Smart Contracts based Automate Payouts Enable Crop Insurance Platform

G. Nivetha[1], K. Meenatchi[2]

[1]M.C.A Scholar, A.R.J College of Engineering And Technology, Mannargudi
[2]Assistant Professor, A.R.J College of Engineering And Technology, Mannargudi

Abstract
Agriculture sector holds a significant position in the Indian economy. Conditions like variations in weather, pest attack, erratic rainfall and humidity affecting agricultural produce is a common problem in India. Thus, it is important to get a coverage in the form of crop insurance for the yield and yield-based losses. Crop insurance is a way to reduce farmers' distress and to promote their welfare. It covers pre-sowing and post-harvest losses due to natural calamities. The existing traditional methods of crop insurance suffer from intricate processes, elevated costs, and a crucial deficit in trust. This lack of trust has become a significant deterrent for farmers, discouraging them from embracing these insurance mechanisms to protect their crops. This project introduces an innovative block chain-based crop index insurance solution to address these challenges. Leveraging block chain ensures unprecedented transparency, recording every transaction and data exchange on an immutable ledger. The primary aim is to establish a connection among smallholder farmers, weather data providers, and insurers within a secure and efficient ecosystem. The utilization of smart contracts within our private block chain ensures that only registered stakeholders can interact, amplifying security and trust within the ecosystem. This fosters trust among stakeholders and reduces the risk of fraud through smart contracts, which also automate claim processing, addressing delayed settlements. Our central emphasis is on crafting an economical, low-cost index crop insurance system that guarantees prompt insurance pay-outs to farmers for valid claims. The proposed system operates on a decentralized, distributed architecture, removing the necessity for intermediaries and providing a safeguard against exploitation for smallholder farmers. This initiative seeks to enhance the overall efficiency and trustworthiness of crop insurance by leveraging the advantages of private block chain technology.

I. INTRODUCTION

Agribusiness is one of the world's most important industries, contributing to a nation's health, nutrition, and economy. Despite these benefits, agriculture is still among the least digitized industries. This is because most of the information generated on-farm is often difficult to transmit off-farm since it is not produced or processed in a manner that permits low-cost, reliable transmission. As a result, agricultural productivity and efficiency are severely limited by the lack of digitization in most modern farming production. This is because information-driven, integrated supply chains enable organizations to extend resources, accelerate time to market, add product value, retain customers, and reduce inventory costs. However, agriculture supply chain systems are faced with several challenges, such as the absence of scale economies, fragmented supply chains, and climate change. In fact, agriculture production is one of the industries most affected by weather as changing climates affect production costs, delivery speed, and the quality of goods. There is a strong link between agricultural production and weather patterns, which is particularly true for developing economies. In fact, small-scale farmers dominate the agricultural sector in developing economies, and weather changes hamper agricultural production activities. Specifically, severe weather events, such as droughts and heavy rains, directly affect the agricultural production of upstream farmers, thereby contributing to the fragility of

agriculture supply chains. Furthermore, climatic unpredictability often results in significant livestock and crop losses, starvation, and relocation. These risks and impacts associated with climate change are imposing pressure on resilience for smallholder farmers in particular. They can improve their financial resilience with a variety of solutions. For example, pooling resources with other farmers. By pooling resources, farmers could reduce costs, increase access to financial services, facilitate pooled sales of goods and negotiate interest rates. Farmers could also protect themselves financially against future risks by purchasing crop insurance or by obtaining loans or credit to develop climate-smart agriculture. loans or credit to develop climate-smart agriculture. In developing economies, insurance can help manage the risk of severe weather in agriculture. Crop insurance provides farmers with a means of protecting themselves from potential negative effects of climate change, including floods, hail, or drought. Hence, it acts as a supply chain risk management tool to protect smallholder farmers from financial crisis. According to the demand for insurance will increase as climate change increases, which would consequently reduce the extent of risk exposure for smallholder farmers. However, insurance may not be easily affordable or accessible, and the insurance payout process might not be transparent, which can lead to distrust Moreover, farmers are not always able to collect their insurance due to tedious procedures, such as before paying out, an insurance company needs to be certain of the genuine events and damage that took place. For the receiving parties, such as smallholder farmers, this procedure can be inconvenient and time-consuming at times. On the insurer's side, the high costs associated with processing small farms, as well as the rising incidence of climate-related crop losses, limit its success.

