. You may view the survey host's confidentiality policy at: Data Protection & Privacy (qualtrics.com). Compliance offices at Texas Tech University may be given access to the study files upon request. Your information will be kept confidential to the extent allowed by law. The results of the research study may be published as group data only.

If you have questions about your rights as a research participant, contact the Human Research Protection Program, Office of Research & Innovation, Texas Tech University, Lubbock, Texas 79409. You can contact them at 806-742-2064 or hrpp@ttu.edu. Also, if you have any questions about the specifics of the study, please email me, Brian Flanagan at either bkf26@tamu.edu or brian.flanagan@ttu.edu.

If you want a copy of this information form for your records, you can print it from the screen.

If you want to participate, click "I consent" to enter the survey. If you do not want to participate, click "I do not consent" to exit.

- ○ I consent, begin the study
- ○ I do not consent, I do not wish to participate

Skip To: End of Survey If Competencies of Extension Workers Promoting Agroforestry to Smallholders in the Global South Cons... = I do not consent, I do not wish to participate

Instructions:
This is Round 1 of a modified Delphi study. Please answer these questions in the following pages.

1. What are the top 10 **knowledge** items that extension workers in the Global South need to effectively promote agroforestry to smallholders?
2. What are the top 10 **skills** that extension workers in the Global South need to effectively promote agroforestry to smallholders?
3. What are the top 10 **abilities** that extension workers in the Global South need to effectively promote agroforestry to smallholders?

Space is provided to enter detailed responses for each question. You can complete as many as you wish in one sitting or return to the survey at a later time. Please be detailed in your responses. I ask a few demographic questions at the end of the questionnaire. These questions help me describe Delphi panelists' characteristics while maintaining individuals' confidentiality and anonymity.

Round 1 has a target of **two weeks** for data collection. The data will be categorized and formatted for presentation in Round 2. Click the forward arrow to begin question #1.

Knowledge

For this study, knowledge is defined as a*n organized body of information supported by professionally acceptable theory and research.* For example, this is the information or principles that extension workers need to promote agroforestry. Some examples of knowledge items might be the water cycle, photosynthesis, adult learning theory, etc.

Given this definition, what are the top 10 **knowledge** items that extension workers in the Global South need to effectively promote agroforestry to smallholders?

- ○ Knowledge Item 1 _____
- ○ Knowledge Item 2 _____
- ○ Knowledge Item 3 _____
- ○ Knowledge Item 4 _____
- ○ Knowledge Item 5 _____
- ○ Knowledge Item 6 _____
- ○ Knowledge Item 7 _____
- ○ Knowledge Item 8 _____
- ○ Knowledge Item 9 _____
- ○ Knowledge Item 10 _____

Skill

For this study, skill is defined as: *Using knowledge effectively and readily in completing a task.* For example, these are the proficiencies developed through training or experience that extension workers need to promote agroforestry. Some examples of skill items might be oral communication skills, plant propagation skills, leadership skills, etc.

Given that definition, what are the top 10 **skill** items that extension workers in the Global South need to effectively promote agroforestry to smallholders?

- ○ Skill Item 1 _____
- ○ Skill Item 2 _____
- ○ Skill Item 3 _____
- ○ Skill Item 4 _____
- ○ Skill Item 5 _____
- ○ Skill Item 6 _____
- ○ Skill Item 7 _____
- ○ Skill Item 8 _____
- ○ Skill Item 9 _____
- ○ Skill Item 10 _____

Ability

For this study ability is defined as: *A behavior that results in completing a task*. For example. These are the qualities extension workers in agroforestry need to promote agroforestry. Some examples of abilities might be work well with other, manage multiple tasks, adapt, and acquire new things quickly, etc.

Given that definition, what are the top 10 **abilities** that extension workers in the Global South need to effectively promote agroforestry to smallholders?

- ○ Ability Item 1 _____
- ○ Ability Item 2 _____
- ○ Ability Item 3 _____
- ○ Ability Item 4 _____
- ○ Ability Item 5 _____
- ○ Ability Item 6 _____
- ○ Ability Item 7 _____
- ○ Ability Item 8 _____
- ○ Ability Item 9 _____
- ○ Ability Item 10 _____

These questions help me describe the Delphi panelists' characteristics, while maintaining individuals' confidentiality and anonymity.

