Impact of the Digital Revolution on Indigenous Technical Knowledge of Land Managers in Kole District, Northern Uganda

Impact of the Digital Revolution on Indigenous Technical Knowledge of Land Managers in Kole District, Northern Uganda

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Abstract:

Purpose: Considering the various challenges and the evidence of the dwindling agricultural productivity among a good number of farmers in Uganda, the focus of this paper was on how Ugandan farmers can produce higher yields for the exploding national and regional population.

Methodology: A desk review method was adopted on selected definitions and earlier models of indigenous technical knowledge are discussed as a basis gauging the consequence of digital revolution on indigenous technical knowledge.

Findings: The outcomes suggest that as a result of advancement in technology, there has been an increasing shift; that the traditional conservation wisdom in the cultural and artistic elements of communities in the development and management of biodiversity and its strategies and policies has no proper application in these modern times. Likewise, traditional knowledge systems in the cultures of people do not have any correlation with the scientific conservation models used in modern farming societies.

Unique Contribution to Theory, Practice and Policy: It is encouraged that an increase in the number of agricultural workers, involvement of higher institutions of learning and proper acknowledgement of land managers for their unique indigenous technical skills should be prioritized by the government of Uganda. With global connectivity, technological advancement and data driven decision making, an improvement in efficiency of production and way of thinking of land managers will culminate in the best resource utilization of agricultural resources in Kole district.

Key words: *Digital Revolution, Indigenous Knowledge, Smart Farming, Farmers*

1. Introduction

One of the salient and precise interrogations that present-day civilizations have to cope with is how to feed the ever-growing human population while at the same time the land available for arable farming continues to dwindle given that land is not only inelastic but the soil nutrients are ever deteriorating. An ever-budding number of characteristics of a good number of civilizations and their survival are indistinguishably connected to variations brought about by climate change that are enormously impacting people's normal routines, insights of agriculture, access to organic food supplies and many others. In their study, Babadjanova, Bobojonov, Bekchanov, Kuhn and Glauben (2024), suggest that rising summer temperatures and soil salinity would considerably reduce wheat production as a result of combined effect of climate change in Uzbekistan. Even though sub-Saharan Africa (SSA) is perceived to be the tiniest generator and/or emitter of carbon world over, the effects of climate change have not by-passed the region (Appiah-Otoo, Ntimoah, Chen & Ankrah Twumasi, 2024). The region is already facing climate tremors perpetuated by climate change effects on both agricultural sector and non-agricultural sector (Zoungrana, N'Guessan & Combary, 2024). There is thus a concern worldwide that current rural farming is not producing food with the king of knowledge and lifelong skills that farmers require to be successful in their enterprises. This shortcoming has put increasing pressure on farmers to enhance their productivity of their farms by ensuring that indigenous knowledge experiences translate into a fulfilling transition to the agricultural market.

Kole district is found in Lango-sub region with two constituencies: Kole North and South and is bordered by Lira district to the east, Apac district to the south and Oyam district to the west and North. Kole North and South comprised of Aboke, Alito and Okwerodot and Ayer, Bala and Akalo Sub-counties respectively. Kole Town council, the district headquarters are located approximately 28 kilometers by road North of Lira City. The precise coordinates being 02 24N, 32 48E (Location & Size, Kole District, n.d.). Land entails all natural resources and no human effort has been used to make or alter them and can be used for the production of goods and services (Greenlaw & Shapiro, 2017). Land manager is a person who is legally responsible for the maintenance, use and development of resources for a section of land or a piece of property. They are responsible for overseeing the management of land and natural resources (Law Insider, n.d) at a time when several land-related conflicts have become rampant in the region (Omodo, Obici & Mwesigwa, 2023a).

