

Blockchain Technology: Agriculture's Next Revolution?

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ABSTRACT As IndiaChain, the Indian government's blockchain initiative remains in beta stage, private companies like BanQu are demonstrating small-scale successes in linking blockchain technology with the agriculture industry. Blockchain technology connects buyers and sellers and allows farmers, especially those without access to formal financial institutions—who tend to be female—the opportunity to create digital identities and build credit histories, making micro loans more accessible. This brief evaluates the costs and benefits of this emerging technology and its potential effects on the agriculture industry. Using prospect theory, this brief explains why certain farmers are more inclined to incorporate the technology than others. Although IndiaChain is a government entity, BanQu's experiences can offer the government a basis for implementing a successful blockchain for their agriculture industry with the goal of bringing millions out of poverty.

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INTRODUCTION

Agriculture has been a fixed sector for all economies for over a millennium, and it will continue to play an important role in the future. Over time, technological advances—from the plough to fertiliser and biotechnology—have revolutionised the industry. Blockchain is the latest technological advancement aspiring to enhance the industry. India's agriculture industry is plagued by multiple physical, economic and environmental challenges, and today fewer people in India consider a career in farming. In a study published in March 2018, Delhi-based Centre for the Study of Developing Societies reported that 76 percent of Indian farmers desire a different profession for themselves and their children, but the lack of adequate nationalised social services and education hampers this ability to escape poverty.¹ Although globalisation has brought harm to the Global South such as a widening wealth gap, benefits of this growing interconnectedness in the international economy include increased intra-industry communication and external reach to new buyers.

Blockchain technology is a secure method for the agricultural community to grow economically through establishing digital identity, ensuring property rights, and enhancing communication of farming practices. It is essential to ensure this industry recruits the next generation to improve productivity and meet the demands of an increasing population.

BREAKING DOWN BLOCKCHAIN TECHNOLOGY

Blockchain technology is built on distributed ledger technology (DLT), which allows data

entered into the system to be fanned out amongst all users. This DLT system allows built-in trust to be established as blockchain technology facilitates peer-to-peer connections. Once a piece of information is written and approved on the blockchain, it becomes part of the ledger. Theoretically, as this technology develops, its upkeep costs will shrink compared to other virtual options as many of them, including Amazon and Google, rely on monthly storage fees while blockchain technology uses DLT, which only requires a one-time storage fee. For instance, a 1GB annual storage on Amazon is worth US\$21.60, while 1GB stored using blockchain technology would need an upfront maximum fee of US\$100 with a lifetime guarantee.² Moreover, since this data is also spread out over multiple networks, it is harder for data to be lost through power outages or computer hacks.³

Blockchain technology reduces the need for middlemen in transactions, making data more transparent and immutable once uploaded. The technology allows users to establish a digital identity, which can later help the user access various opportunities, including “financial services, social benefits, healthcare, education, political and legal rights, gender equality, and migration.”⁴ The creation of a digital identity is paramount for women and other disadvantaged groups who are less likely to have established histories of trustworthiness, like through property rights, when applying for credit, loans, or other contracts.

As of 2017, around 1.7 billion adults worldwide still lacked a bank account, with China and India having the biggest shares at 225 million and 190 million, respectively. In

both of these countries, about 60 percent of the unbanked are women.⁵ To further highlight the potential revenue of this population, Accenture reported there is a revenue window of up to US\$380 billion that could be generated by banks by 2020 if this unbanked population was formally and financially included in the economy.⁶ Two-thirds of this population already has access to a mobile phone, but the adoption of blockchain technology in agriculture needs to become more widespread and accepted.⁷

As of September 2018, BanQu, a blockchain-focused software company, had already been operational in eight countries giving digital identities to over 15,000 farmers, internally displaced persons (IDPs) and refugees, including streamlining the connection between Anheuser-Busch InBev and 2,000 Zambian farmers selling 2,000 tonnes of cassava.⁸ A June 2019 update showed this operation's expansion to four new countries, including India, and there are plans for expansion to China and Mexico by the end of the year.⁹