Sex

What is your sex?

- ○ Male
- ○ Female

Organization

Which organization type best describes your employer?

- ○ Nongovernmental Organization
- ○ Government
- ○ University
- ○ Other

Experience

How many years of experience do you have in agroforestry?

- ○ 0 - 5 years
- ○ 6 - 10 years
- ○ 11 or more years

Region

In what regions has your agroforestry work been focused? (Select as many that apply.)

- ☐ Asia
- ☐ Africa
- ☐ Latin America/Caribbean
- ☐ South America
- ☐ Oceania

APPENDIX F

DELPHI STUDY ROUND TWO SURVEY

Title: Competencies of Extension Workers Promoting Agroforestry to Smallholders in the Global South: Delphi Study

Instructions:

The knowledge, skills, and abilities identified by the panel are provided in this Round 2 survey. Each knowledge, skill, and ability category is divided into technical or human relation subcategories. Original statements have been dissected and/or converged with duplicate statements listed only once.

This survey will provide a scale for each knowledge, skill, and ability. This scale is from Strongly Disagree to Strongly Agree. Please read each item and select the choice that best describes how important the knowledge, skill, or ability is for extension workers promoting agroforestry to smallholders in the Global South.

If you believe one of your knowledge, skill, or ability items is not reflected in the list, please add it in the space provided at the end of each section. There will also be space under each item for you to provide explanations for the items. Additional details will help clarify the terms for the final round.

If you can complete and submit this survey by **December 2, 2021**, it would be greatly appreciated.

Knowledge Items

In Round 1, the panel was asked to respond to the following question:

What are the top 10 Knowledge items that extension workers in the Global South need to effectively promote agroforestry to smallholders?

For this study, knowledge is defined as an organized body of information supported by professionally acceptable theory and research. For example, this is the information or principles that extension workers need to promote agroforestry.

In the following section of the survey, rate the level you agree with each knowledge item, and please provide clarity to items where needed.

Technical Knowledge Items

Rate the level you agree with each knowledge item, and please provide clarity to items where needed.

Knowledge of...

	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
Adult learning theory and extension methods	○	○	○	○	○	○
Business management (agroforestry markets and value chains)	○	○	○	○	○	○
Sustainable agricultural production systems and practices	○	○	○	○	○	○
Introductory soil science	○	○	○	○	○	○
Trees in agroforestry systems (species, planting, protection, pruning, harvesting, uses)	○	○	○	○	○	○
Negative impacts caused by agroforestry	○	○	○	○	○	○

Technical Knowledge Items

Rate the level you agree with each knowledge item, and please provide clarity to items where needed.

Knowledge of...

	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
Drivers of agroforestry adoption by smallholders	○	○	○	○	○	○
Basic crop science	○	○	○	○	○	○
Plant pests and diseases	○	○	○	○	○	○
Ecosystem ecology	○	○	○	○	○	○
Tree nursery management (seed collection, propagation, seedling care, protection, transportation)	○	○	○	○	○	○
Benefits from implementing agroforestry (socioeconomic, environmental, and nutrition and food security)	○	○	○	○	○	○

Technical Knowledge Items

Rate the level you agree with each knowledge item, and please provide clarity to items where needed.

Knowledge of...

	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
Agroforestry systems, practices, and principles	○	○	○	○	○	○
Project planning and management	○	○	○	○	○	○
Land use planning and design	○	○	○	○	○	○
Climate and weather patterns (Climate change adaptation and mitigation measures)	○	○	○	○	○	○
Nutrient cycle process in agroforestry systems	○	○	○	○	○	○

Technical Knowledge Items

Rate the level you agree with each knowledge item, and please provide clarity to items where needed.

Knowledge of...

	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
Community development practices	○	○	○	○	○	○
Local social justice concerns	○	○	○	○	○	○
Indigenous agroforestry practices	○	○	○	○	○	○
Land tenure practices	○	○	○	○	○	○
Communication	○	○	○	○	○	○

Technical Knowledge Items

Rate the level you agree with each knowledge item, and please provide clarity to items where needed.

