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Smart Contracts Based Automated Payouts Crop Insurance Platform

[1]Dr. Karthick. M, [2]Anusri .N, [3]Nithishkumar. P, [4] Siva. P, [5] Supreetha.G

[1] Associate professor, Department of Information Technology, Nandha College of Technology, Erode-638 052
[2,3,4,5] UG Final year, Department of Information Technology, Nandha College of Technology, Erode-638 052
[1]magukarthik@nandhatech.org, [2]anusri.n3101@gmail.com, [3]nithish07123@gmail.com, [4]sivasabaris40@gmail.com, [5]supree.g24@gmail.com
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ABSTRACT -

Agriculture sector plays a pivotal role in the Indian economy, but farmers often face challenges like unpredictable weather, pest attacks, and erratic rainfall, leading to significant losses. Crop insurance is crucial to mitigate these risks and coverage for pre-sowing and post-harvest losses due to natural calamities. Block-chain based insurance system for farmers with smart contracts. The system is designed to provide farmers with insurance coverage against crop failure due to natural disasters. The system uses smart contract to automatically calculate and pay out insurance claims to farmers based on data from the weather cloud app. This approach involves using block-chain technology to create a decentralized and immutable ledger that records all insurance contracts, claims, and payouts. This system could greatly benefit farmers by providing them with more reliable and timely financial support in the event of adverse weather conditions or crop failures, thereby reducing their risk and encouraging greater investment in crop production. The crop index insurance is based on objectively measurable and verifiable data (e.g., weather data, satellite imagery) to determine insurance payouts, thus minimizing the need for on-the-ground assessments and reducing the risk of fraudulent claims. Furthermore, the model includes a decentralized application (DApp) interface for stakeholders to interact with the insurance policies seamlessly, view real-time data, and monitor the status of their coverage and claims. The utilization of Ethereum and Polygon networks ensures the scalability, sustainability, and accessibility of this solution, paving the way for a more resilient agricultural sector.

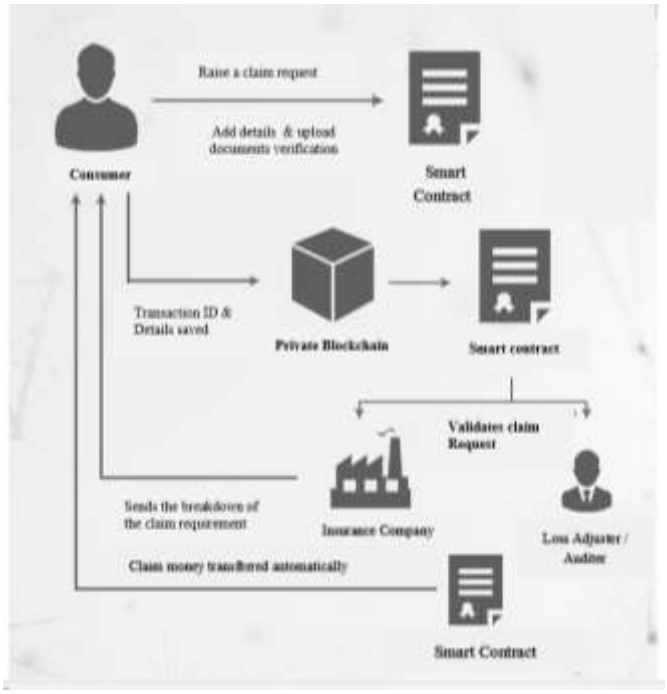
Key Word Block-Chain, Smart Contract, polygon, Transparency, Crop Index Insurance, Distributed ledger.

I. INTRODUCTION

The paper idea for a block-chain based claim insurance system for farmers with smart contracts is to create a secure and efficient platform for farmers to protect their crops and livelihoods against various risks such as natural disasters, pest infestations, and other unpredictable events[3]. The system would be based on block- chain technology, which provides a transparent and tamper-proof ledger that can be accessed by all parties involved. The key idea behind the paper is to use smart contracts to automate the insurance claims process, removing the need for intermediaries and reducing the time and cost associated with traditional insurance claims processing. The smart contracts would be programmed to trigger automatic payouts when certain conditions are met, such as the occurrence of a natural disaster or the failure of a crop[9]. By leveraging the power of block-chain technology and smart contracts, the paper aims to provide a more efficient and cost-effective way for farmers to obtain crop insurance coverage, while also reducing fraud and increasing transparency.

The paper would also involve designing a user-friendly interface for farmers to interact with the system, such as a mobile app or web portal. Creating a decentralised and automated platform that can give farmers a dependable and effective way to safeguard their crops and livelihoods against various risks, while also cutting the time and expense associated with traditional insurance claims processing, is the overall goal of the paper idea for a block-chain based claim insurance system for farmers with smart contracts.Farmers can receive payouts quickly in the event of crop failure or damage, providing them with much-needed financial support to mitigate losses and sustain their operations. Furthermore, leveraging block-chain technology ensures transparency and immutability, enhancing trust among all stakeholders involved[8]. Data regarding weather patterns, crop yields, and payout histories are securely recorded on the block-chain, providing a reliable audit trail and preventing fraud.

Figure.1 describes the claimant submits a claim through the blockchain network, providing necessary documentation and details about the claim. The claim is verified and validated by multiple parties on the blockchain network. Once the claim is verified, smart contracts are automatically executed based on predefined conditions. These contracts define the terms of the claim settlement, including payment amounts, deadlines, and other relevant factors. This consensus mechanism ensures that all parties agree on the outcome of the claim processing. Upon successful verification and execution of the smart contract, the claim settlement is initiated automatically.



