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Social Media as Tools for Agricultural Extension in Uganda: A Text Mining Approach

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Abstract:- The article discusses the potential of social media as a tool for agricultural extension in Uganda. The authors argue that social media platforms, such as Facebook, X formerly Twitter, WhatsApp, and YouTube, offer a range of opportunities for communication, information sharing, and collaboration among farmers. The study is guided by the Media Richness Theory, which asserts that channels of information based on technology are more effective for transmitting text than other media. The article highlights the challenges faced by traditional extension approaches in reaching remote areas and delivering timely and personalized advice, and suggests that social media can help overcome these challenges. Despite the potential benefits, the authors note that there is limited research on how social media can be effectively utilized for agricultural extension purposes in Uganda. The article concludes by emphasizing the need for agricultural extension workers to utilize social media to engage farmers and improve the effectiveness of agricultural extension services.

Keywords:- *Social Media, Text Mining, Agriculture Extension, Business Intelligence, Data Mining.*

I. INTRODUCTION & BACKGROUND

Agricultural extension refers to the process of collaborating with rural communities to enhance their well-being by assisting farmers in boosting the productivity of their agricultural ventures (Belay et al., 2017; Elias et al., 2015; Makate et al., 2016). This involves providing technical guidance on agriculture, providing essential inputs and services, disseminating innovative ideas developed by agricultural research institutions, and supporting the development of local farmers' organizations (Piñeiro et al., 2020). Agricultural extension encompasses a range of topics, including the use of improved crop varieties, effective livestock management, efficient water utilization, and the management of pests, diseases, or weeds (Ashraf et al., 2020). It aims to provide farmers with knowledge, information, and resources to improve their farming practices, productivity, and livelihoods (Makate et al., 2016).

The three main sources of agricultural extension are the public sector, private non-profit sector, and private for-profit sector. The public sector consists of government agencies such as ministries and departments of agriculture, as well as agricultural research institutions. The private non-profit sector covers local and international non-governmental organisations, foundations, community boards and associations, and bilateral and multilateral aid projects. Lastly, the private for-profit sector encompasses commercial companies, commercial farmers or farmer group-operated enterprises, agro-marketing and processing firms, trade associations, and private consulting and media companies. The agricultural extension system in developing countries has often failed to meet the demands of farmers, especially in rainfed agricultural systems that are diverse and in addressing emerging challenges such as promoting sustainability, diversification, and connecting farmers with markets (Abate et al., 2015; Deichmann et al., 2016; Eastwood et al., 2017; Makate et al., 2016; Kuehne et al., 2017). To tackle the new and emerging challenges in agricultural markets, technology, and sustainability, innovative approaches to agricultural extension are needed (Deichmann et al., 2016). These approaches should involve participatory methods to shape services that are driven by demand, multiple providers of extension services, and strategies to foster agricultural innovation systems (Jost et al., 2016). However, agricultural extensions services have today been greatly supported by developments in Information and Communication Technology (ICT) which is today characterized by the rampant use of social media platforms (Deichmann et al., 2016). These present exciting opportunities to reach and engage with farmers on a large scale, facilitating knowledge exchange, peer learning, and access to expert advice. In recent years, social media has emerged as a powerful platform for communication, information dissemination, and networking, across various domains. Moonsammy & Moonsammy (2020), claim that the global access to information among farmers has drastically increased in the past 15 years.

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Communication among farmers has been largely improved, turning into a basic need on top of clothing, food and shelter Raj & Bhattacharjee (2017). However, social media platforms are a prevalent mode of digital communication in modern times, comprising a range of evolving tools for discussion, interaction, and information sharing among individuals (Barau & Afrad, 2017). These digital tools, including but not limited to Facebook, Twitter, WhatsApp, and ResearchGate, serve as platforms for communication and collaboration hence laying potential grounds for agricultural extension (Alhassan et al., 2023; Paudel & Baral, 2018). Studies (Iftikhar et al., 2019; Walter, 2016; Paudel & Baral, 2018; Moonsammy & Moonsammy, 2020) stress that YouTube is increasingly being recognised as a valuable tool for learning and skill development, reflecting its growing integration into our cultural landscape. According to Raj & Bhattacharjee (2017), social media is a type of web-based electronic communication tool that enables users to engage in a variety of activities, such as sharing information and ideas in various forms (e.g. text, images, videos) and discussing them in virtual communities and networks. These tools also allow for the creation, retrieval, and exchange of information and ideas, which can be archived and accessed by anyone (Ankita et al., 2023).