BanQu's main long-term goal is to lift 100 million people from extreme poverty by 2028, using their technology, which allows farmers to directly connect with buyers and access financial capital quickly.¹⁰ Though middlemen might not be completely eliminated, the transparent data input on the app, when used, will ensure that fraud is not being committed. This can allow production to increase because the easier-to-access capital can be more swiftly reinvested, and information about weather patterns and better farming techniques can be exchanged. Other benefits include verifying and protecting property rights and records from corruption, which is more common with paper records.¹¹

FEMALES' ROLE IN AGRICULTURE

Females play a crucial, and often overlooked, role in agriculture. Many societies remain patriarchal, preventing females, primarily in developing countries, from accessing the same financial services as their male counterparts. Further exacerbating the situation is that "almost 70% of the world's population lacks access to land registration systems", creating further obstacles for females trying to prove and secure landownership.¹² With no access to a land title or a bank account, it becomes virtually impossible for women farmers to build their credibility through formal methods, such as successfully completed contracts or repayments of loans. This makes it harder for banks to understand and value their worth and trustworthiness when offering a loan, and it can also make it harder for buyers to feel confident entering into a contract with them. Yet numerous studies have argued the importance of female farmers. One such study concluded that if women's access to resources, like finance, were on par with men's, females' "agricultural yields could increase by 20 percent to 30 percent, national agricultural production could rise by 2.5 percent to 4 percent, and the number of malnourished people could be reduced by 12 to 17 percent."¹³ The World Bank estimated that in 2018, about 43 percent of Indians worked in the agricultural sector and 57 percent of those were female.¹⁴

There are various documented reasons detailing how blockchain technology can increase economic output, including access to information like harvesting recommendations and market acquisition as well as loans to expand production. Though BanQu focuses on

IDPs, which may not be the group that most developing countries' governments focus on, this technology, nevertheless, grants users economic identities, which is beneficial to growing the financial inclusion of female farmers in India. Facets in the ledger might include individuals with successful user transactions, what was sold, how much was sold, and the price at which it was sold, allowing future collaborators more comfort in working with a person with proven financial history.¹⁵

Blockchain helps increase financial inclusion by allowing users to circumvent traditional middlemen. As women and other disadvantaged groups do not have much proven credit history, traditional middlemen are wary to work with them for fear of non-payment or breach of contract. Agriledger is one of a few companies utilising blockchain to give these groups a digital identity allowing them to access important information about harvesting and competition, trace their goods, and record their sales. It also allows these groups to expediate the sale of their products, retain a higher profit from not having to pay middlemen, or even if working with middlemen, preventing fraud, including contract changes and added fees. Globalisation has brought a widening of the wealth gap, but it has also resulted in benefits of an ever-growing and interconnected international economy, which these farmers would not have easily been able to penetrate even 20 years ago. In all sectors, people notice parts that can be improved, and technology is created to address those inefficiencies or faults. The agricultural sector is no different. From the creation of the plough to an irrigation system to genetically modified

organisms, farmers have been adaptive to new technology, thereby increasing their yields and easing the labour required. Blockchain is another technological advancement paired with its own learning curves and pitfalls, but also with its own benefits.

METHODOLOGY

When trying to understand why decisions are made on the individual level of analysis, such as which farmers are more likely to implement blockchain technology, utilising a psychological (behavioural) theory makes greatest sense. Though it has its own limitations, which will be addressed later in this brief, prospect theory provides valuable insights on why certain people tend to behave in certain ways. Prospect theory centres around the notion of how a situation or policy is framed, not what it objectively means, and impacts a person's decision to be for or against it. For example, a health initiative might be promoted in two different ways: one using the predicted mortality percentage, and the another using the predicted survival percentage.¹⁶ The information is constant, but observers take on different mindsets depending on how the information is framed. For example, an observer would likely feel much less confident in the policy if it were framed with 10 percent predicted to die versus if 90 percent were expected to survive. Though this uses the same policy, most people would already feel they are at a loss if it was framed as "predicted deaths percentage" as opposed to a gain if it were framed as "predicted survival percentage."

