

Research evidence of the impacts of blockchain technology on improving food security through African Indigenous Vegetables in Western Kenya

Blockchain technology can contribute to improved food security, smallholder farmer incomes, and agricultural productivity by improving the functionality of entire agri-food value chains. In the last several years, the number of last-mile mobile phone-based technologies designed to support smallholder producers has proliferated throughout the agriculture sector in Kenya and other low- and middle-income countries (LMICs). Blockchain, the distributed ledger on which digital currencies (such as Bitcoin and Ethereum) operate, is among such emerging information and communication technologies (ICTs). Blockchain is heralded primarily for its ability to contribute to agriculture by improving information flows, and thus transparency and trust in agri-food value chains. However, there is limited evidence as to whether blockchain technology (BCT) can be used to leverage improvements in food security – either through improving income or increasing the availability and desirability of nutritious foods. This brief, intended for policymakers and key Kenyan agriculture sector stakeholders, presents evidence on how BCT can contribute to achieving the objectives of the Agriculture Sector Transformation and Growth Strategy (ASTGS) by presenting research findings from the project *Exploring the Use of Blockchain Technology to Improve Food Security Through African Indigenous Vegetables (AIVs) in Kenya*. It also presents recommendations on the investments required to capture the transformative effects of blockchain.

This study is one of the first to explore how BCT could be used to improve food security. The research objective was to investigate how BCT can be deployed in horticultural value chains with the express purpose of improving food and nutrition security among all AIV value chain actors – e.g., producers, traders, retailers, and customers. The study also focused on understanding how digital platforms using BCT will secure the place of women and youth in the agricultural value chain.

Over six months, some 50 smartphones with the AgUnity BCT-based app were distributed to selected producers, traders, and retailers in AIV value chains in Kakamega County located in Western Kenya.

The AgUnity technology differs from digital services or solutions in the way it addresses challenges specific to each group of value chain actors as well as broken linkages between value chain actors, including the end consumer. Other apps and digital solutions tend to focus on farmers – addressing

- 1** – Blockchain technology can improve trust and transparency within agricultural value chains.
- 2** – Food security can be positively impacted through value chain strengthening by improving incomes, reducing waste, and increasing the availability and desirability of nutritious foods like African indigenous vegetables.
- 3** – Corruption and exploitation by dishonest brokers can be significantly reduced by creating a network of trusted actors and providing access to reliable market information.
- 4** – When coupled with multi-sector services (i.e., credit, insurance, social services, and training), blockchain technology has the potential to transform the Kenyan agricultural sector.

Key Takeaways

their challenges to improving yields, productivity, and access to markets. In contrast, AgUnity's blockchain-powered smartphone application creates a *network* of agri-food system players and requires their cooperation and participation in order to benefit. Results from this study show that these players are willing to do just that. The widespread creation of these networks could lead to a complete transformation of the agri-food sector in Kenya.

The AgUnity BCT-based app was selected as the test case for this study.

AgUnity has pioneered a business model that will ensure that last-mile users have access to smartphones, thus increasing their access to innovative technologies like BCT.

How does the app work?

Each time a buyer and seller agree on the cash price for a certain amount of a vegetable, they both capture and approve this transaction in their app by scanning a QR code on the other user's phone.



This creates a block of information that is added to the blockchain.



This information stored on the blockchain is *immutable*, giving users confidence that their records of transactions are accurate and reliable.



It is also able to create *traceability* of information along the value chain, communicating characteristics of the vegetables from producer through to the consumer.

For more technical details see the [AgUnity YouTube Channel](#) or the project's [5-minute documentary](#).

The AgUnity App

Blockchain technology has the potential to transform the entire AIV value chain.

The blockchain functionality of the AgUnity app was found to improve the functionality of the entire AIV value chain in select sub-counties of Kakamega by increasing transaction efficiency, cooperation among value chain actors, and access to information. This led to the improvement of food security by improving incomes through reducing post-harvest loss, improving quality, and capturing increased willingness to pay from consumers, saving time, and diversifying income into off-farm sources.

Producers were able to use their transaction data to identify the AIVs demanded by the market. Further, the introduction of a new AIV grading system through this study enabled producers to focus on improved production practices that could generate higher incomes from Grade A vegetables. Consumers were also willing to pay a price premium for these higher-quality vegetables.