The study was guided by the Media Richness Theory (MRT) which was advanced by Daft and Lengel in 1986. The theory asserts that channels of information based on technology are more effective for transmitting text than other media (Iftikhar et al., 2019). According to the theory, richness refers to the medium's capacity for transmitting information from the sender to the receiver. For instance, emails are less rich than telephone calls as they only contain text, but telephone calls are richer than emails as they allow for the transmission of tone. Video calls are the richest of all as they not only allow for the transmission of words, but also show the gestures and expressions of the person speaking. The MRT is concerned with the idea that communication should involve a rich source in order to be effective and hence this particular study intended to explore how social media is used as a tool for communicating agricultural information to farmers in Uganda.

➢ *Problem*

Agricultural extension services play a crucial role in disseminating information, providing advisory services, and facilitating technology adoption among farmers (Eastwood et al., 2017; Moonsammy & Moonsammy, 2020). However, traditional extension approaches face challenges in reaching remote areas, delivering timely and personalized advice, and improving emerging communication channels effectively (Kumar Ghosh et al., 2021). With the widespread adoption of social media platforms in Uganda, there is a growing opportunity to explore their potential as a tool for enhancing agricultural extension services. Despite the potential benefits, there is limited research on how social media can be effectively utilized for agricultural extension purposes in Ugandan. Farmers mostly use social media platforms for leisure activities such as gossip, music and entertainment. Nevertheless, agricultural extension workers in Uganda have not put in enough effort to make use of the prevailing social media tools to extend services to the local farmers. Alhassan et al. (2023) noted that extension agents in communities need to utilize social media to engage young people in agriculture in order to guarantee the business's future viability. The involvement of youth is essential for boosting agricultural output and lowering the unemployment rate. Many farmers practice traditional methods and applying the knowledge dispersed through social media requires much sensitization and training which is not the case. Ignorance impedes farmers from mining relevant information from the large volume of data available on social media (Pushpam & Jayanthi, 2017). Therefore, this study aims to explore how social media supports agricultural extension in Uganda using a text mining approach.

➢ *Objectives*

- To establish the level at which farmers in uganda utilize social media for agricultural extension
- To establish the common social media tools used by farmers to access agricultural information in Uganda
- To identify the difficulties faced by farmers in Uganda when trying to obtain agricultural information from social media sources.

➢ *Questions*

- How do farmers in Uganda perceive social media as a tool for accessing agricultural data in Uganda?
- Which social media tools do farmers commonly use to access agricultural information in Uganda?
- How are farmers in Uganda challenged when accessing information regarding agricultural extension via social media?

II. LITERATURE REVIEW

➢ *Social Media and Disseminating Agricultural Information*

The importance of social media in distributing agricultural information is substantial, especially when it comes to connecting with farmers and rural communities. Platforms such as WhatsApp, WeChat, and educational TV shows serve as vital channels for filling the knowledge gap in agriculture. They empower farmers to access the latest information on crops, fertilizers, seasonal seeds, monsoon updates, pesticides, and the genuine value of products. Moreover, these platforms facilitate the education of farmers on advanced technologies, agricultural practices, and financial management skills, ultimately boosting awareness and knowledge within the agricultural sector. The impact of social media in spreading agricultural information to farmers is substantial, as it serves to bridge the gap caused by the inadequacy of the farmers' extension ratio (Shaikh et al.,

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2020). The utilization of social media for agricultural information has been demonstrated to enhance farmers' engagement in agricultural activities, particularly in regions with limited access to conventional extension services. Farmers frequently obtain information on agrochemicals, superior crop varieties, and pest and disease control from social media platforms such as Facebook.

