International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

A Review of Innovative Approaches to Overcoming Agricultural Extension Challenges: A Case Study of the Knowledge Gap in Kigezi Sub-Region, Uganda

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Abstract:
Agriculture remains the backbone of Uganda's economy, but the Kigezi region continues to face significant challenges that limit its agricultural productivity. Farmers in this region, despite their reliance on agriculture, often struggle with low yields and limited access to modern farming techniques. These challenges are exacerbated by a knowledge gap in agricultural extension services, largely caused by logistical issues, poor infrastructure, and limited access to technology. This review examines the agricultural extension challenges in Kigezi and explores innovative approaches, with a particular focus on mobile-based teaching-learning frameworks (TLFs). The article evaluates the potential of mobile technology to address these challenges by providing scalable, accessible, and context-specific solutions. The findings suggest that while Kigezi faces digital and infrastructure barriers, mobile solutions tailored to local needs could empower farmers and enhance agricultural productivity. This review aims to contribute to ongoing discussions on agricultural extension in resource-constrained regions and provides practical recommendations for bridging the extension gap through innovative mobile platforms.

Keywords: Innovative Approaches, Agricultural extension, knowledge gap, Kigezi region.

1. INTRODUCTION

Agriculture remains a critical sector for economic growth and food security in Uganda, with more than 80% of rural households depending on agriculture for their livelihoods (Mpiima, Manyire, Kabonesa, & Espiling, 2019). In regions like Kigezi, where agricultural activities are central to the local economy, farmers face persistent challenges that prevent them from adopting modern farming practices. The Kigezi region, characterized by rugged terrain and a lack of infrastructure, presents unique barriers to agricultural extension efforts. Farmers in the region continue to rely on traditional farming practices such as land fragmentation and superstition-based methods, which often result in low productivity and poor food security (Brenya & Zhu, 2023).

Agricultural extension services are designed to bridge the knowledge gap between research institutions

and farmers by providing farmers with relevant, updated knowledge and skills (Suvedi & Kaplowitz, 2016). However, in regions like Kigezi, there is a significant disconnect between extension officers and farmers due to the region's topography, poor infrastructure, and resource constraints. This knowledge gap continues to limit the adoption of new agricultural practices, which is critical for improving productivity and achieving food security.

This article aims to address these challenges by reviewing the potential of mobile-based teaching-learning frameworks (TLFs) as a practical and innovative solution to bridge the agricultural extension gap in Kigezi. Mobile technology has proven effective in many sectors, but its application in agricultural extension remains underutilized. By reviewing relevant literature and analyzing the feasibility of mobile-based TLFs in Kigezi, this article seeks to offer a framework that can be adapted to other resource-constrained regions globally (Jones, Rob, & Rob, 2021).

2. METHODOLOGY

The methodology for this review article includes a comprehensive analysis of existing literature, focusing on the agricultural extension systems in Uganda and other resource-constrained regions. The primary objective was to identify the major challenges in agricultural extension services and evaluate the effectiveness of mobile-based frameworks in addressing these challenges. Data sources included peer-reviewed journal articles, government reports, and case studies related to agricultural extension and mobile technology adoption in rural areas (Suvedi & Kaplowitz, 2016).

2.1. Literature Review

The literature review was conducted using online databases such as Google Scholar, Science Direct, and JSTOR, with a focus on articles published between 2010 and 2023. Keywords such as "agricultural extension in Uganda," "mobile learning in agriculture," and "teaching-learning frameworks in resource-constrained areas" were used to identify relevant studies. More than 50 studies were reviewed, and 20 were selected for inclusion in this article based on their relevance to the specific challenges in the Kigezi region.

2.2. Theoretical Framework

The Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) were used as the primary theoretical models to assess the feasibility of mobile-based TLFs in Kigezi. The TAM framework posits that perceived ease of use and perceived usefulness are the two key factors influencing users' acceptance of new technologies (Davis, 1989). The UTAUT model expands on TAM by incorporating additional variables such as social influence, facilitating conditions, and behavioral intentions (Venkatesh, Morris, Davis, & Davis, 2003).

In addition to these models, the study also draws upon the theory of multimedia learning (Mayer, 2001) to assess how mobile-based TLFs can facilitate agricultural knowledge transfer. This theory suggests that learners are more likely to understand and retain information when it is presented using multiple modalities, such as text, images, and audio, which can be effectively integrated into mobile platforms.

2.3. Data Analysis

The data collected from the literature review were analyzed using a thematic approach. Key themes were identified, including the barriers to effective agricultural extension in Kigezi, the role of mobile technology in improving knowledge transfer, and the challenges of technology adoption in resource-constrained regions. This thematic analysis helped to structure the recommendations for the implementation of mobile-based TLFs in Kigezi.