As it relates to farmers, studies in different developing countries have shown certain

trends regarding acceptance of technology in agriculture. One such study covered a group of Bangladeshi farmers' reaction to modern-seed technology. The resource-poor farmers tended to not adopt the new technology, while farmers who were a little richer, and had small to middle-sized farms, were more willing to test it. The results showed that new technology can directly reduce poverty by increasing "small farmers' productive capacity."¹⁷ In this scenario, the poorer farmers who decided against incorporating this new technology were already in a domain of gain. They were not comparing themselves to other farmers; they instead compared their current situation with one of total loss. Richer farmers had the financial cushion of testing the technology, while not entirely relying on it. These farmers viewed themselves in a domain of loss compared to either richer farmers or those in other professions, and their monetary reserve allowed them to test this technology, where they had little to lose, but much to potentially gain. Though there was minimal difference in land ownership between adopters and non-adopters, the richer farmers cultivated more of their land, signalling the financial ability to do so. If governments or companies lowered the cost of adoption through subsidies or education, poorer farmers might feel more inclined to try the new technology.

To get support for a policy, legislators must first understand the target group; from general groups like farmers to sub-groups like female farmers, and what they view as their current place and needs. With that knowledge, lawmakers can cater policies to address specific needs in areas that targeted groups

already feel in a domain of loss. Targeted constituents might also have suggestions in how they think outsiders can best help, which also increases the probability that the people receiving the aid will be more embracing of it as they feel they have a strong say in how something so integral to them is impacted, including what changes and what remains the same.

FINDINGS: PROSPECT THEORY AND ACCEPTANCE OF TECHNOLOGY

Though figures were not readily available on the age and sex of farmers who were approached and ultimately partnered with BanQu to incorporate blockchain technology, consulting other studies can help assess which groups of people have been more likely to adopt new technology and, therefore, should be targeted in this initiative. In general, studies have shown that young adults (referred to as 'millennials', who are ages 23-38 in 2019) are more inclined to embrace technology.¹⁸

In a study conducted by Pew Research Center, older people, especially those above 65, displayed higher amounts of computer anxiety and less confidence in their ability to learn necessary computer skills to accompany new technology.¹⁹ The internet offers many advantages, from increasing socialisation to accessing essential services, but in general, older people still hesitate due to negative preconceived attitudes about the cost, security, and necessary skills for proper use of the technology.²⁰ With regards to prospect theory, the older generation survived without internet for most of their lives, so they do not feel the pressure of being in a domain of loss.

Pew's results also revealed a digital divide in two other groups: minorities, and those less educated. Women also demonstrated higher levels of computer anxiety. Digital technology is becoming a greater necessity in society, so this skill and usage gap must be addressed before it becomes too wide to easily shrink. Establishing an infrastructure to support educating the targeted groups can mitigate access and the learning curve.

In addition, governments can establish joint ventures with the private IT sector to dispatch professionals to rural parts of the country to train locals to use this technology. Pew also noted that it is imperative that older adults experience success as they begin embracing the new technology in order to feel they are productively moving into the domain of gain. This can be accomplished by creating a structured learning plan that gradually expands their skills so trainees do not feel rushed, and continuously giving trainees proper feedback.²¹

Paramount in predicting the adoption of new technology, especially in older adults, is its perceived usefulness and reliability. For a person to change habits, they must view themselves in relation to their reference point in a domain of loss. They are willing to accept the risks of embracing the new technology because the benefit is needed or desired. A higher degree of perceived usefulness and reliability of the product will yield a more positive adoption, despite the potential difficulty of the learning curve and cost. But the core issue of prospect theory is that perception cannot always be easily predicted based on socio-economic status or other classifiers.