For instance, in a study (Lakshmi and Babu, 2018) to assess the degree of extension functionaries' utilization of social media in southern India, it was reported that the majority of extension officials (97%) relied on Gmail, followed by WhatsApp (59%), Facebook (55%), and YouTube (47%) for sharing information. The study further indicated that innovativeness and information-seeking behavior were both found to be positively correlated. Social media serves as a valuable platform that enables extension professionals to stay informed about the latest advancements, establish connections, exchange knowledge, and reach out to a diverse audience. Despite the obstacles that farmers encounter in accessing social media, such as limited network coverage, high fees, power outages, and the absence of infrastructure, social media continues to be a vital tool for disseminating agricultural information to countless farmers. Social media platforms can be employed to supplement extension services, establish feedback mechanisms, and facilitate the tracking and assessment of the outcomes of agricultural projects.

- *Social Media Tools and Agriculture Extension*

Farmers frequently employ social media platforms like Facebook, YouTube, WhatsApp, Google Plus, and LinkedIn to gain access to agricultural information (Uddin & Karim, 2023; Shaikh et al., 2020; Kanjina, 2021). These platforms provide a vast array of information to farmers, including farming methods, technical knowledge, agricultural management, and treatment-related information (Daigle & Heiss, 2021). Additionally, social media enables farmers to connect with one another, share experiences, and learn from both success stories and failures (Uddin & Karim, 2023). For instance, in a Kenyan study, 42.9% of respondents utilised Facebook as their primary social media platform when seeking agricultural information, while 41.3% of participants relied on WhatsApp for the same purpose (Kanjina, 2021). In Thailand, farmers primarily use social media applications like LINE, Facebook, and YouTube for communication, staying up-to-date, and entertainment (Kanjina, 2021). However, the efficacy of social media in transmitting agricultural information to farmers is contingent upon the veracity of the information and the level of access to social media platforms (Daigle & Heiss, 2021; Shaikh et al., 2020; Uddin & Karim, 2023). Although social media provides farmers with a broad range of information, it is crucial to ensure that the information is reliable and pertinent to their needs (Uddin & Karim, 2023). Moreover, efforts must be made to address the challenges faced by farmers in accessing social media, such as poor network connectivity, power outages, and costly internet charges (Uddin & Karim, 2023). Social media platforms transcend geographical limitations to create communities of individuals who share common interests. Users of these platforms also seek information from traditional media sources. Rhoades and Hall (2007) highlighted the significant presence of blogs discussing agriculture-related topics. The majority of these blogs were formally written, although a significant proportion were not media-related. Agricultural media is now recognizing the potential of Web 2.0 technologies and adapting them for their audiences. As a result, it is crucial to examine each of these Web 2.0 applications carefully. Moreover, understanding how audiences prefer to receive information in today's fast-paced world is crucial (Rhoades & Aue, 2010). They emphasize the need for research to determine the extent to which audiences want or do not want agricultural information disseminated through Web 2.0 technologies.

- *Challenges Faced by Farmers in Attaining Agricultural Information from Social Media Sources*

There are a number of obstacles that agricultural producers confront when attempting to procure information from social media. The obstacles that farmers face in accessing agricultural information from social media emphasize the need for improving the accessibility, affordability, and infrastructure of digital resources to enhance their utilization for agricultural purposes. Some of the common ones are:

- Farmers often face challenges in obtaining agricultural information as a result of inadequate network connectivity, which limits their ability to fully utilize social media platforms.
- Lack of internet access significantly hinders farmers' ability to access agricultural information on social media platforms, despite social media being a valuable source of information.
- Agricultural information access presents challenges for farmers, as power outages can disrupt their ability to access the internet and engage with online content.
- Lack of access to reliable internet connectivity and technology hinders farmers' ability to access agricultural information on social media, limiting their ability to utilize online resources effectively.
- Agricultural information dissemination on social media platforms is often delayed, thereby limiting farmers' access to current data vital for their farming operations.
- Social media platforms provide agricultural information that farmers may struggle to comprehend and apply to their farming practices, which can hinder their ability to utilize the knowledge effectively.
- Lack of awareness about the sources of agricultural information on social media may restrict farmers' access to valuable resources and knowledge.