Digital revolution refers to widespread adoption and integration of digital technologies in various aspects of society; leading to significant changes in how individuals interact, communicate, work, and conduct business (Hantrais, Allin, Kritikos, Sogomonjan, Anand, Livingstone…Innes, 2020; Warren, 2021). This transformation is characterized by the rapid advancement of digital technologies such as computers, the internet, mobile devices, and artificial intelligence, which have fundamentally altered the way information is created, shared and consumed (Balbi, 2023). Regarding land management, it appreciates the use of modern technologies to create and maintain a spatial platform for digital agriculture and the digital economy (Earth and Environmental

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Science, 2021). Consistent with Azmath (2021), digital revolution is a shift or transformation which harnesses the power of data, drive service excellence and building the capabilities of society to integrate data resources and analytics for real-time insights and recommendations for people related questions. Indigenous technical knowledge (ITK) refers to knowledge about the local environment that is produced, held, and used by indigenous peoples and communities (Agrawal, 1995). The phrase Indigenous technical Knowledge can be variedly called and or referred to as "indigenous knowledge" or "traditional knowledge", "local knowledge", "traditional ecological knowledge" "ethno-ecology" to mean the same thing (The World Bank, 1998).

Warren (1987) describes indigenous knowledge as a local knowledge that is unique to a given culture or society. According to Rajasekaran (1993), indigenous knowledge is the systematic body of knowledge acquired by local people through the accumulation of experiences, informal experiments and intimate understanding of the environment in a given culture. To Haverkort and De Zeeuw (1992), indigenous knowledge is the actual knowledge of a given population that reflects the experiences based on traditions and includes more recent experiences with modern technologies. However, Modern digital technologies form a new system infrastructure for supporting land management, which makes it possible to comprehensively optimize the processes in the management of country land resources to achieve important positive economic changes in related sectors of the economy that depend on spatial development since indigenous understandings of the land itself had become incompatible to the ecological knowledge especially following ethnoecological studies (Berkes, 2012:3).

Examples of Digital revolution, relating to land management, include: (a) Geographic Information System (GIS) which consists of integrated computer hardware and software that helps to analyze, manage store, edit, output, and visualize geographic data (DeMers, 2009; Chang, Kang-Tsung, 2016). (b) Computer Aided Design (CAD) which is technology designed for creators to design, draft, and produce technical documentation replacing manual hand-drawn and drafting techniques with a digital first process (Srinath, 2020). (c) Building Information Modelling (BIM), which serves to create and manage information on construction, Big Data which refers to large, diverse data sets made up of structured, unstructured and semi-structured data Big data refers to large, diverse data sets made up of structured, unstructured and semi-structured data used across almost every industry to draw insights, perform analytics, train artificial Intelligence and machine learning models, as well as help make data-driven business decisions (Azhar, Nadeem et al. 2008; Bazjanac 2006). And (d) Block chain, which is a secure database shared across a network of participants, where up-to-date information is available to all participants at the same time (McKinsey, 2022).

1.1 Statement of the problem

The central attention of this paper is the dominant condition of the indigenous knowledge in the agricultural sector in Uganda, which is facing numerous threats as a result of dynamic climatic conditions in the country. There are signals that threats being experienced in Uganda's indigenous knowledge is organizational in nature, that is, a number of farmers are migrating from traditional farming methods and therefore adopting smart technologies in farming and food system. This condition is a giant trial for the relevance of indigenous knowledge, given the rampant land-related conflict in the region (Omodo et al., 2023b), and consequently, desires instantaneous consideration. Owing to this challenge, this paper examines the impact of digital revolution and the observable challenges facing that revolution in Kole district, northern Uganda.

1.2 Objective of the paper

The core research questions of this paper, which reflect areas of concern in this paper, are basically two, namely: (a) What is impact of digital revolution on the indigenous technical knowledge in Kole district? (b) What are the observable challenges facing digital revolution in respect of indigenous knowledge in Kole district?

2. Methodology

The central method for this paper was a desk review of obtainable experiential and theoretical works on digital revolution in Uganda and other countries of the world. Desk research is essentially the gathering of information from available sources, for example, academic periodicals, the net, the media, diagnostic and experiential information and statistical journals. This is then proceeded by cross-referencing and organization of information (Ennever & Browne, 2023). It has been recognized to be very helpful and can be used in the preliminary stage of a research venture as much of the straightforward evidence can effortlessly be put together and then applied as a guide in the research development.