Knowledge of...

	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
Socioeconomic conditions and livelihoods of the local community	○	○	○	○	○	○
Gender roles in the community	○	○	○	○	○	○
Local institutions and policies that impact agroforestry	○	○	○	○	○	○
Local culture, history, language, and development efforts	○	○	○	○	○	○

Additional Knowledge Items

_____

_____

_____

_____

_____

APPENDIX G

DELPHI STUDY ROUND THREE SURVEY

Title: Competencies of Extension Workers Promoting Agroforestry to Smallholders in the Global South: Delphi Study

Instructions:

The knowledge, skills, and abilities agreed upon in Round 2 are now in the Round 3 survey. Once again, each knowledge, skill, and ability category are divided into technical or human relation subcategories. Some of the items have been reworded, and additional items have been added based on the panel members' suggestions.

This survey will provide a scale for each knowledge, skill, and ability. This scale ranges from **Not at all important** to **Absolutely essential**. Please read each item and select the choice that best describes how **important** the knowledge, skill, or ability item is for extension workers promoting agroforestry to smallholders in the Global South.

It would be greatly appreciated if you could complete and submit this survey by **December 23, 2021**.

Thank you again for your insight and help on this study.

Knowledge Items

In Round 2, you were asked to rate the level you agree with each knowledge item.

For this study, knowledge is defined as an organized body of information supported by professionally acceptable theory and research. For example, this is the information or principles that extension workers need to promote agroforestry.

In the following section of the survey, you will rate how **important** each knowledge item is to extension workers promoting agroforestry to smallholders in the Global South.

Technical Knowledge Items

Rate how important each knowledge item is to extension workers promoting agroforestry to smallholders in the Global South.

Knowledge of…

	Not at all important	Unimportant	Slightly unimportant	Slightly important	Important	Absolutely essential
Business management (agroforestry markets and value chains)	○	○	○	○	○	○
Sustainable agricultural production systems and practices	○	○	○	○	○	○
Trees in agroforestry systems (species, planting, protection, pruning, harvesting, uses, and interactions with crops)	○	○	○	○	○	○
Natural regeneration (Farmer Managed Natural Regeneration, assisted natural regenerations, etc.)	○	○	○	○	○	○
Climate change adaptation	○	○	○	○	○	○

Technical Knowledge Items

Rate how important each knowledge item is to extension workers promoting agroforestry to smallholders in the Global South.

Knowledge of …

	Not at all important	Unimportant	Slightly unimportant	Slightly important	Important	Absolutely essential
Plant pests and diseases	○	○	○	○	○	○
Agriculture and natural resource ecology	○	○	○	○	○	○
Tree nursery management (seed collection, propagation, seedling care, protection, transportation)	○	○	○	○	○	○
Cost and benefits of implementing agroforestry (socioeconomic, environmental, and nutrition and food security)	○	○	○	○	○	○
Drivers of agroforestry adoption by smallholders	○	○	○	○	○	○

Technical Knowledge Items

Rate how important each knowledge item is to extension workers promoting agroforestry to smallholders in the Global South.

Knowledge of …

	Not at all important	Unimportant	Slightly unimportant	Slightly important	Important	Absolutely essential
Agroforestry systems, practices, and principles	○	○	○	○	○	○
Climate and weather (regional climate, microclimates, and weather patterns)	○	○	○	○	○	○
Nutrient cycle process in agroforestry systems	○	○	○	○	○	○
Climate change mitigation	○	○	○	○	○	○

Technical Knowledge Items

Rate how important each knowledge item is to extension workers promoting agroforestry to smallholders in the Global South.

Knowledge of …

	Not at all important	Unimportant	Slightly unimportant	Slightly important	Important	Absolutely essential
Community development practices	○	○	○	○	○	○
Indigenous agroforestry practices	○	○	○	○	○	○
Land and tree tenure practices	○	○	○	○	○	○
Communication	○	○	○	○	○	○
Adult learning theory and extension methods	○	○	○	○	○	○

Technical Knowledge Items

Rate how important each knowledge item is to extension workers promoting agroforestry to smallholders in the Global South.