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- Agricultural information from social media can be challenging for farmers to access as it caters to diverse user groups' needs, potentially hindering information dissemination.

Extensively, a study (Kumar Ghosh et al., 2021), it was found that there are ten common and claim to be the major problems faced by farmers in the use of social media. These are: fear by farmers, lack of information, miss information, lack of awareness, illiteracy among farmers, lack of training, high costs of internet, negativity and rumors, poor internet access in rural areas, and limitation of agriculture related platforms like blogs, pages and groups.

III. METHODS

The study adopts an exploratory design with a qualitative research approach. Secondary data is sought from unstructured data as regard to social media application in the delivery of agricultural extension in uganda. Unlike structured data which can be analyzed with tables, unstructured data can not easily be searched and analyzed without further processing (Coursera, 2023). These data include images, videos, audio, email and text formats usually availed on various social media platforms regarding agriculture extension. However, ex-post-facto publications specifically regarding social media application in agriculture extension in Uganda were identified, examined and subjected to the analysis. These data were obtained and later subjected to meta analysis techniques so as to provide valuable insights. The analysis included generating and labeling units from the data, classification and establishing the relationship between categories and later presented in form of tables and discussions

IV. FINDINGS

From the data collection exercise, a total of thirty nine research reports were subject to scrutiny in regard to the objectives of the study. All the documents were retrospective studies that were mined from various online databases. It yielded a sample of thirty nine items concerning social media adoption and use by farmers particularly in Uganda. Items published in the open access domain were accessed and their findings were cross examined and then subjected to meta analysis to obtain the necessary data pertaining to this particular study.

➢ *Farmers' Awareness, Perception and Usage of Social Media in Uganda*

Farmer perceptions toward social media used have a strong influence on adoption behavior (Tomasi, n.d.). Active engagement with social media can broaden the scope of social interactions for farmers and enhance their social networks, which is positively linked to adopting new agricultural practices or technologies. The study indicates that more active participation in short-video social media increases the likelihood of farmers adopting improved cultivation techniques. Additionally, higher social media engagement is associated with a greater likelihood of adopting these techniques with more intensity. This is likely because farmers can gain more information about the long-term economic and environmental benefits through short-video social media, which expands their social networks and allows them to learn and imitate video bloggers who possess greater knowledge of farming practices.

However, research findings indicate a restricted ability to utilize phone-based extension services, particularly those that necessitate a smartphone, as well as a discrepancy between the anticipated level of use and the actual level of use, current capabilities, and potential opportunities. These findings offer potential starting points for designing suitable digital extension initiatives and interventions, highlighting the need for capacity development**.**

➢ *Social Media Tools Used by Farmers to Access Agricultural Information in Uganda*

In Uganda, farmers commonly use several social media tools to access agricultural information as depicted in table 1.

Table 1 **Social Media Tools Used by Farmers to Access Agricultural Information in Uganda**

Social Media Tool	Retrospective Finding	Source (s)
Facebook	This is widely used by farmers and agricultural organizations to share information, join groups related to farming practices, market their produce, and connect with peers and experts in the agricultural community	Anderson et al., 2016; Tuheirwe-Mukasa et al., 2019
Twitter	This is popular among farmers for accessing real-time updates on agricultural news, weather forecasts, market prices, and policy developments. Hashtags related to agriculture are often used to facilitate discussions and information sharing	Anderson et al., 2016; Deichmann et al., 2016
WhatsApp	WhatsApp groups are commonly used by farmers to communicate with each other, share information, seek advice, and coordinate activities. Agricultural extension services also utilize WhatsApp to deliver educational content and training materials directly to farmers' mobile phones	Byamugisha et al., 2008; Anderson et al., 2016; Tuheirwe-Mukasa et al., 2019