BLOCKCHAIN LIMITATIONS: CREATION AND ADOPTION

Blockchain technology is still in its infancy, which makes investors and developers wary. There are legitimate concerns with DLT, including scalability, volatility, and ambiguity. But the status quo for many rural Indians is hardly liveable. Blockchain technology provides a steep curve for testing and implementation, but it is an opportunity to impact millions of the world's poorest. Private companies like BanQu have demonstrated small-scale success without an overly modern infrastructure, thereby providing a proven foundation and example to replicate. Cheaper and older technology could still offer a route for the blockchain system. As minor successes are demonstrated and confidence grows, more money can be invested in developing the infrastructure further to increase effectiveness. With time and enhanced knowledge of DLT, regulations will become debated and implemented.

Blockchain continues to face hurdles in convincing consumers to adopt it. However, targeted branding and support show this acceptance is possible. Female farmers continue to be a disadvantaged group in agriculture, who find it harder to build a credit history and receive loans because of their lack of access to land ownership and formal financial institutions. But organisations like BanQu, Stellar and Oradian are striving to bring open source payment and microfinancing to the developing world.²² For example, a joint initiative between these providers allowed "300,000 Nigerians (90% of them women) to cheaply transfer money between microfinance institutions over the

Stellar network.”²³ Another comparison case study of repayment rate focused on the differences between non-refugee and refugee loan repayments showing only a 0.2 percent difference, with non-refugees repaying 96.8 percent and refugees repaying 96.6 percent. On top of that, 55 percent of those benefiting from refugee loans were female, showcasing the strong need of this monetary access.²⁴

Expanding such initiatives is necessary to increase yields of female farms up to 30 percent, and decrease hunger up to 17 percent, as sourced previously. Though male farmers might be interested in the technology, their access to other avenues of capital make them less in need than females who are currently in a domain of loss. Farmers already live on the margins of society, and a disastrous crop season can bankrupt them; thus they often cling to the status quo. These examples of companies, like BanQu working in Africa, show risk aversion is not always the case. Female farmers are some of the most marginalised, but they have shown their desire to seize opportunities if given the chance and support.

Technology is playing a greater role in developing countries, where mobile penetration is over 50 percent in even low-income countries.²⁵ “Large majorities in all six sub-Saharan countries surveyed [Kenya, South Africa, Ghana, Tanzania, Nigeria, and Senegal] own mobile phones” while in four of those countries, adults 50 and older surveyed the same likelihood as those 30 and younger to have a mobile phone.²⁶ Smartphones are also not a necessity for people utilising blockchain as the app allows users “to create a secure online profile through simple SMS-enabled phones.”²⁷ Developing countries should focus

on limiting the financial burdens posed on farmers with this technology, including providing free cell phones and training.

India is a growing pioneer on the international stage for technological development, and can showcase this status to help the most marginalised. In Bengaluru, the Indian government is funding an incubator for startups called Startup Warehouse, and seeks to help 10,000 startups in the next ten years.²⁸ Similarly, a government-funded think tank proposed a blockchain initiative called IndiaChain.

This public devotion to projects targeting innovation should be pursued and maximised. The government could offer scholarships or competitions for these startups to produce the best results and further innovation to areas not already considered. In regard to blockchain and agriculture, the government could sponsor extremely localised startups in a certain state or region to evaluate whether farmers would be risk acceptant. For those willing to test blockchain's incorporation, as was done in Africa with BanQu, more knowledge can be gained in its usefulness or its challenges to better assess the requirement of additional or redistribution of resources to other innovative projects.

Unfortunately, not all of India is being included in this technology revolution, where a sizeable percentage still lacks a mobile phone. In 2017, only 650 million people were mobile phone users. Furthermore, more than 66 percent of Indians did not have access to the internet.²⁹ But these are areas that can be improved with government and private sector focus. Initiatives between September and December 2016 have sought to decrease

mobile data cost by almost 96 percent to spur mobile phone usage. The BBC reported that in March 2019, India “has the cheapest mobile broadband prices in the world” with one gigabyte of data for \$0.26.³⁰ Furthermore, a new focus on creating operating systems in regional languages, something pursued by Indus OS, looks to influence an increase in mobile phone purchases to accompany the increase in data affordability.³¹ With lack of quality education, developing systems in regional dialects is crucial in connecting with communities. Though “research suggests that poverty and social isolation are closely related,”³² community-based learning utilising professionals and local leaders can be invaluable in empowering these communities with mentorship, confidence, growth, and self-sufficiency.