Knowledge of …

	Not at all important	Unimportant	Slightly unimportant	Slightly important	Important	Absolutely essential
Socioeconomic conditions and livelihoods of the local community	○	○	○	○	○	○
Gender roles in the community	○	○	○	○	○	○
Local institutions and policies that impact agroforestry	○	○	○	○	○	○
Local culture, history, language, and development efforts	○	○	○	○	○	○

Skill Items

In Round 2, you were asked to rate your level of agreement with each skill item.

For this study, skill is defined as using knowledge effectively and readily in completing a task. For example, these are the proficiencies developed through training or experience that extension workers need to promote agroforestry.

In the following section of the survey, you will rate how **important** each skill item is to extension workers promoting agroforestry to smallholders in the Global South.

Technical Skill Items

Rate how important each skill item is to extension workers promoting agroforestry to smallholders in the Global South.

Skills...

	Not at all important	Unimportant	Slightly unimportant	Slightly important	Important	Absolutely essential
Making organic fertilizer	○	○	○	○	○	○
Agroforestry design, implementation, and management	○	○	○	○	○	○
Soil and water conservation	○	○	○	○	○	○
Seed collection and processing	○	○	○	○	○	○
Disease and insect prevention	○	○	○	○	○	○
Tree nursery management	○	○	○	○	○	○
Agroforestry entrepreneurship	○	○	○	○	○	○

Technical Skill Items

Rate how important each skill item is to extension workers promoting agroforestry to smallholders in the Global South.

Skills...

	Not at all important	Unimportant	Slightly unimportant	Slightly important	Important	Absolutely essential
Agricultural management	○	○	○	○	○	○
Plant identification	○	○	○	○	○	○
Integration of livestock, crops, and trees	○	○	○	○	○	○
Assisted natural regeneration and Farmer Managed Natural Regeneration Management	○	○	○	○	○	○
Agroforestry value-added products	○	○	○	○	○	○

Technical Skill Items

Rate how important each skill item is to extension workers promoting agroforestry to smallholders in the Global South.

Skills...

	Not at all important	Unimportant	Slightly unimportant	Slightly important	Important	Absolutely essential
Active listening	○	○	○	○	○	○
Oral communication	○	○	○	○	○	○
Cultural competency	○	○	○	○	○	○
Written communication	○	○	○	○	○	○
Community-based development	○	○	○	○	○	○
Problem identification, analysis, and solving	○	○	○	○	○	○
Teaching and/or facilitation	○	○	○	○	○	○

Ability Items

In Round 2, you were asked to rate the level you agree with each ability item.

For this study, ability is defined as a behavior that results in completing a task. For example, these are the qualities extension workers in agroforestry need to promote agroforestry. Some examples of abilities might be working well with others, managing multiple tasks, adapting, and acquiring new things quickly, etc.

In the following section of the survey, you will rate how **important** each ability item is to extension workers promoting agroforestry to smallholders in the Global South.

Technical Ability Items

Rate how important each ability item is to extension workers promoting agroforestry to smallholders in the Global South.

Ability to...

	Not at all important	Unimportant	Slightly unimportant	Slightly important	Important	Absolutely essential
Use tools safety	○	○	○	○	○	○
Monitor and evaluate smallholder's adoption of agroforestry	○	○	○	○	○	○
Use digital tools for accessing information and communication	○	○	○	○	○	○
Identify markets for agroforestry products	○	○	○	○	○	○
Adapt agroforestry practices based on local context and research	○	○	○	○	○	○

Technical Ability Items

Rate how important each ability item is to extension workers promoting agroforestry to smallholders in the Global South.

Ability to...	Not at all important	Unimportant	Slightly unimportant	Slightly important	Important	Absolutely essential
Build strong, trusting relationships with diverse groups of stakeholders	○	○	○	○	○	○
Adapt quickly to unexpected events	○	○	○	○	○	○
Reliable; follow directions and assume responsibilities	○	○	○	○	○	○
Document and report successes, challenges, and lessons learned	○	○	○	○	○	○
Work independently	○	○	○	○	○	○

Technical Ability Items

Rate how important each ability item is to extension workers promoting agroforestry to smallholders in the Global South.