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YouTube	Farmers rely on YouTube for accessing video tutorials, demonstrations, and educational content on various agricultural topics, including crop cultivation techniques, livestock management, and agribusiness strategies	Matuha et al., 2013
Instagram	This is used by farmers to showcase their farming operations, products, and daily activities through photos and short videos. It also serves as a platform for promoting farm-to-table initiatives and engaging with consumers interested in sustainable agriculture	(Matuha et al., 2013)
LinkedIn	LinkedIn is utilized by agricultural professionals, researchers, and agribusinesses to network, share industry insights, and access career opportunities in the agricultural sector. It's particularly valuable for connecting with experts and accessing professional development resources	Barungi et al., 2016
Agricultural Apps	While not traditional social media platforms, agricultural apps play a crucial role in providing farmers with access to agricultural information and resources. These apps cover a wide range of functions, including weather forecasting, crop monitoring, pest identification, market analysis, and farm management	Pedrick, 2018; Sheila et al., 2022
	Less than 15% of smallholder farmers are using applications, taking color pictures, browsing the internet or using social networking sites.	Anderson et al., 2016

Table 2 Perceived Benefits of Social Media for Accessing Agricultural Data in Uganda

Benefit of Social Media	Retrospective findings	Source (s)
Efficiency and effectiveness	Reduced time and effort for accessing agricultural information	Byomire et al., 2016
	Saving costs for marketing and advertising produce	Byomire et al., 2016
	Social media increases information exchange, enhances productivity, facilitates marketing activities and saves time. For instance, youth living close to towns also use social media, such as Facebook and WhatsApp, for marketing their services and products in the livestock sector.	UN Women, 2021; Deichmann et al., 2016
	Perceived Value, Training, Social Influence and Social Awareness are deemed as important factors for the use of social media to strengthen service delivery for urban agriculture in Uganda	Byomire et al., 2016
	Social networks also played an important role in information access	Freeman & Qin, 2020; Matuha et al., 2013; Matuha et al., 2013
	Increasing information channels and the confluence between them, including social networks and community interaction, allows farmers to access and make sense of more information.	Freeman & Qin, 2020
Awareness	Over 90 percent of respondents received agriculture information from a strong-tie member of their social network, such as a family member or close friend.	Freeman & Qin, 2020
	Awareness creation was measured by the new practices and technologies that farmers were exposed to through Video Mediated Extension Approach. Farmers indicated how many new practices and technologies they were aware of as a result of exposure to video shows.	Karubanga et al., 2016
	While social media allow farmers to move between various information sources and shifting between in-person experts (extension agents), social networks are integral in the adoption process.	Freeman & Qin, 2020

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	Uses of social media in livestock agribusiness include the provision of extension services and agro- inputs, record-keeping and marketing of produce. For instance, youth who own phones could use e-vouchers to register and order medicines from vets.	UN Women, 2021
	Notably, some of the existing social media tools are mainly used for social networking (83.6%) and rarely for business (16.5 %), or research on agriculture.	UBOS, 2021
	the use of mobile phones, audio conferencing and portable external loudspeakers have also been found to enable farmers to access advice and link them with agricultural extension workers	FAO, 2014
	Concludes that access to extension services is a big contributor to food security as well as agricultural productivity among Ugandan farmers. Notably,	Pan et al. (2018) cited in Mpuuga et al., 2023

Table 3 Challenges faced by farmers in using social media for agricultural data in Uganda

Challenges	Retrospective Findings	Source(s)
Information overload	Farmers that primarily depended on strong ties within their social networks to access information are often constrained by the amount and type of information available to them.	(Freeman & Qin, 2020) and Qin, 2020
	The extension workers also cited challenges in accessing and distributing agro- meteorological information including unavailability of the information, low literacy levels among the farmers, and high poverty levels (farmers cannot afford modern equipment such as radios, mobile phones, computers).	Tuheirwe-Mukasa et al., 2019
	Some of the farmers are in hard-to-reach areas and therefore inaccessible.	Tuheirwe-Mukasa et al., 2019
	Many of the farmers do not believe in the accuracy of the seasonal weather forecast information and rely more on their own experiences.	Tuheirwe-Mukasa et al., 2019

Table 4 Recommendations for improving farmers' access to agricultural data through social media