II. LITERATURE REVIEW

A crop insurance policy can be quite useful for developing countries like Kenya, India, etc., since it can provide a number of advantages, such as stable income and minimal debt. Conventional crop insurance schemes such as indemnity-based crop insurance, on the other hand, are complicated and frequently not economically viable. Farmers have to adhere to various terms and conditions to obtain insurance under these traditional insurance systems. Most farmers are not highly educated, so they are more likely to suffer losses if a natural disaster strikes due to their inability to comprehend the conditions. Extreme weather threatens food security by affecting agricultural production. Indemnity-based crop insurance can cover losses accurately but can be subject to problems associated with asymmetric information. Productions that cannot be quantified, such as grazed meadows, cannot be insured, leading to financial loss. The idea of index-based insurance arose as a result of the shortcomings of indemnity-based insurance. By using an objective and independent physical indicator, index-based insurance overcomes existing challenges in agricultural insurance and can result in cost savings. Despite this, farmers are usually hesitant to buy crop insurance because they lack confidence in insurance companies and worry about claims not being paid or being delayed. There is limited demand for insurance in the market, limited supply, as well as a lack of trust between insurers and farmers as a result of delayed or nonpayments of insurance claims. Demand is low, primarily because many smallholder farmers are unaware of how agriculture insurance might help them lower their risk exposure. Additionally, they view insurance products as expensive with limited coverage and lengthy claims periods, which makes them an unattractive option. On the other hand, the most common factors affecting the supply-side are related to acquiring high-quality data, startup expenses, and the lack of government economic support. Furthermore, policies are generated and disseminated by intermediaries who are unable to scale their products at a reasonable cost and properly track real-time weather data related to various policies due to a lack of infrastructure. Our blockchain-based crop index insurance tackles both demand and supply barriers by enhancing insurance through shorter claim cycles and lower transaction costs, as well as enhanced transparency and increased trust through smart contracts on the blockchain. Furthermore, blockchain can help to improve index-based insurance by assuring timely payment schedules and allowing the automatic integration of weather data and other data sources. Blockchains are networks of nodes that keep records of

transactions, called blocks, in multiple databases. This type of storage is often known as a ‘‘digital ledger’’. Digital signatures are required for each transaction in this ledger, which validates the transaction and safeguards the data. As a result, the data in the digital ledger is immutable and trustworthy.

III. RESEARCH METHODOLOGY

In our proposed solution, we advocate the use of a private blockchain-based platform designed to shield underinsured smallholder farmers from escalating climate vulnerabilities while fostering secure connections with insurers. This choice of a private blockchain is underpinned by a compelling rationale deeply rooted in the unique needs and circumstances of our target user group. Smallholder farmers often face challenges such as limited access to financial services and a lack of trust in traditional insurance processes. A private blockchain offers an ideal solution by establishing a controlled and secure environment that bolsters trust, promotes transparency, and addresses the specific challenges faced by these farmers. While public blockchains have garnered significant attention, we recognize that the selection of a private blockchain warrants a thorough justification. Private blockchains offer distinct advantages, particularly in the context of our solution. They provide a controlled ecosystem where only authorized participants are allowed to engage in the network, ensuring heightened security and privacy-a paramount concern in the realm of insurance. Moreover, private blockchains often exhibit superior scalability, allowing us to tailor the environment to the unique requirements of smallholder farmers, insurers, and other stakeholders. This strategic choice aligns closely with our goal of providing accessible, affordable, and secure crop insurance policies, effectively leveraging blockchain technology to empower smallholder farmers.

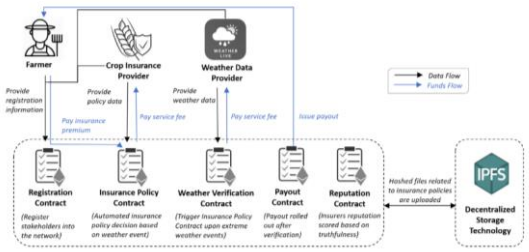

Fig 3.a. System overview of a private blockchain-based crop index solution using Ethereum smart contracts and decentralized storage system

This section presents the implementation details of the proposed private blockchain-based crop index insurance solution, which aims to protect smallholder farmers by insuring them with affordable and trustworthy insurance policies. The system overview discussed earlier in Section IV was implemented and tested using the Remix IDE whereby the smart contracts were coded using the Solidity language. This code is made publicly available to all users on GitHub. There are five different types of smart contracts in our solution: Registration smart contract, Insurance policy smart contract, Weather verification smart contract, and Payout smart contract.