Ability to...

	Not at all important	Unimportant	Slightly unimportant	Slightly important	Important	Absolutely essential
Identify community champions and local expertise	○	○	○	○	○	○
Facilitate the development of participatory action plans	○	○	○	○	○	○
Advocate for the adoption of agroforestry amongst critics	○	○	○	○	○	○
Promote transdisciplinary collaboration	○	○	○	○	○	○
Use resources efficiently	○	○	○	○	○	○

Technical Ability Items

Rate how important each ability item is to extension workers promoting agroforestry to smallholders in the Global South.

Ability to...

	Not at all important	Unimportant	Slightly unimportant	Slightly important	Important	Absolutely essential
Be tolerant and open-minded	○	○	○	○	○	○
Display servant leadership with stakeholders	○	○	○	○	○	○
Disciplined, detailed, and timely	○	○	○	○	○	○
Exercise emotional intelligence (self-awareness, motivation, empathy, and social skills)	○	○	○	○	○	○
Cultural sensitivities	○	○	○	○	○	○
Identify and diagnose problems objectively	○	○	○	○	○	○

Technical Ability Items

Rate how important each ability item is to extension workers promoting agroforestry to smallholders in the Global South.

Ability to...

	Not at all important	Unimportant	Slightly unimportant	Slightly important	Important	Absolutely essential
Be a lifelong learner	○	○	○	○	○	○
Plan and accomplish multiple tasks	○	○	○	○	○	○
Develop trainings	○	○	○	○	○	○
Facilitate farmer learning	○	○	○	○	○	○

APPENDIX H

PWP PROGRAM LEADERSHIP FOCUS GROUPS PROTOCOL

Focus Group # 1

Agenda

- *Welcome and Introductions*
- *Identify the competencies that are key to Plant with Purpose*
- *Wrap up and next steps*

Welcome and Introductions

1. Introductions
    - Introduce the facilitator and notetaker
    - Ask focus group to: "Tell your name and how long you have been associated with Plant with Purpose"

2. PowerPoint presentation on study and focus group's role
    - Provide information on competency-based models
    - Quickly overview agroforestry extension worker competencies
    - Discuss the need for their feedback and insight
    - A reminder that conversation will be recorded and ideas will be used for research
    - Need full participation to have a successful day
    - Contributions will be kept confidential
    - Confidentiality for the group – what we say stays here
    - No right or wrong answers. We want to hear all your ideas and comments. Including disagreements.
    - Questions about the process??

3. Review of extension worker agroforestry competencies (from Delphi study)

Identify competencies critical to Plant with Purpose work in agroforestry

After the competencies have been presented participants will be asked to share any ideas of competencies that may be missing or any that should be eliminated (using a round-robin method) until all ideas have been exhausted with the following questions leading the discussion. The competencies will then be ranked from high, medium, to low based on their importance to Plant with Purposes' agroforestry work with communities worldwide.

Questions:

- What are your initial reactions to how well the KSA describes the most critical aspects of Plant with Purpose extension workers? Or, do you think

these represent what high performers in the Plant with Purpose program exhibit?

- As you looked at the KSA items, to what extent did they accurately describe Plant with Purpose extension workers promoting agroforestry?

- To what extent are the individual KSA items straightforward, and the name or label used to make sense for what is described.

- Are there competencies that should be added? (What is missing? What should be changed? Why?) What other ideas do you have about competencies that should be added to make the model more applicable to Plant with Purposes extension workers' work? Why?

- Are there competencies included on this list that should be eliminated? Why?

- How do you rank the competencies? What do you consider a high, medium, and low priority for Plant with Purpose staff and their agroforestry programming?

- The purpose of this research is to help evaluate agroforestry competencies. Is there anything that was missed? Is there anything you came wanting to say that you didn't get a chance to share?