Indicators	Prospective Studies	Source(s)
Increase awareness of the use of social media in accessing agriculture data among farmers	Sensitization on agricultural practices and training programmes by extension workers through social media tools	Byamugisha et al., 2008
Training of farmers	Undertake the provision of training and capacity-building initiatives to bolster farmers' digital literacy and proficiency in leveraging social media platforms and obtaining agricultural data online. Workshops, training programmes, and community outreach endeavours can impart knowledge to farmers on how to effectively traverse social media, seek out agricultural information, and interact with extension services over the internet.	Barihaihi & Mwanzia, 2017
Improve internet connections in rural areas	Enhance rural farmers' access to dependable internet connectivity and mobile networks in Uganda's remote areas to enable them to access social media platforms and agricultural data online. This could be achieved by investing in infrastructure development, such as expanding network coverage, deploying rural broadband solutions, and reducing the cost of internet access.	Bachmann et al., 2017

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Creation of social media hubs for farmers	Develop social media hubs and community networks in rural regions, where farmers can access shared devices, internet connectivity, and training resources for utilizing social media and accessing agricultural data online. These hubs can function as community centres for digital learning, knowledge sharing, and collaboration among farmers.	Barihaihi & Mwanzia, 2017
Collaborate with Agricultural Extension Service providers	Partner with government agencies, agricultural extension services, and non-profit organizations to integrate social media into existing extension programs and advisory services. Train extension workers on how to leverage social media platforms to disseminate agricultural information, engage with farmers, and provide personalized support online.	Bachmann et al., 2017
Engage Youth and Women Farmers	Undertake outreach initiatives aimed at young and female farmers, who may encounter additional obstacles when accessing agricultural data and social media platforms. Create tailored campaigns, mentorship schemes, and rewards to motivate and encourage their involvement in online agricultural communities.	Barihaihi & Mwanzia, 2017
Provide Real-Time Updates and Alerts	Utilize social media to deliver instantaneous updates, alerts, and advisories regarding agricultural emergencies, weather projections, pest infestations, and fluctuations in the market. Maximize the potential of social media monitoring tools to identify and address pressing concerns impacting farmers and rural populations expeditiously.	Byomire et al., 2016
Continuously monitoring and evaluation	Continually assess and analyse the influence of initiatives aimed at enhancing farmers' access to agricultural data via social media in Uganda. Gather opinions from farmers, extension workers, and other relevant parties to evaluate the success of the implemented measures and modify approaches based on the insights gained and evolving requirements.	Deichmann et al., 2016

V. CONCLUSIONS

Huge volumes of agricultural data are generated and shared on a daily basis to various people using platforms mainly because agriculture is the backbone of the Ugandan economy. Over the years farmers have relied on traditional approaches and methods by depending on mother nature for fundamental inputs like rain, fertilisers, seeds and repetitive crop and animal reproduction with no due analysis and prediction of future trends. Traditionally information and knowledge has been passed on from elders and established farmers by word of mouth through gatherings and occasional consultations from peers in the field. Information and knowledge are vital to farmers as it can be used to make timely and informed decisions for better yields and improve on the profitability of farming practices in the market as a whole. Most of the information generated season after season is scattered all over different farmers without centrally gathering it for proper analysis and pattern trend detection which can potentially contribute to useful insights. In Uganda social media has gained ground with the reduction of internet prices per megabyte and access to smartphones, users continually share real time information about general news and events over platforms such as WhatsApp, Tik Tok, Facebook and Twitter (Now "X"), on the other hand users from the agriculture value chain like farmers, traders and dealers share various information about the latest experiences and trending stories using same channels. Government and policy makers through their agencies are beginning to use the same channels to reach farmers and stakeholder as well to communicate new approaches and researched information useful to farmers in real time. Clearly, there is a simple and effective means of communication with great potential yet to be exploited and organised to derive value from the information generated and shared that will guide decision making in the Ugandan context. A more comprehensive inquiry should delve into the means of promoting the utilization of services such as email and websites for the dissemination of weather forecast information to farmers. One of the key challenges that needs to be addressed is evaluating the impact on agricultural productivity that arises from farmers employing weather forecast information to make decisions related to agriculture.

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