3. Results of the study

3.1 Impact of digital revolution on the indigenous technical knowledge

Due to advancement in technology, there has been an increasing shift (Battiste, 2002); that the traditional conservation wisdom in the cultural and artistic elements of communities in the development and management of biodiversity and its strategies and policies has no proper application in these modern times. Also, conservationists and some scholars opine that traditional knowledge systems in the cultures of people do not have any correlation, whatsoever, with the scientific conservation models used in modern societies (Materer et al. 2002, Battiste 2002). As such, the digital revolution has over time impacted on the indigenous technical knowledge of Land managers in quite a number of ways. These includes:

    a) *Technological Advancements:* The digital revolution by continuous technological advancement that have enabled the development of innovative tools and platforms for

communication, data storage, analysis, and automation. These technologies have revolutionized industries such as healthcare, finance, education and entertainment (Railean, 2017). For example, in Kole district land managers have embraced the use smart phones, computers, GPS devices for acquisition of land elevation, weather detection and disease outbreak for proper planning and this in particular is currently being used by Ogweng farm in Ayer Sub-County practicing both upland rice and fish farming.

b) *Global connectivity*: One of the defining features of digital revolution is the global connectivity facilitated by the internet, Facebook, WhatsApp and other digital networks. This interconnectedness has transformed how people collaborate across geographical boundaries, access information instantaneously and engage in online communication (Park, Freeman & Middleton, 2019; Amalia, 2024). Some land managers in Kole district for example Prof. Otim Nape owning and managing a farm in Akalo sub-county, Kole district; dealing with livestock specifically cattle and goats, and in addition rice cultivation uses internet to enable him get information in regards to SMART farming.

c) *Disruption of traditional industries:* Digital revolution has disrupted traditional industries by introducing new business models that leverage digital technologies to deliver products and services more efficiently (Liu & Liu, 2023; Kuok, Chiu, Bakri, Rahman & Yun, 2023). Companies that fail to adapt to these changes risk becoming obsolete in rapidly evolving digital landscape (Allam & Jones, 2021). Traditional practices common in the past with traditional land managers included 'Myelo Kot' meaning dance for the rain to come under a big tree but this has been replaced by new and more digital technologies for solar powered irrigation, weather forecasts on radio stations etc., and currently this has been adopted by Omoo Geoffrey and family fish, cattle and rice farming in Bala Sub- County.

d) *Increased access to information:* The digital revolution has enabled land managers in Kole district to access a vast amount of technical knowledge through online resources, databases, and platforms (Minjauw, Rasheduzzaman, Huang, Lozano, Baumgartner, Dorward,…Cohen, 2024). For instance, the Ugandan Government's National Agricultural Research Organization (NARO) provides farmers with agricultural information through its website and mobile applications for example Omara Sandrew in Aboke sub-county, Kole District agrosilvopastrol system of agriculture is currently using it. Unlike in the traditional enterprise systems, digital revolution exhibits new properties as cited in the work of Kallinikos et al., (2013) where he described the digitalization as generative, malleable and combinatorial. Second, many digital technologies cannot be restricted to the boundaries of specific families, society, firms or industries but involve a wider ecosystem and the demand-side causing flexibility and ready for use by anyone, not just by companies (Tilson et al., 2010).

e) *Enhanced communication:* Digital tools have facilitated better communication among land managers and other extension agents, researchers and other stakeholders allowing them to share technical knowledge, best practices and challenges more efficiently (Wang, Wang &

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Xiong, 2024). An example is Aboke development WhatsApp group that brings together land managers, stakeholders and extensionist on one platform for sharing real-time information on pests and diseases affecting crops in Kole district and other currently available SMART farming digital technological knowledge.

f) *Improved data collection and analysis:* Through digital technologies, land managers in Kole district can now collect and analyze data more efficiently using computer and other ICT tools, leading to better-informed decision-making processes (Gaber, Rösch & Bieling, 2024; Su, Liu & Wang, 2024; Melaku, Sefereh, Emunu & Wassie, 2024; Liu & Liu, 2023). This is currently being done in Akali Ayom and family Agroforestry and cattle farming as way for future planning and risk mitigation.