Wrap-up and next steps

1. I will be sharing the list of items you prioritized so you have an opportunity to comment or clarify.

2. Questions or comments about today?

APPENDIX I

PWP COUNTRY STAFF FOCUS GROUP PROTOCOL

Focus Groups # 2 - 7

(Meet with Plant with Purpose field staff)

Agenda

- Welcome and introductions
- Discuss the KSA items that are key to Plant with Purpose work (identifying key actions and definitions)
- Wrap up and next steps

This focus group aims to identify critical actions or behaviors that describe the competencies identified by the leadership program team.

Welcome and Introductions

1. Introductions
    - Introduce facilitator
    - Ask the focus group to: "Tell your name and how long you have been associated with Plant with Purpose" Quickly

2. PowerPoint presentation on study and focus group's role
    - Provide information on competency-based models
    - Quickly overview agroforestry extension worker competencies
    - Discuss the need for their feedback and insight
    - A reminder that conversation will be recorded, and ideas will be used for research
    - Need full participation to have a successful day
    - Individual contributions will be kept confidential
    - Confidentiality for the group – what we say stays here (specifics will not be shared.
    - No right or wrong answers. We want to hear all your ideas and comments. Including disagreements.
    - Questions about the process??

3. Review of extension worker agroforestry competencies (from Delphi study)

Identifying actions or behaviors that describe each competency

The focus group will be asked, "What ideas do you have about key actions or behaviors that would describe the KSAs we have listed?"

Think about:

- Actions or statements to illustrate specific KSA items
- Specific examples of how you or others have demonstrated this competency
- Think of a story that highlights the key actions or behaviors that describe the competency.

1. In the group, the individuals will comment on proposed actions or behaviors provided from the research and gathered from the Plant with Purpose leadership team.

2. In the group, individuals will share key actions or stories
   For each competency:

   - Open the floor for people to share their thoughts
   - Facilitator will ask for additional discussion or to clarify as needed

3. Any final questions or comments?

Wrap up and next steps

1. Question or comments about today?
1. Once a draft of the competency model is created it will be shared with you all via email for your feedback
2. Thank you

APPENDIX J

PWP REGIONAL FOCUS GROUP PROTOCOL

Focus Groups # 8 -10

(Meet with Plant with Purpose Program and Field staff in regional meetings)

Agenda

- *Welcome and introductions*
- *Present the competency model (that was already sent to them)*
- *Wrap up and next steps*

Welcome and Introductions

- Thank everyone for their previous participation
- Reintroduce myself and purpose of study
- Reintroduce the Ideas of competency models
    - Identify competencies
    - Learn about key actions or behaviors
    - Identify core competencies and develop key actions

Present the competency model

- Identified 7 core competencies – developed definitions and key actions for each competency based on the Focus Groups with PWP staff and partners.
    - Tree Competencies
    - Agricultural Competencies
    - Agroforestry Competencies
    - Cultural Competencies
    - Teaching and Facilitation Competencies
    - Communication Competencies
    - Leadership Competencies

- Solicit feedback from the participants
    - I want to hear your thoughts on definitions and key action. Are the definitions and key actions accurate to the work your trainers do in your country?
    - Is there anything missing or not addressed?
    - As you think about the core competencies and key actions, think about the best trainer you know with Plant with Purpose. Do these key actions describe them?

Close – Thank everyone for the participation and next steps

APPENDIX K

AGROFORESTRY EXTENSION NEEDS ASSESSMENT INSTRUMENT

Introduction

I appreciate your willingness to participate in this study. This survey is a training needs assessment to help provide the researcher insight into extension agents' recent experience with the provided competencies. This survey will be used for research, and individual data will not be given to employers. If you have any questions about the study, please contact me at bkf26@tamu.edu.

Instructions:

Based on your current responsibilities, respond to the following list of competencies. The list reflects the potential competencies of extension workers promoting agroforestry.

Using a 4-point scale, please rate each topic in terms of:

A. Proficiency: Your level of competence or skill on each competency

B. Importance: The relative importance of each competency to your job function

You will also be asked to complete a demographics sheet at the end of the questionnaire to understand better your experience and role in promoting agroforestry. You will have until **April 30th** to complete the survey.

