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PROMOTING PEER-ASSISTED LEARNING (PAL) FOR DIGITLIZATION OF AGRICULTURE IN COOPERATIVE SOCIETIES

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ABSTRACT
The objective of the paper was to address the need for digitalization of agricultural practices of farmer-members of cooperative societies. Peer-assisted learning having been widely acknowledged as an instructional strategy that promotes the acquisition of knowledge, skill and behavior among status equals who are not professional teachers was advanced as a deliberate model to fit the desire of scaling up use of digital tools and technologies in cooperative societies. To achieve this, the paper took an exploratory dive to dimension concepts relevant to digitalization of agriculture, the cooperative as a learning platform and the dynamics of peer-assisted learning as a tool for individual interdependence, face-to-face interaction and individual accountability for small group skills. Thereafter, an explicit mechanism of a model that adopts PAL in cooperative societies for achieving greater depths of digital tools adoption and utilization for increased farm productivity, efficiency, profitability and high sense of community building was proposed. Finally, partnership of cooperative societies with pedagogical experts on PAL advancement, a concerted plan of cooperatives to stay updated on agriculture digital tools while equally making higher budgetary allowance for credit to members regarding these technologies were important recommendations from the work.
Keywords: Peer-assisted learning, Digitalization, Agriculture, Cooperative societies

Introduction
The role of technology and innovation has remained indispensable to the growth and advancement of modern society. In agriculture, it is generally observed and empirically evidenced on low uptake of digitalization in the sector (Ayim, Addison and Tekinnerdogan 2022; Abdulai 2023). This condition often results from a poor strategy in making these technologies

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available to actors in the agriculture value chain. Many smallholder farmers in developing countries resort to collective actions by forming cooperative societies to overcome structural rigidities that hinder their farm production. Essentially though, cooperative is a peer-driven organization that provides education and training to members and board members to help them contribute meaningfully to the development of their cooperatives, individual enterprises and the larger community wherein they operate.

Topping (1996) had defined peer-assisted learning (PAL) as people from similar social groupings who not professional teachers are helping each other to learn and learning themselves by teaching. PAL as a technique in wider education delivery has been noted to deliver positive learning outcomes. As a contemporary instructional strategy, it aims to promote learning that affords opportunities to learners to formulate their questions, explain their view points while engaging in cooperative and collaborative actions that lead to team building in problem solving (Christudason, 2003).

Peer-assisted learning embodies the social learning theory that emphasize that people can learn from each other through observing, modelling and imitating the behavior, attitudes and emotional reactions of others (Bandura, 1977). This helps and explains how new skills and behavior can be acquired through paying attention and then trying to reproduce these behaviors themselves. There is the need for cooperative managers to deploy efficient knowledge sharing techniques that would promote the technological, social and economic interests of their societies' members. The objective of the paper is therefore to explore the application of peer assisted learning to enhance digital solution and technology adoption by members of cooperative societies. The paper will be exploratory, building on literature to highlight concepts and finally progressing to advance an effective mechanism and framework for practical utilization of PAL to deliver digitalization in members farm activities. In order to achieve this objective, the paper will be divided into the following sections:

- Digital Agriculture and Digitalization of Agriculture
- Concept of Peer Assisted Learning
- Cooperative as a Learning Platform
- Mechanism and Framework for the use PAL in Cooperative for Effective Agriculture Digitalization
- Conclusion
- Recommendations

Digital Agriculture and Digitalization of Agriculture

Global developmental trends call for Agriculture to align with current realities of a digital enabled world. This is particularly so that the sector remains key to food and nutrition security. Digital technologies will

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drive innovation in farming methodologies for improved farm productivity particularly for marginal and smallholders who are most constrained by structural rigidities around their production systems.

Degila et al. (2023) espoused Digital Agriculture as the digitalization of the different aspects of farming value chains. According to Ozdogan, Gacar and Aktas (2017) digital agriculture uses computer and communication technologies to provide services to farmers. Such services would include information, inputs and market access that result into increased profitability and productivity of farmers.