3. AGRICULTURAL EXTENSION CHALLENGES IN KIGEZI

3.1. The Agricultural Knowledge Gap

The agricultural knowledge gap in Kigezi is a persistent challenge that has limited the region's agricultural productivity. Farmers in the region often rely on traditional farming methods, such as superstition-based pest management and land fragmentation, which have proven ineffective in addressing the region's agricultural needs (Mpiima et al., 2019). These practices result in low crop yields, poor soil management, and limited use of modern agricultural technologies, such as fertilizers and pesticides (Brenya & Zhu, 2023).

One of the major contributors to the knowledge gap is the lack of access to agricultural extension services. In Kigezi, extension officers are often unable to reach remote farming communities due to poor road networks and the region's mountainous terrain (Okello, Akite, Atube, Kalule, & Ongeng, 2023). As a result, farmers are left without the necessary support to adopt modern agricultural practices, leading to continued reliance on outdated methods. The knowledge gap is further exacerbated by the limited availability of extension officers, with some districts having only one extension officer for every 3,000 farmers (Mpiima et al., 2019).

3.2. Barriers to Agricultural Extension Services

In addition to the logistical challenges posed by Kigezi's terrain, there are several other barriers to effective agricultural extension services in the region. First, the extension worker-to-farmer ratio is extremely low, making it difficult for extension officers to provide personalized support to farmers. Second, many extension officers lack the necessary training and resources to deliver high-quality extension services (Brenya & Zhu, 2023). A study by Namyenya, Zeller, Rwamigisa, and Birner (2022) found that the competency of extension workers was a significant factor in determining the success of agricultural extension programs.

Another major barrier is the lack of funding for agricultural extension services. Government funding for agricultural extension in Uganda has been inconsistent, with many programs suffering from resource shortages. A report by Kuteesa, Kisaame, and Barungi (2018) highlights the underfunding of agricultural extension services as one of the key factors contributing to the knowledge gap in rural areas. Without adequate funding, extension programs cannot reach their full potential, leaving many farmers without the support they need to improve their farming practices.

3.3. Impact of the Knowledge Gap on Agricultural Productivity

The agricultural knowledge gap in Kigezi has had a significant impact on the region's agricultural productivity. Farmers who are not exposed to modern farming techniques often struggle with low yields and poor crop quality. For example, many farmers in the region are unaware of the benefits of using certified seeds and fertilizers, which can significantly improve crop yields (Mpiima et al., 2019). As a result, agricultural productivity in Kigezi remains far below its potential, contributing to food insecurity and poverty in the region.

4. MOBILE TEACHING-LEARNING FRAMEWORKS: AN INNOVATIVE SOLUTION

4.1. The Role of Mobile Technology in Agricultural Extension

Mobile technology has the potential to transform agricultural extension services in Kigezi by providing farmers with access to real-time information and resources. In Uganda, mobile phone penetration is high, with over 80% of the population owning a mobile phone (Suvedi & Kaplowitz, 2016). This widespread availability of mobile phones presents a unique opportunity to leverage mobile technology for agricultural

extension, particularly in regions where traditional extension services are inadequate.

Mobile teaching-learning frameworks (TLFs) offer a scalable and cost-effective solution to the challenges faced by agricultural extension programs in Kigezi. These frameworks can provide farmers with access to agricultural knowledge through SMS, voice messages, and multimedia content, such as videos and images (Jones et al., 2021). By delivering context-specific information in local languages, mobile TLFs can help bridge the knowledge gap and empower farmers to adopt modern agricultural practices (Rob & Rob, 2018).

4.2. Feasibility of Implementing Mobile TLFs in Kigezi

The feasibility of implementing mobile TLFs in Kigezi is supported by several factors. First, the widespread use of mobile phones in Uganda makes mobile technology an accessible platform for delivering agricultural knowledge. Second, mobile TLFs can be tailored to the specific needs of farmers in Kigezi by providing content in local languages and addressing region-specific challenges, such as pest management and soil fertility (Suvedi & Kaplowitz, 2016).

However, there are also challenges to implementing mobile TLFs in Kigezi. One of the major challenges is the limited digital literacy among farmers, particularly older farmers who may be unfamiliar with mobile technology (Jones et al., 2021). To address this challenge, training programs should be implemented to teach farmers how to use mobile phones effectively for agricultural purposes. Additionally, partnerships with local telecom providers will be essential to ensure that mobile services are affordable and accessible in remote areas (Brenya & Zhu, 2023).