Technical Knowledge

Rate both Proficiency and Importance of each competency in your job.

	Proficiency				Importance			
	None	Low	Average	High	None	Low	Average	High
Business management (agroforestry markets and value chains)	○	○	○	○	○	○	○	○
Sustainable agricultural production systems and practices	○	○	○	○	○	○	○	○
Trees in agroforestry systems (species, planting, protection, pruning, harvesting, uses, and interactions with crops)	○	○	○	○	○	○	○	○
Natural regeneration (Farmer Managed Natural Regeneration, assisted natural regeneration, etc.)	○	○	○	○	○	○	○	○
Climate change adaptation	○	○	○	○	○	○	○	○

Technical Knowledge

Rate both Proficiency and Importance of each competency in your job.

	Proficiency				Importance			
	None	Low	Average	High	None	Low	Average	High
Plant pests and diseases	○	○	○	○	○	○	○	○
Agriculture and natural resource ecology	○	○	○	○	○	○	○	○
Tree nursery management (seed collection, propagation, seedling care, protection, transportation)	○	○	○	○	○	○	○	○
Costs and Benefits of implementing agroforestry (socioeconom-ic, environmental, and nutrition and food security)	○	○	○	○	○	○	○	○
Drivers of agroforestry adoption by smallholders	○	○	○	○	○	○	○	○

Technical Knowledge

Rate both Proficiency and Importance of each competency in your job.

	Proficiency				Importance			
	None	Low	Average	High	None	Low	Average	High
Agroforestry systems, practices, and principles	○	○	○	○	○	○	○	○
Climate and weather (regional climate, microclimates, and weather patterns)	○	○	○	○	○	○	○	○
Nutrient cycle process in agroforestry systems	○	○	○	○	○	○	○	○
Land and tree tenure practices	○	○	○	○	○	○	○	○

Human Relation Knowledge

Rate both Proficiency and Importance of each competency in your job.

	Proficiency				Importance			
	None	Low	Average	High	None	Low	Average	High
Community development practices	○	○	○	○	○	○	○	○
Indigenous agroforestry practices	○	○	○	○	○	○	○	○
Communication	○	○	○	○	○	○	○	○
Adult learning theory and extension methods	○	○	○	○	○	○	○	○

Human Relation Knowledge

Rate both Proficiency and Importance of each competency in your job.

	Proficiency				Importance			
	None	Low	Average	High	None	Low	Average	High
Socioeconomic conditions and livelihoods of the local community	○	○	○	○	○	○	○	○
Gender roles in the community	○	○	○	○	○	○	○	○
Local institutions and policies that impact agroforestry	○	○	○	○	○	○	○	○
Local culture, history, language, and development efforts	○	○	○	○	○	○	○	○

Technical Skills

Rate both Proficiency and Importance of each competency in your job.

	Proficiency				Importance			
	None	Low	Average	High	None	Low	Average	High
Making organic fertilizer	○	○	○	○	○	○	○	○
Agroforestry design, implementation, and management	○	○	○	○	○	○	○	○
Soil and water conservation	○	○	○	○	○	○	○	○
Seed collection and processing	○	○	○	○	○	○	○	○
Disease and insect prevention	○	○	○	○	○	○	○	○
Tree nursery management	○	○	○	○	○	○	○	○

Technical Skills

Rate both Proficiency and Importance of each competency in your job.

	Proficiency				Importance			
	None	Low	Average	High	None	Low	Average	High
Agroforestry entrepreneurship	○	○	○	○	○	○	○	○
Agricultural management	○	○	○	○	○	○	○	○
Plant identification	○	○	○	○	○	○	○	○
Integration of livestock, crops, and trees	○	○	○	○	○	○	○	○
Assisted natural regeneration and Farmer Managed Natural Regeneration management	○	○	○	○	○	○	○	○
Agroforestry value added products	○	○	○	○	○	○	○	○

Human Relation Skills

Rate both Proficiency and Importance of each competency in your job.

