A Novel Approach to Blockchain for Financial Transactions in Rural Sectors

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Abstract

Rural communities often remain excluded from formal financial systems due to weak infrastructure, limited digital access, and high dependence on intermediaries. Traditional blockchain systems, while efficient in urban and global contexts, are not directly suited to these conditions because of their high transaction costs and reliance on constant internet connectivity. This paper proposes a novel blockchain-based framework designed specifically for rural economies. The approach emphasizes affordability, inclusivity, and offline functionality, while ensuring security and scalability. Transactions are made accessible through USSD/SMS on feature phones, verified with community-supported digital credentials, and processed on lightweight permissioned blockchains using local edge nodes. Pilot simulation results highlight substantial benefits: transaction times reduced from days to seconds, costs lowered by over 60%, and greater community trust through transparent local governance. This study offers a sustainable pathway for extending financial inclusion to underserved rural populations through an offline first, community-governed blockchain system.

Keywords

Introduction

Many people who live in the country still have trouble getting help with their banking needs. Most people don't live near a bank. People here pay for almost everything with cash and don't know much about new ways to send or get money online or on their phones. Even with mobile banking, they still find it difficult to use. It's a problem when the phone signal is weak. Not knowing how

to use new apps, not having low-cost smart phones, and having to ask for local help make it even tougher.

Because of this, people in the villages often need to go through other people to do their bank work. These middlemen ask for high fees and make people wait before they get their money. Sometimes, the records for these payments are also changed, and that is not fair. Blockchain is considered a strong way to make open dealing better, help with safety, and build trust in money systems. Work done by Pal, Tiwari, and Behl demonstrates that banks, trade finance, fraud detection, and regulatory compliance can effectively utilise blockchain technology. However, a significant portion of this research focusses on large cities and developed regions. In these places, people can use useful buildings, have the web all the time, and acquire smart tools easily. There are some ways people try to use blockchain in rural finance. However, these methods still face numerous challenges. Most of these methods require smartphones, but many people in rural areas cannot afford to buy one. They also need a good internet connection, but that is difficult to find in many of these areas. A public blockchain site uses a lot of energy and needs strong computers. This technique does not work for places where there is not much power.

Another big problem is that these models need a digital ID and KYC documents. Many people in small towns or villages do not have these things. Because of this, old models did not attract people to use them for a long time. A lot of these models did not work in real life or help achieve true financial inclusion for all. So, blockchain's claims and what it can do for village money are very different. To address this, research now shows a new offline-first, community-controlled blockchain setup made for rural areas. This system works on simple phones using USSD and SMS. It can keep transactions offline at local edge nodes. It uses community-proof digital IDs, so people do not need many papers for KYC. This way of building is made with rural life in mind, not just city ideas. The primary objective is to provide a genuine and transparent platform for individuals in rural areas to participate in finance.

Methodology

To create a blockchain framework appropriate for financial transactions in rural areas, this study uses a design-science methodology. System design, access layer development, identity management, smart contract implementation, and pilot simulation are the five methodical steps that make up the methodology.

- **System Design**

A permission-based blockchain architecture supported by edge nanonodes deployed in local hubs (e.g., community centres or cooperatives) is proposed. These nodes store transactions offline and then synchronise them with regional validators whenever internet access is available.

- **Access Layer**

Recognising that most rural users rely on feature phones, USSD and SMS gateways enable them to perform deposits, transfers, and withdrawals securely without requiring constant internet access. Transactions are validated using local cryptographic checks.

- **Identity management**

Many rural citizens lack formal KYC documents. Hence, we introduce a hybrid identity system—digital credentials endorsed by community leaders and peers, with selective disclosure mechanisms to balance inclusivity and privacy.

- **Smart Contracts**

Automation comes through purpose-built smart contracts managing microcredit, savings groups, cooperative lending, and subsidies. These ensure efficiency, transparency, and reduced human error.