With blockchain’s ability to increase transparency and traceability, it can also increase those willing to partner with disadvantaged groups. The younger generation now focuses on social responsibility to influence the companies they work for and buy from. This transparency can be extremely attractive to the outside world, from verifying that products are safe and ethically produced, to ensuring aid is being properly distributed and used. Certain churches and charities, like World Vision and Heifer Project International already sponsor the poor, from buying a bicycle for a pastor in Africa, to buying a goat for a family in Haiti. This could soon expand to donating mobile phones.

Food giants like Nestlé, Tyson Foods, Unilever and Walmart have already begun to incorporate blockchain technology and its role

in traceability, which can have an impact on lowering costs and inefficiencies, as well as lowering the amount of time it takes to identify a product’s origins and the width of the areas exposed when recalls are necessary.³³ Though blockchain is still developing—and most experts in the agricultural industry and in the business world agree that full-scale implementation is three to five years away—current vested interest shown by major companies indicates that the spread and depth of its use will only continue.³⁴

CONCLUSION

Understanding inherent privileges and biases in a system can help policymakers and influencers focus on predicting the mindsets different individuals are likely to have, based on their position within the system: either in a domain of gain or loss. This provides a starting point to predict and assess how well the system changes. It allows the government to narrow focus by more effectively using limited financial and technical resources to target select groups.

It is imperative that developing countries, including India, which has a high percentage of women farmers, devote greater focus and resources to empowering them. Compared to their male counterparts who have access to traditional methods of financial inclusion, females view themselves in a domain of loss, which makes them more risk-acceptant to improve their situation. Though they might have a learning curve embracing the new technology or a financial curve purchasing a mobile phone, it is one they are highly likely to accept in hopes of moving into a domain of gain and a more satisfactory life.


Furthermore, it is also imperative that younger adult farmers be targeted for initial incorporation of this technology because they are likely to have already had higher exposure throughout their lives to rapidly changing technology, and thus a lower learning curve and predicted anxiety. Governments, especially India's, should partner with top technology firms to produce an app that utilises blockchain technology and facilitates the necessary functions that agricultural workers will benefit from, such as creating a digital identity and transfer of funds, modelling it from or working with current ones like the one BanQu uses.

IT personnel from bigger cities trained to operate and educate using blockchain for agriculture, could go to rural areas to learn what impediments the locals have to increasing output and global market reach, to simply wanting to access capital more easily. From there, IT professionals can be deployed to different regions as educators and mentors until an educational comfort level is reached, after which locals can continue working together and IT professionals can check-in consistently throughout the year. It is also imperative that governments attempt to ease associated financial burdens by aiding the farmers with free mobile phones and access to these experts.

Stakeholders must accept that DLT will require long-term effort for creation,

adoption, and success, but blockchain technology will not eliminate all the challenges of the agricultural industry. Prime Minister Narendra Modi should prioritise working with the agricultural sector to incorporate blockchain technology. In November 2017, NITI Aayog, a government think tank had proposed a blockchain initiative called IndiaChain to offer services, from benefit distribution to verifying educational certificates.³⁵ But there has been sparse public update on its progress.

Blockchain is a long-term, but worthwhile investment to increase farmers' prosperity. Although there are many costs associated with DLT, organisations can complement each other to maximise their effectiveness to these communities. While that is being developed, tested, and scaled, the Indian government must address issues like lack of quality public education in these communities, to help alleviate poverty and ensure the agricultural sector is functioning at its most productive level for the future.

It may not appear cost-effective now and long-run initiatives are hard to sell, but the payoff in empowering society's poorest will be reflected. The status-quo is barely viable for them. Nothing appears to offer meaningful change, and as less people are becoming farmers, it can destabilise the future. Investing in this technology may yet end up revolutionising the industry. 

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