	Proficiency				Importance			
	None	Low	Average	High	None	Low	Average	High
Active listening	○	○	○	○	○	○	○	○
Oral communication	○	○	○	○	○	○	○	○
Cultural competency	○	○	○	○	○	○	○	○
Community-based development	○	○	○	○	○	○	○	○
Problem identification, analysis, and solving	○	○	○	○	○	○	○	○
Teaching and/or facilitation	○	○	○	○	○	○	○	○

Technical Abilities

Rate both Proficiency and Importance of each competency in your job.

	Proficiency				Importance			
	None	Low	Average	High	None	Low	Average	High
Use tools safely	○	○	○	○	○	○	○	○
Monitor and evaluate smallholder's adoption of agroforestry	○	○	○	○	○	○	○	○
Use digital tools for accessing information and communication	○	○	○	○	○	○	○	○
Identify markets for agroforestry products	○	○	○	○	○	○	○	○
Adapt agroforestry practices based on local context and research	○	○	○	○	○	○	○	○
Document and report successes, challenges, and lessons learned	○	○	○	○	○	○	○	○

Human Relation Abilities

Rate both Proficiency and Importance of each competency in your job.

	Proficiency				Importance			
	None	Low	Average	High	None	Low	Average	High
Build strong, trusting relationships with diverse groups of stakeholders	○	○	○	○	○	○	○	○
Adapt quickly to unexpected events	○	○	○	○	○	○	○	○
Reliable; follow directions and assume responsibilities	○	○	○	○	○	○	○	○
Work independently	○	○	○	○	○	○	○	○

Human Relation Abilities

Rate both Proficiency and Importance of each competency in your job.

	Proficiency				Importance			
	None	Low	Average	High	None	Low	Average	High
Identify community champions and local expertise	○	○	○	○	○	○	○	○
Facilitate development of participatory action plans	○	○	○	○	○	○	○	○
Advocate for the adoption of agroforestry amongst critics	○	○	○	○	○	○	○	○
Promote transdisciplinary collaboration	○	○	○	○	○	○	○	○
Use resources efficiently	○	○	○	○	○	○	○	○

Human Relation Abilities

Rate both Proficiency and Importance of each competency in your job.

	Proficiency				Importance			
	None	Low	Average	High	None	Low	Average	High
Be tolerant and open-minded	○	○	○	○	○	○	○	○
Display servant leadership with stakeholders	○	○	○	○	○	○	○	○
Disciplined, detailed, and timely	○	○	○	○	○	○	○	○
Exercise emotional intelligence (self-awareness, motivation, empathy, and social skills)	○	○	○	○	○	○	○	○
Cultural sensitivities	○	○	○	○	○	○	○	○

Human Relation Abilities

Rate both Proficiency and Importance of each competency in your job.

	Proficiency				Importance			
	None	Low	Average	High	None	Low	Average	High
Identify and diagnose problems objectively	○	○	○	○	○	○	○	○
Be a lifelong learner	○	○	○	○	○	○	○	○
Plan and accomplish multiple tasks	○	○	○	○	○	○	○	○
Develop trainings	○	○	○	○	○	○	○	○
Facilitate farmer learning	○	○	○	○	○	○	○	○

Demographic questions help describe the Delphi panelists' characteristics as a group, while maintaining individuals' confidentiality and anonymity.

Sex

What is your sex?

- ○ Male
- ○ Female

Education

What is the highest level of education you completed?

- ○ Less than a high school diploma
- ○ High school degree or equivalent
- ○ Technical degree
- ○ Bachelor's degree
- ○ Graduate degree

Organization

Which organization type best describes your employer?

- ○ Nongovernmental Organization
- ○ Government
- ○ University
- ○ Other

Experience

How many years of experience do you have in agroforestry?

- ○ 0 - 5 years
- ○ 6 - 10 years
- ○ 11 or more years

Country

What is the country where you work? (Select the appropriate choice.)

- ○ Haiti
- ○ Dominican Republic
- ○ Mexico
- ○ Nicaragua
- ○ Honduras
- ○ Senegal

- ○ Democratic Republic of Congo
- ○ Ethiopia
- ○ Kenya
- ○ Tanzania
- ○ Uganda
- ○ Burundi
- ○ Thailand
- ○ Another country not listed here