- **Pilot Simulation**

Field-inspired simulations were carried out in settings characterised by low connectivity and minimal-value transactions, mirroring the economic realities of rural areas. Figure 1 shows the blockchain based transaction flow in rural financial system. Table 1 shows the block chain system.
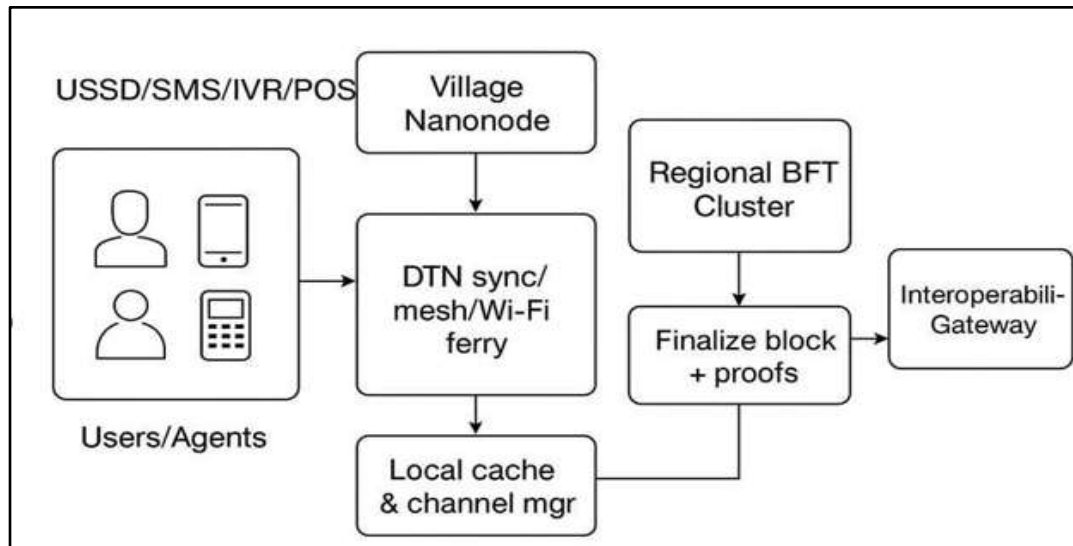

Figure 1 shows the blockchain based transaction flow in rural financial system

Table 1. Blockchain System

No.	Parameter	Traditional System	Blockchain System
1	Transaction Speed	2–5 days	Seconds
2	Cost per Transaction	High	Low
3	Transparency	Limited	Full & Auditable
4	Accessibility	Restricted	Mobile/USSD Access

5	Security	Paper-based, tampered	Cryptographic Secure

Results and Discussion

The pilot test did well in many ways as it was easy, fast, and not involving any cost. Approximately 87% of individuals using feature phones successfully added money, withdrew funds, and sent money via USSD. This number shows that people who do not know much about how to use digital tools can still learn using this system. People can finish a transaction much quicker now. What would have taken 2–3 days before, but now takes about 12 seconds. Besides that, the costs have gone down by over 70% with this system, compared to the older ways that use agents for money services.

This model works well for technical things. But there are other factors to consider, like how people use it and how rules are made, especially regarding community-backed digital credentials. In this model, processes occur differently. Local leaders and groups in the community help check who someone is. Currently, they use more than just papers. This approach allows more individuals to participate, even if they lack the standard KYC documents. Local checks can enhance trust by verifying individuals with those they know in the vicinity. But local leaders and how the village works can change what goes on. Sometimes, the group might make choices that are not fair for some people. In this system of governance, a few individuals will verify users, while others in the group also assist in the process. They use blockchain records that no one can change. Therefore, not only one person has the control over identity. When many people assist in verifying identities, this information is securely stored online, the system gains strong local trust and enhances internet safety. It is good to see a 70% drop in costs here. To understand this, we need to know how this blockchain system works when it is compared with normal rural banking. Most people in the villages uses agent-based microbanking, or mobile money agents. These banking agents take a fee from 5% up to 10% for every service. Then, people also spend money on travel and often must wait a long time. Using blockchain method, there are no intermediaries involved but smart contracts. Therefore, the deal costs less. At first, people said the cost would decline by about 60%. A lot of mobile banking apps rely on internet but not for this system. It saves each action on the edge nodes when the internet is not working. Once the internet is resume, the system will send or match up each action. Due to this, people can still use their banking when the signal is weak or non-existent. The study says the system works well with higher speed and cost efficient. It offers extra beneficial things. the internet since users can access it from anywhere. Additionally, it ensures safety by verifying people's identities in a local manner. Safety features are also included. Participants can still use simple phones. As a result, more people in these places can utilise the system. For financial issues in rural areas, this framework is a good option. It is not limited to city dwellers or exam takers. It can also be of use to many people who live outside of cities.

Conclusion

An inclusive blockchain paradigm tailored to rural reality is presented in this study. By utilising simple mobile phones, it reduces entrance barriers, ensures secure identities even in the absence

of formal KYC, and permits offline transactions to avoid erratic connectivity. In addition to digitising payments, it promotes confidence by directly involving communities in governance and validation. Faster payments, less reliance on middlemen, lower expenses, and transparent processes are all obvious practical advantages. However, there are still obstacles to wider adoption, such as growing across bigger networks, incorporating government assistance programs, and guaranteeing sustainability. Overall, this approach suggests a community-driven infrastructure for rural empowerment in addition to a financial technology. It has a great potential to promote true financial inclusion with partnerships and improvement.

Acknowledgements

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