Digitalization of agriculture is more comprehensively defined as applying digital tools and systems to aid agriculture practices and process (Palloni et al. 2018). For instance, Artificial Intelligence (AI), Precision Agriculture, Remote sensing, Big data and Analytics, Blockchain, Unmanned Aerial Vehicle (Drones) are key emerging technologies applied to digitalization of agriculture. This is aside the basic use of phones in digital wallet, internet and computers. OECD (2022) associates digitalization with the adoption of ICT (Information Communication Technology), including internet, mobile technologies and devices, as well as data analytics used to improve the generation, collection, exchange, aggregation, combination, analysis, access, searchability and presentation of digital content, including for the development of services and application. However, Digitization is distinct from Digitalization. According to Brennen and Kreiss (2021) digitization has been explained as the non-theoretical procedure of changing analogue messages into digital data.

Besides these digital technologies, their application in agriculture could generally be classified into three groups as – data/data collection, decision support software/tools and precision equipment or input adjustment. Accordingly, these are shown in Table 1

Table 1: Digital Agriculture Tools and Classification

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Data collection tools	Decision support tools	Precision equipment
• Accelerometers	• Soil maps	• Automated guidance GPS/GNSS
• Automated heat detection	• Tracking of livestock	• Controlled traffic
• Crop sensor	• Yield maps	• Digital pasture management
• Digital pasture management		• Distributed ledger technologies
• Precision weighing scale		• Milking robot
• Satellite /Drone imagery		• Soil maps
• Virtual fencing		• Telemetry
• Yield monitor		• Variable rate technology

Source: Adapted from OECD (2020) with modification

Many other digital trends in agriculture have contributed in improving efficiency and helping farmers build resilience. New technologies have made vital data available for making predictions on weather conditions, understanding the incidence of pest and diseases. Big data, analytics and artificial intelligence have changed the face of farm operations by making and facilitating decision processes for positive eventual outcomes on productivity. In fact, real time gathering of data on crop performance for instance, has made veritable contributions in improving quality of farm outputs. There are also web-based data which are available and are used to make predictions that are necessary for preparing farmers to adverse weather conditions and shocks, thereby improving their resilience. Generally, digitalization increases the access to information, enhance productivity, profitability and strengthen resilience for smallholders and communities (Abdulai, 2022). The need and use of these tools are becoming pervasive and important for agricultural development. Groupe Speciale Mobile Association GSMA (2020) had for instance noted that 437 digital services were in application in Agri Tech as at 2020.

In reality, many factors have impeded the effective digitalization of agriculture in developing countries. However, several studies show that lack of knowledge and relevant skills on use of digital tools and technologies remain critical (Olagunji et al. 2021; Baumuller and Addom 2020). This situation could be dire with cooperative societies in Nigeria because of the general low levels of literacy among members. Moreover, farmer-members of cooperatives need strong financial base to acquire infrastructure that are necessary to support digitalization such as high- speed internet and power to enable several of these web-based digital devices. Accordingly, authors have highlighted poor infrastructure and limited capital for investments as constraining variables in the agriculture sector (National

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Communications Commission NCC 2021; United States Agency for International Development USAID 2020). Organization of European Community Development OECD (2022) identified infrastructure and connectivity, cost, relevance, user-friendliness, skills, risk and trust building as policy issues to focus for effective digitalization to take place.

Cooperative as a Learning Platform

Cooperative societies are considered important in the economic and social transformation of our communities. Their roles in agricultural development stems from helping in providing farmer-members with production inputs such as seeds, agro-chemicals, land and fertilizers at reduced prices as well as in creating market access for their produce. They equally provide farmers platform for knowledge sharing on skills and technologies.

Interestingly, cooperatives as peculiar business organizations that are driven by values and principles. These Principles create guidelines for cooperatives to follow and allow them to put their values into action. According to International Cooperative Alliance ICA (1995) in its statement on cooperative identity, the definition of cooperative, its values and principles are stated thus:

> *A cooperative is an autonomous association of persons united voluntarily to meet their common economic, social and cultural needs and aspiration through a jointly-owned and democratically controlled enterprise. Cooperatives are based on the values of self-help, self- responsibility, democracy, equality, equity and solidarity. In the tradition of their founders, cooperative members believe in the ethical values of honesty, openness, social responsibility and caring for others.*

The seven principles of cooperatives are thus listed:

1. Voluntary and open membership
2. Democratic member control
3. Member economic control
4. Autonomy and independence
5. Education, training and information
6. Cooperation among cooperatives
7. Concern for community

As espoused fully for Principle 5 from the Statement on Cooperative Identity;

"cooperatives provide education and training for their members, elected representatives, managers and employees so they can contribute effectively to the development of their cooperatives. They inform the general public – particularly young people and opinion leaders about the nature and benefits of cooperation"

This Principle establishes the cooperative as a learning platform that seeks to inform and educate her members, managers, elected representatives, employees and the public. At the center of the objective consideration in cooperative formation is usually her members. This member driven orientation

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makes them fundamentally different from other business organizations. The United States Department of Agriculture (USDA) in her study of 1987 on positioning farmer cooperatives for the future defined cooperative as a user-owned, user-controlled business that distributes benefits on the basis of use (USDA,2002). This peculiarity in cooperative confers all the three rights of ownership, control and benefit to her members and therefore makes it different from investor-owned-firms(IOFs).

From general experience in developing countries, cooperative societies have not been effective at promoting strategies for advancing innovation such as digitalization at farmer-members' enterprises. In Agriculture, particularly for front-end-technological innovations, their diffusion has mostly been carried out by cooperatives through talks and demonstration of specialized methods (Kolade and Harpham 2014). As a group-based enterprise, economies of scale should be leveraged by the cooperative to help minimize the costs of diffusing these innovations to individual farmer-members. This advantage should contribute to increased scale for technological innovation. Although studies abound on how agricultural cooperatives enhance adoption of improved agricultural technologies (Ainembabazi et al. 2017; Ma and Abdulai 2017), it is however lacking in depth of digitization. Importantly too, it is believed that information access on innovation and benefits are easily available in cooperatives while extension workers show preference in dealing with farmer groups rather than individual farmers in the extension delivery system (Adeogun, Olawoye and Akinbile 2010)

The gap is that cooperative societies have not developed any clear functional strategy that would trigger digitalization among members of their various associations. There is therefore the need to invent learning strategies that could enhance modern digital agriculture uptake by farmers who belong to these joint-owned enterprises. This is more compelling given the fact that cooperatives are built on the principle of education, training and information to her members.

Cooperative business organizations are critical but yet underutilized in driving innovative solutions for the growth of agriculture sector. Unlocking effective peer influenced learning approach would afford farmer-patrons the opportunity to unleash the required digital solutions for increased agricultural productivity. Members of cooperative societies as equals will harness the benefits of PAL if deployed as technique for members to acquire the skills and knowledge on digital tools and technologies. The core of this paper is essentially to advance a framework for effecting the use of peer- assisted learning in promoting digitalization among members of agricultural cooperatives. It highlights how members' influence as peers could necessitate the promotion and uptake digital technological tools by other farmer-members. This analysis does not aim to situate digitalization at the

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organizational level of cooperative enterprise itself, rather it addresses on how the cooperative enterprise could become the agency for its promotion at farmer-member enterprises.

Concept of Peer Assisted Learning and Framework for its Application for Digitalization in Agricultural Cooperatives

Peer assisted learning is an instructional method that aims to promote acquisition of skills, knowledge and new behaviors among status equals in a social setting. In contrast to PAL, Didactic teaching is the standard of having teacher lecture students (Anantharaman et al.2019). PAL also refers to Dyadic and small group learning opportunities led by students (Ginsburg-Block, Rohrbeck, Fantuzzo and Delquadri 2002) and Cooperative learning (Johnson and Johnson 1989). Topping had defined peer assisted learning as people from similar social grouping who are not professional teachers helping themselves by teaching. PAL is essentially imbedded in the social theory of Albert Bandura that emphasize that people can learn from each other through observing, modelling and imitating the behaviors, attitudes and emotional reactions of others (Bandura,1977). It helps explain how new skills and behavior are acquired through paying attention and then trying to reproduce the behavior themselves. This strategy of learning espouses a cooperative and collaborative engagement of teams in problem solving.