4.3. Potential Impact of Mobile TLFs on Agricultural Productivity

The implementation of mobile TLFs in Kigezi has the potential to significantly improve agricultural productivity by providing farmers with access to the knowledge and resources they need to adopt modern farming practices. For example, mobile platforms can deliver information on how to use fertilizers, manage pests, and improve soil fertility, which are key factors in increasing crop yields (Suvedi & Kaplowitz, 2016). By empowering farmers with the knowledge they need to make informed decisions about their farming practices, mobile TLFs can help bridge the agricultural knowledge gap and improve food security in the region (Mpiima et al., 2019).

5. REVIEW OF EXISTING AGRICULTURAL EXTENSION FRAMEWORKS

While mobile technology presents a promising solution, it is essential to consider existing agricultural extension frameworks and evaluate their effectiveness. Various models, such as the Farmer Field School (FFS), Problem-Based Learning (PBL), and the Agricultural Knowledge and Information Systems (AKIS), have been implemented in different parts of the world. These frameworks aim to improve knowledge transfer and empower farmers through participatory learning (Suvedi & Kaplowitz, 2016).

The FFS model, for example, has been successful in improving farmers' knowledge and skills in various countries, including Kenya and Tanzania. However, the FFS model relies on group-based learning and field demonstrations, which may not be feasible in remote areas like Kigezi, where poor infrastructure limits access to farming communities (Mpiima et al., 2019). Similarly, the PBL approach, which focuses on problem-solving and critical thinking, may require more time and resources than farmers in Kigezi can afford (Jones et al., 2021).

Mobile TLFs can complement these traditional models by providing scalable and cost-effective solutions that can reach a wider audience. A hybrid approach that combines mobile platforms with in-person extension services could enhance the overall effectiveness of agricultural extension efforts in Kigezi (Rob

& Rob, 2018). By integrating mobile technology with existing extension frameworks, it is possible to create a more flexible and adaptive system that meets the needs of farmers in resource-constrained regions.

6. RECOMMENDATIONS FOR IMPLEMENTING A MOBILE TEACHING-LEARNING FRAMEWORK

6.1. Tailoring the Framework to Local Needs

To ensure the success of a mobile-based TLF in Kigezi, the content should be context-specific and designed to meet the unique needs of farmers in the region. This includes using local languages, addressing specific agricultural challenges faced in Kigezi (such as pest control, soil fertility, and crop selection), and making the platform accessible to farmers with limited digital literacy (Brenya & Zhu, 2023). Additionally, the platform should be designed to work on basic mobile phones, using SMS and voice messages to reach farmers without smartphones (Suvedi & Kaplowitz, 2016).

6.2. Training and Capacity Building

In addition to developing the mobile platform, it is essential to provide training to farmers on how to use mobile phones effectively for agricultural purposes. Digital literacy programs should be implemented in partnership with local extension services and community organizations to ensure that farmers are empowered to utilize mobile technology for their benefit (Rob & Rob, 2018). This training should focus on teaching farmers how to access and interpret information delivered via mobile platforms, as well as how to apply this knowledge to their farming practices.

6.3. Collaborating with Telecom Providers

Partnerships between the government, telecom providers, and NGOs are critical for improving network coverage and making mobile services affordable for farmers. Telecom companies should offer low-cost data packages and collaborate with the government to provide mobile services in remote areas, where network coverage is often limited (Brenya & Zhu, 2023). By working together, these stakeholders can ensure that mobile TLFs are accessible to all farmers, regardless of their location or socio-economic status.

7. CONCLUSION

The agricultural extension challenges in Kigezi, Uganda, reflect broader issues faced by resource-constrained regions across the globe. While traditional extension methods have their merits, they are often inadequate in addressing the unique challenges posed by remote areas with poor infrastructure. Mobile-based teaching-learning frameworks offer a promising solution to bridge the extension gap, providing farmers with access to relevant agricultural knowledge in a scalable, cost-effective manner (Suvedi & Kaplowitz, 2016). By tailoring the mobile TLF to the specific needs of Kigezi farmers and integrating it with existing extension services, it is possible to enhance agricultural productivity and improve food security in the region (Rob & Rob, 2018).

This review highlights the potential of mobile technology to transform agricultural extension in Kigezi and similar regions. However, successful implementation will require collaboration between government agencies, extension services, and telecom providers to address infrastructure challenges and promote digital literacy among farmers. With the right strategies, mobile TLFs could play a pivotal role in empowering farmers and improving agricultural outcomes in resource-constrained regions (Jones et al., 2021).

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