According to Hilbert and López, (2011), the digital revolution, brought radical transformations in information storage, transmission, and computational power. According to him, by 2007, the world's information storage capacity was over 15 times greater than in the early 1990s, with 97% of information storage in digital form. This shows a remarkable improvement in the data collection, analysis and storage as a whole (Billari and Zagheni, 2017).

g) *Increased efficiency by using remote sensing and GIS application:* Digital revolution is a critical driver in the global evolution of society and the economy compared to Indigenous technical knowledge (Diriba, Takele, Karuppannan & Hussein, 2024; Nambisan et al., 2019; Guandalini, 2022). For example, the use of remote sensing and geographic information systems (GIS) has empowered land managers in Kole district to make informed decisions regarding land use planning and management by promoting information land use patterns, soil quality, water resources and vegetation cover. This is currently being done by Opio Odongo Cattle and rice farm in Ilera village, Alito sub-county, Kole district to boost his business especially assessment of soil quality to improve pasture for cattle.

h) *Capacity building initiatives:* The term "digital revolution" describes a fundamental change in activities, processes, competencies, and organizational models to fully leverage the opportunities and impacts of various digital technologies in a strategic and prioritized manner (Scoop.eu, 2021). Emerging digital technologies, such as cloud computing (CC), big data (BD), the Internet of Things (IoT), and artificial intelligence (AI), along with existing information and communication technologies (ICT), are reshaping how individuals and businesses operate (Gaber et al., 2024; Nelson, Faxon & Ehlers, 2024; Acanga, Mwesigwa, Oryang & Oboi, 2022a; Meneghello et al., 2019; Rakowski et al., 2021; Polak, 2021). For example, in Kole District, Various initiatives supported by the ministry of Agriculture, RELAPU (Responsible Land Project in Uganda), Ministry of Land, Planning and Urbanization and district authorities have focused on training land managers in the region on how to leverage digital technologies for improved technical knowledge.

i) *Mobile applications for agriculture:* The need for growing enough food for a growing human population while reducing food systems' impacts on ecosystems cited in (Acanga et al., 2022; Godfray and Garnett 2010; Foley 2011) has called for change in the indigenous technical knowledge under the current wave of technological innovation and digitization in agriculture, known as the digital agricultural revolution (DAR). This has been evidenced by recent technological advancements such as artificial intelligence (AI), robotics, three-dimensional (3-D) printing, nanotechnology sensors, unmanned aerial vehicles (UAVs), blockchain, controlled-environment agriculture (CEA), big data analytics, and the Internet of Things (IoT) (Weersink et al. 2018; Klerkx and Rose 2020).The development of mobile applications tailored to the agricultural sector has provided land managers in Kole district with real-time information on weather patterns, market prices, pest-outbreaks etc. enhancing their technical knowledge base specifically Ogweng farm, Omoo Geoffrey and family, Pro. Opio Odong have reached this pinnacle of using the moble Apps. These have culminated into improved disaster management i.e.; digital technologies enable early warning systems (Early warning and early actions) for natural disasters like floods or drought by providing real-time data on weather patterns and soil moisture levels thus informing disaster preparedness efforts and mitigate impact of disasters on agricultural production systems across the district.

j) *E-extension services:* The introduction of e-extension services has enabled land managers in Kole district to receive expert advice, guidance, and technical information remotely, contributing to their overall knowledge enhancement (Klerkx, L., 2021). Nowadays, digital and virtual spaces are there for extension and advisory services which helps the land managers to learn about their environment protection, the changing trends in climate and research for development among others (Higgins et al., 2017; Darnhofer Citation2020; Comi, 2020), which shape farmers' decision making and innovative behavior and provide spaces for radical changes in the traditional knowledge. For example, Land managers in Kole district receive virtual refresher training to help enhance their SMART farming knowledge