Research results abound on the use of PAL to improve teaching skills (Buckley and Zamon,2007), enhance and deliver medical education (Glynn, MacFarlane, Kelly, Cantillon and Murphy 2006), improve learning outcomes in science subjects and engineering education (Tugba, Ali and Hamiyet 2016; Weldon and Felder 2000). All these evaluations have shown that PAL contributed positively to the overall performance of the learner. The ease of communication between peers is a noted factor to the effectiveness of peer assisted learning (Oluwafolakemi, Hongtao and Bamidele, 2021). There is barely no literature at least to the knowledge of the authors to its applicability in delivering digital technological knowledge in agriculture.

PAL essentially provides learners with formal learning opportunities in which peers help each other regarding their understanding and skills. This way peers are able to help each other in effectively teaching the concepts of instruction or tasks. In the most fundamental application of PAL in academics, three models have been highlighted in literature – class-wide peer tutoring, reciprocal peer tutoring and cooperative learning (Ginsburg-Block et al., 2006). The cooperative learning strategy appears more suitable when learning goals or mastery of skills and retention of materials are essential, a task complex, problem solving or higher-level reasoning required,

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creativity desirable and high-quality performance expected (Johnson, Johnson and Holubec 1998). According to Ginsburg-Block et al. (2006) cooperative learning models are based on five core components. These components are:

i. Positive independence: This component ensures that the student learns the material or skills and to make certain that all group members learn same. Positive independence is achieved in which the group works towards a common group goal and rewards interdependence whereby each group member receives a reward when group achieves its goals.
ii. Face-to-face interaction: Group members encourage and help each other reach group goals by using feedback, challenging each other's' ideas and sharing materials and results from the positive interdependence
iii. Individual accountability: this requires each group member to provide an individual contribution to the group.
iv. Interpersonal and small group skills: this component is particularly useful to those with low skills or those who are more accustomed to traditional independent or competitive learning model. Training and reinforcement of group is required to ensure that students acquire and use skill necessary for working together in a group.
v. Group processing: The final component of cooperative learning is the technique required to improve group effectiveness. Here, members of the group discuss how well they have as a group and subsequent decisions made on how to proceed.

Further, it is believed that cooperative learning generally deepens students' understanding and offers benefit to task accomplishment of the learner. Learning based on peer instruction support a student-student interaction that is combined with the use of technology. This learning strategy has been used effectively in medical training and had demonstrated positive outcomes in relation to knowledge, skill and attitude/perception (Anantharaman et al. 2019).

Therefore, the conceived framework for its application in promoting digitalization of agriculture in cooperative societies is illustrated in a flow chart shown in figure 1.

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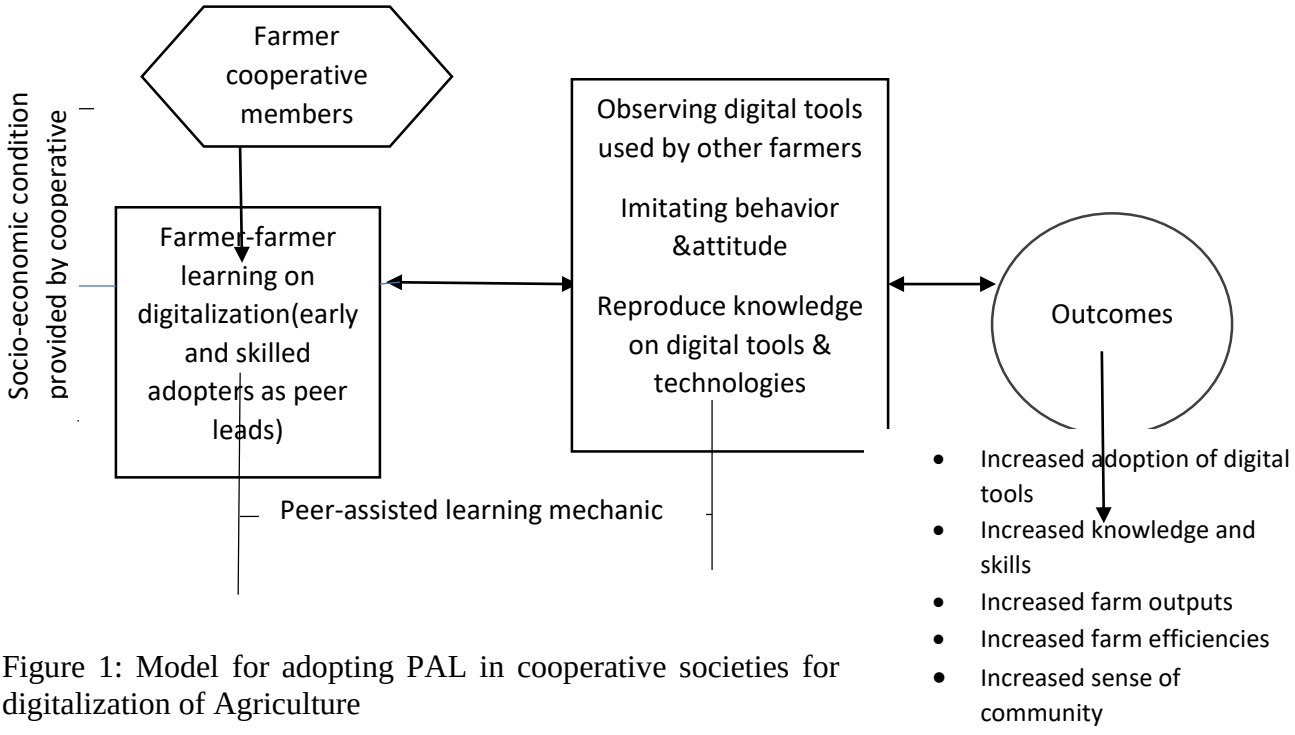