Improved value chain functionality was achieved through the strong connectivity between producers and traders, which significantly reduced the time spent trying to coordinate the sale of AIVs. Since transactions in the AgUnity BCT-based app can only occur between actors registered in the network, coordination and cooperation were easier since each user had access to a known group of

individuals they could transact with. As one female producer commented,

“Normally I had to hawk around the market for the whole day to find buyers. Now it is so swift. I know already who to trade veggies to and the buyer comes to fetch the goods.”

Since the study participants were provided a smartphone and were not asked to pay a subscription fee to use the AgUnity app, the study explored potential pricing models for the BCT service. Approximately 75% of producers, traders, and retailers indicated they were willing to pay 150 KSH per month to continue to use the AgUnity app; however, to be willing to pay this price, the app would also need to offer complementary services and features. Additional services that could be offered as applets on the AgUnity app include access to micro or crop insurance, information on integrated pest control techniques, trainings, new markets for AIVs, etc.

BCT-based smartphone applications have the potential to engage youth and women more fully in agri-food value chains, which contributes to improved income and control over it. Women felt empowered and proud to participate in agricultural activities because the app allowed them to capture their gains from their entrepreneurial activities. Youth were attracted to participate because it allowed them to learn modern ways of farming. Six months after the project, more than 150 youth in Kakamega are interested in joining the AgUnity network from word of mouth alone. Youth can also participate in other parts of the digital ecosystem; for example, a hackathon was conducted as part of this study that allowed students at Egerton University to code applets with complementary services.

“We are now proud in selling AIVs ... [we] are proud to be digital women.”
 ~ Female AIV producer

The Kenyan government should invest in scaling blockchain technology to transform agri-food value chains and improve food security.

BCT differs from other digital services and solutions because it strengthens the entire value chain simultaneously rather than focusing on smallholder farmers alone. BCT can also be delivered alongside other digital services (i.e., extension, financial services) through a digital platform. As the willingness to pay among study participants indicated, a comprehensive digital service can elicit enough value to make this a viable business opportunity.

Kenya has a unique opportunity to advance the ASTGS by scaling BCT with new and complementary services. Informed by the results of this study, the table below provides recommendations on ways to invest in blockchain-based applications in order to leverage its transformative potential to achieve the goals of the ASTGS.

ASTGS Anchors	Recommendation	Anticipated Outcome
Increase small-scale farmer incomes	<ul style="list-style-type: none"> • Work with financiers to provide smallholder farmers and other value chain actors with affordable repayment terms in order to purchase a smartphone that can host blockchain technology. • Continue to support ICT infrastructure in rural areas. • Incorporate blockchain-based technology into government programming, provide technology training to extension agents, and work with county governments to create access to digital education and tech support. 	<ul style="list-style-type: none"> • Scale of smartphone ownership will increase, even in rural areas. • Businesses delivering services with blockchain technology will be able to reach the critical mass of users required to create the network effect for sector transformation. • Agri-food systems will be more inclusive and reduce the exploitation of smallholder farmers. • Risk of lending to smallholder farmers will be reduced.

ASTGS Anchors	Recommendation	Anticipated Outcome
	<ul style="list-style-type: none"> • Provide incentives to the financial service sector to integrate their products with blockchain-based service platforms. 	<ul style="list-style-type: none"> • Women and youth are more engaged and included in agri-food value chains.
Increase agricultural output and value addition	<ul style="list-style-type: none"> • Identify priority complementary services to blockchain technology for companies offering blockchain-based digital solutions. • Create favorable investment environment for tech development to create features and services that can be delivered alongside blockchain technology. • Consider updating regulations and standards to align with digital monitoring technologies. 	<ul style="list-style-type: none"> • Smartphone ownership can be leveraged to create access to extension information. • Value addition can be captured in the traceability functionality of blockchain, allowing value chain actors to capture the financial return on their respective activities.
Boost household food resilience	<ul style="list-style-type: none"> • Create favorable investment terms for companies that will work in value chains for nutritious foods. • Work with sector stakeholders to prioritize key value chains that can be supported by BCT (i.e., fortified flours, horticulture value chains, poultry). 	<ul style="list-style-type: none"> • The use of BCT to simultaneously strengthen the entire value chain means that nutritious foods become more consistently available and affordable in the market. • Increased nutritional awareness (including how to prepare foods to maximize nutritional awareness).

Partnerships between the public and private sectors can also support the Government of Kenya to make significant gains in achieving the ASTGS goals.



A trader and a retailer transact on the AgUnity blockchain-based smartphone application.

Project Name: Exploring the Use of Blockchain Technology to Improve Food Security Through African Indigenous Vegetables in Kenya

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