k) *Adoption of farm management software:* Many land managers in Kole district have started using farm management software that helps them track activities, monitor progress, and make data-driven decisions for better land management practices an example being Farm-Master developed by Farm-Master Software Solutions Ltd designed specifically for small holder farmers in Africa but also land managers in Kole district have also benefited example, Acede Nicky and family poultry farming is currently using the software to assess production levels of his farm. Other features of the software are crop planning and monitoring, livestock management, financial tracking, market information and weather forecasting that other land managers in Kole district take advantage of. Another software is Farmer line's Farm Force with capabilities to provide personalized SMS alerts on weather conditions, market prices, input availability, and best farming practices and is used

by Prof. Otim Nape to manage his farm in Akalo Sub- County, Kole district as it is reliable with his busy schedule because of the SMS alerts.

l) *Climate Smart Agricultural practices:* Digital tools have facilitated the adoption of climate-smart agriculture practices among land managers in Kole district by providing them with insights on sustainable farming methods suited for local conditions (Allam & Jones, 2021). For example, Prof. Otim Nape's farm in Akalo Sub- County, Kole district uses Solar powered irrigation system to help provide sufficient water supply to allow sustainable upland rice production even with the ongoing climatic change that have become un-reliable.

m) *Improved monitoring and evaluation:* The digital revolution has brought about monitoring and evaluation tools that enable land managers in Kole district to assess the impact of their interventions accurately and adjust strategies accordingly. For instance, the Italian surveillance system of livestock farms (Tomassone, Scali, Formenti, Alborali, ARagrande, Canali,…De Meneghi, 2024) has been successful thus suggesting that digital technologies enable real-time monitoring of agricultural production systems using remote sensing techniques like satellite imagery analysis that provides real time data on farm practices and progress helping land managers such as Otim Nape to strategize appropriately.

n) *Collaboration and platforms:* Digital platforms have encouraged collaboration among different stakeholders involved in land management in Kole district, fostering knowledge exchange and innovation within the sector e.g., farmers can collaborate with extension agents or researchers through digital platforms like WhatsApp groups an example is Aboke development WhatsApp group, online forums for example Kole brokers; to share best practices and learn from each other's experiences and market opportunities amongst the managers made easier. Through digital platform like e-commerce websites or online market places, land managers in Kole district can explore new market opportunities for their produce, expanding their technical knowledge on Market trends and demand.

o) *Policy advocacy through digital channels:* land managers in Kole district can now engage in policy advocacy efforts through digital channels such as social media or online forums, amplifying their voices and influencing decision-makers based on sound technical knowledge example., the government of Uganda has undertaken land reforms to support the digital transformation of the land sector. This includes updates to the Land Act, Land acquisition Act, Physical planning act, Registration of titles Act, and the national land policy of 2013. These reforms facilitate the digitalization of land records and transaction which are crucial for land managers in Kole district to access up-to-date information.

p) *Increased transparency:* Digital technologies enable greater transparency in agricultural value chain by providing real-time information on prices, market trends, and supply logistics. This can help reduce price volatility and improve market efficiency (Melissa, 2022). For example, Land managers in Kole district have also benefited from the implementation of the Uganda national Land Information System that has been a key

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development where the system decentralized land governance, allowing for the establishment of Ministry Zonal Offices across the country. This has therefore improved land acquisition therefore allowing for well-planned district planning and development.

q) *Digitalization of Land Record:* For corporations and investors, access to up-to-date information in the form of a "digital land profile" means that land can be located, offered and demand quantified, and prices for land, production and natural resources, such as carbon credits, calculated. This is one of the ways in which the digital revolution has impacted on the indigenous technical knowledge in our land management. In Kole district, digital land records provide an insight on land elevation that allows for proper farm planning using digital tools like AutoCAD, GIS and the likes and this is currently being used by Prof. Otim Nape.