IV. CONCLUSION

Our paper highlights the paramount importance of establishing a private blockchain-based crop index insurance solution tailored to the needs of smallholder farmers. Agriculture serves as a cornerstone of income generation in many developing countries, supporting a significant workforce. However, the inherent vulnerability of the agricultural supply chain to natural disasters, such as earthquakes and floods, poses a substantial threat to both crop delivery timelines and the livelihoods of smallholder farmers. Our proposed solution addresses these challenges by introducing a decentralized mechanism for crop insurance and harnessing the power of blockchain and decentralized storage technologies. The core objectives of our solution encompass reducing claim cycles, minimizing transaction costs, and fostering enhanced transparency

and trust between farmers and insurers. The versatility of our designed system architecture, sequence diagrams, algorithms, and testing scenarios allows for seamless customization to accommodate various crop index insurance policies. The utilization of smart contracts within our private blockchain ensures that only registered stakeholders can interact, amplifying security and trust within the ecosystem. We have made our smart contract code openly available on GitHub, facilitating its adoption by researchers and practitioners. Our rigorous security assessment substantiates the effectiveness of our system, demonstrating that registered stakeholders can engage in trusted and secure interactions. Looking ahead, we envision promising avenues for future work. One notable direction involves the development of decentralized applications capable of automating additional facets of insurance processes, delivering tangible benefits to all stakeholders involved. Furthermore, while our work showcases the potential of blockchain technology, it is essential to acknowledge that the blockchain landscape is still in its infancy, accompanied by several open challenges. These encompass scalability concerns, governance structures, and energy consumption optimization. Addressing these challenges will be critical for the continued evolution and adoption of blockchain-based solutions in the domain of crop insurance and beyond.

REFERENCES

[1] J. Bolt, ‘‘Financial resilience of Kenyan smallholders affected by climate change, and the potential for blockchain technology,’’ CCAFS, Tech. Rep., 2019. [Online]. Available: https://edepot.wur.nl/472583

[2] V. S. Yadav, A. R. Singh, R. D. Raut, S. K. Mangla, S. Luthra, and A. Kumar, ‘‘Exploring the application of Industry 4.0 technologies in the agricultural food supply chain: A systematic literature review,’’ Comput. Ind. Eng., vol. 169, Jul. 2022, Art. no. 108304.

[3] M. Pincheira, M. Vecchio, R. Giaffreda, and S. S. Kanhere, ‘‘Costeffective IoT devices as trustworthy data sources for a blockchain-based water management system in precision agriculture,’’ Comput. Electron. Agricult., vol. 180, Jan. 2021, Art. no. 105889. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S0168169920330945

[4] K.Manoj, K. Makkithaya, and V. G. Narendra, ‘‘A trusted IoT data sharing and secure Oracle based access for agricultural production risk management,’’ Comput. Electron. Agricult., vol. 204, Jan. 2023, Art. no. 107544. [Online]. Available: https://www.sciencedirect.com/ science/article/pii/S0168169922008523

[5] M. Torky and A. E. Hassanein, ‘‘Integrating blockchain and the Internet of Things in precision agriculture: Analysis, opportunities, and challenges,’’ Comput. Electron. Agricult., vol. 178, Nov. 2020, Art. no. 105476. [Online]. Available: https://www.sciencedirect .com/science/article/pii/S0168169919324329

[6] X. Peng, Z. Zhao, X. Wang, H. Li, J. Xu, and X. Zhang, ‘‘A review on blockchain smart contracts in the agri-food industry: Current state, application challenges and future trends,’’ Comput. Electron. Agricult., vol. 208, May 2023, Art. no. 107776. [Online]. Available: https://www. sciencedirect.com/science/article/pii/S0168169923001643

[7] S. Hu, S. Huang, J. Huang, and J. Su, ‘‘Blockchain and edge computing technology enabling organic agricultural supply chain: A framework solution to trust crisis,’’ Comput. Ind. Eng., vol. 153, Mar. 2021, Art. no. 107079. [8] A. Musamih, K. Salah, R. Jayaraman, J. Arshad, M. Debe, Y. Al-Hammadi, and S. Ellahham, ‘‘A blockchain-based approach for drug traceability in healthcare supply chain,’’ IEEE Access, vol. 9, pp. 9728–9743, 2021.