Figure 1: Model for adopting PAL in cooperative societies for digitalization of Agriculture

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The mechanism's operational success will very much depend on the social conditioning in the cooperative at galvanizing membership as well as their potential awareness of digital tool landscape for agricultural utilization. This model in itself suggests the cooperative to provide enabling environment that would allow farmers (peers) who are not professionals share skills relevant to various digital tool applications through interaction with other patrons in their enterprises wherein these technologies are initially domiciled. The flow explains how farmers belonging to cooperative societies are offered convivial setting to formulate their questions on these tools, seek explanation from their peers who as peer leaders had already adopted these tools and also offer intra-member watch on behaviors in relation to tasks execution. Digitalization skills are achieved in this scenario through the systematic process of observing, imitating and consequently reproducing or replicating such skills and technologies learnt at a peer-to-peer level. The success result is measured by the percentage of farmer-members successively deploying respective digital tools and their overall impact on farm profitability and output. Essentially though, challenges are shared among members and then consequently resolved as a common group problem. It confers that further advantage of transaction cost reduction in relation to shared peer technical expertise. Also, the resultant component gains from the positive independence, individual accountability and group processing through the cooperative learning model give impetus to the efficacy of implementing this model. The diligent application of the framework is thought to facilitate the deepening of digitalization in the respective farm operations of members of agricultural cooperatives.

Conclusions

PAL promotes learning of skills, behaviors and aptitudes among status equals in a social setting with an overall positive learning outcome. Given that cooperatives promote members welfare and knowledge sharing through its principle on education, training and information of her patrons, a learning strategy such that it would help deal with any enterprise management solution of members become relevant. It is in this context that PAL was conceptually fitted to frame a model for cooperatives to adopt in seeking the deepening of digitalization of agribusinesses of her farmer-members. The use of digital tools and technologies has pointedly proven to be key to the progressive trajectory on enhanced agricultural productivity and income. However, learning some of these skills, technologies and tools have been structurally constrained. This paper consequently provided a clear path in seeking solution. The postulation of the paper therefore highlighted how cooperative societies could provide platform for members to deliberately incorporate PAL as a strategy for enhancing the adoption of digitalization.

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Recommendations

The following are important recommendations arising from the paper:

i. There is a current need for agricultural cooperatives to partner with pedagogical experts to strengthen and embed PAL as an important strategy to promote digitalization of members farming activities
ii. Management of cooperative societies on a long-term should focus and target acquiring capacity for effectively training members of the societies in-house on up-to-date digital tool utilization
iii. Cooperative societies should make greater budgetary provision for the proposed trainings from her statutory percentage of net-margins allotted for education
iv. The loan portfolio for acquisition of digital tools granted to members should be deliberately upscaled in order to increase depth of enterprise digitalization among members of agricultural cooperative societies

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