3.2 Observable challenges

a) *Inequity in terms of access to digital resources:* With the increasing rate of digitalization slow growing communities tend to be left out and marginalized in the process. Not until recently that the Uganda Electricity Transmission Company is establishing a double circuit transmission line as part of the grid expansion reinforcement project passing through Kole district, but previously Kole district relied on kerosene lamps for lighting at night still even persisting in some less developed communities (UETCL Set to Connect West Nile to National Grid in 2023). This existing gap will result in marginalization of some communities therefore improvement of indigenous technical knowledge of land managers in Kole district will be held on a standstill.

b) *Erosion of cultural identity:* As modern technologies become more prevalent, there is a risk that traditional practices and beliefs for example 'Myel Kot' i.e., dancing for rain practiced in Kole district last done about 50 years ago by traditional land managers, has been overshadowed or replaced by mainstream digital culture. This shift can result in a disconnect between younger generations and their cultural heritage, impacting the preservation and continuity of technical indigenous knowledge related to land management (United Nations Permanent Forum on Indigenous Issues (UNPFII) | Division for Inclusive Social Development (DISD), n.d.)

c) *Intellectual property concerns:* Digitization of traditional knowledge for commercial purposes without proper consent or benefit-sharing arrangements can lead to misappropriation and loss of control over valuable resources. Land managers in Kole district therefore find it challenging to protect their technical indigenous knowledge from unauthorized use or appropriation in the digital age (WIPO - World Intellectual Property Organization, n.d.)

d) *Low internet connectivity:* The distribution grid of internet service providers in Kole district i.e., MTN Uganda and Airtel insufficiently covers most parts the district. This

therefore makes it challenging for land managers in Kole district to access online information and also apply digital tools like GIS in SMART farming.

e) *Inability to acquire required technological knowledge:* Deficiency in education as well as training has hampered acquisition and harnessing of particular digital tools as pertains SMART farming in Kole district. An example is Ariko David who owns a family Agroforestry and cattle farm in Apuru parish, Aboke sub-county who has insufficient education and training to use tools like GIS run in computers.

f) *Cybercrime:* As a result of rapid advancement in ICT threats to data security bring to rise at a rapid level and this also includes threats to land managers in Kole district. Commonly in Kole district are online scammers that steal money from land managers especially on financial tools such Mobile money, bank accounts and also VSLA that many land managers subscribe to in Kole district.

g) *Financial challenge:* As a result of the daunting price of internet and its accessory devices, a big gap is created in uptake of these tools in normal farm running and land management planning by land managers in Kole district. An example is Opio Abenego Farm located in Aboke Nubi, Aboke sub- country that has slowly picked up Smart farming as a result of the accruing financial challenges.

4. Conclusion

The conclusion of this paper, from the various definitions is that digital revolution has had significant positive impact in Kole district but at the same time posing challenges for the district to cope with the ever-changing global village. Uptake of the latter has helped improve the livelihood, knowledge, and overall way of life in Kole district. With global connectivity, technological advancement and data driven decision making, an improvement in efficiency of production, way of thinking of land managers will culminate in the best resource utilization in the district. But at the same time posing a challenge of equity in terms of resource access to digital resources and the risk of erosion of our precious traditional knowledge.

5. Recommendations

From the conclusion of this study, it is encouraged that:

a) Scouting for external investors, for example NGOs, and lobbying for funds from the Government to help provide start capital and at the same time providing desired training to Land managers especially farm managers therefore easing adoption of Climate Smart farming.

b) Government can take up control of SMART devices; regularly updating and improving security therefore reducing incidences of cybercrime related acts or preying on Land managers' essential information.

c) The government can also increase the number of agricultural extension workers in Kole district to help bridge the gap between the marginalized land managers in hard-to-reach areas bringing them at the same level with those that technologically advanced.

d) Involvement of higher institution of learning such as universities to carryout informative research identifying and preserving different indigenous technical knowledge within Kole district as pertain land management.

e) Proper acknowledgement of land managers for their unique indigenous technical skills allowing sense of belonging and improving sharing of such valuable information therefore preventing loss of such knowledge.

f) The government should offer tax holidays or subsidies for internet service providers like MTN, and airtel so that grid expansion of boosters to hard-to-reach areas is achieved therefore improving internet connectivity in hard-to-reach areas in Kole district.

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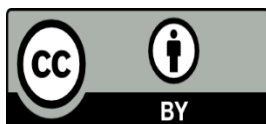
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