II. RELATED WORK

Some initiatives combine block-chain with IoT (Internet of Things) devices to collect and record real-time data on environmental conditions directly onto the block-chain[7]. This integration enhances the accuracy of data used for crop index insurance.

For instance, [13] proposed a NEO blockchain-based weather index insurance solution using a smart contract linked to oracle services to reduce the time wasted in evaluating the compensation process. However, the framework is limited to analyzing the losses incurred during drought while it fails to function in extreme weather conditions. Reference [14] propose a decentralised peer-to-peer crop insurance framework by creating a smart contract between farmers and investors to promote trust in a trustless environtment.

There are emerging decentralized platforms dedicated to providing block- chain based solutions for agricultural supply chains and insurance[4]. These platforms aim to connect farmers, insurers, and other stakeholders directly, reducing the need for intermediaries and lowering costs.The academic community has shown interest in exploring the theoretical and practical implications of applying block- chain technology to agricultural supply chains and insurance[2]. Reference [1] explores the potential of smart contractsin the insurance sector while studying their legal challenges.Ongoing development in block-chain technology, including advancements in scalability, privacy, and interoperability, is crucial for its successful application in agriculture and insurance.

III. SCOPE OF WORK

1.Enhanced Transparency and Trust

Implement a transparent and immutable ledger of records for insurance contracts and claims, which can be accessed by farmers, insurers, and other stakeholders. Development of a block-chain platform to record and verify all transactions and contracts related to crop index insurance, ensuring data integrity and reducing fraud.

2. Automated Insurance Contract Execution

Utilize smart contracts for automating insurance contract execution, including premium payments and claims settlements based on predefined conditions.Integration of smart contracts that automatically trigger payments to farmers when certain conditions (e.g., weather parameters) meet the criteria set in the insurance agreement.

3. Real-Time Data Collection and Analysis

Leverage IoT devices and remote sensing technology for real-time data collection on weather conditions, soil health, and crop status[6]. Deployment of sensors and satellite imagery to collect data, which feeds into the blockchain system for accurate and timely execution of insurance contracts.

4. Increased Accessibility for Smallholder Farmers

Make crop index insurance more accessible to smallholder farmers, who are often the most vulnerable to climate risks but have the least access to insurance. Development of user-friendly platforms and mobile applications that enable smallholder farmers to easily enroll in insurance schemes, pay premiums, and receive alerts.

5. Cross-Border Risk Pooling and Reinsurance

Facilitate cross-border risk pooling and reinsurance to spread risk more broadly and improve the resilience of the insurance model.Establishing a block-chain network that connects different insurance providers and reinsurance companies across regions, allowing for efficient risk sharing and management.

6. Regulatory Compliance and Reporting

Ensure that the block-chain based insurance system complies with local and international regulatory requirements.Implementation of mechanisms for regulatory oversight, including data privacy protection, anti-money laundering (AML) compliance, and regular reporting to regulatory bodies.

7. Stakeholder Engagement and Capacity Building

Engage all stakeholders, including farmers, insurers, governments, and NGOs, to ensure the system meets their needs and capabilities. Conducting workshops, training sessions, and pilot projects to familiarize stakeholders with blockchain technology and the crop index insurance model.

8. Sustainability and Scalability

Design the system to be sustainable in the long term and scalable to different regions and crop types.

Continuous evaluation and improvement of the block-chain platform, exploring partnerships for expansion, and adapting the model for different agricultural contexts.

IV.BACKGROUND

We discuss the problems with the current index-based crop insurances in this section. We also stress how crucial it is to use blockchain technology to address these current issues.

A. Challenges with existing index based crop insurance

Traditional crop insurance plans, such indemnity-based crop insurance, are more intricate and usually not financially feasible. Under these conventional insurance schemes, farmers must comply with a number of terms and conditions in order to receive insurance. Because extreme weather affects agricultural production, it poses a threat to food security.

Crop insurance based on indemnity can accurately cover losses, but it may have issues with asymmetric information. Financial loss results from the inability to guarantee productions that cannot be measured, such grazed meadows. The drawbacks of indemnity-based insurance gave rise to the concept of index-based insurance.

Create a set of smart contracts to manage the insurance process, including policy creation, premium payments, claim submissions, and payouts. Define the data structures and functions necessary for policy management, such as storing policy details, calculating premiums, and verifying claims .Farmers can interact with the smart contract to create insurance policies by providing details such as crop type, coverage period, insured amount, and premium payment.

Farmers pay premiums using Ether or a stablecoin directly to the smart contract. Implement mechanisms to handle premium payments securely, such as using escrow services or multi-signature wallets .Define conditions for triggering insurance payouts, such as crop failure due to adverse weather conditions or other predefined events. Integrate with oracles to fetch real-time data, such as weather reports, to determine if payout conditions are met.Upon verification of a valid claim, automate the payout process by transferring funds from the smart contract to the insured farmer's address.Farmers can submit claims through the platform, providing relevant evidence such as crop damage photos or official reports.Implement a verification process to ensure the validity of claims, potentially using third-party data sources or consensus mechanisms.

Ethereum, especially in its current state, faces scalability issues, with high transaction costs (gas fees) and slower processing times during network congestion. This could affect the feasibility of small or frequent insurance claims.Each block has a specific capacity to store data. This makes the validation of transactions very slow and tedious. There is no scope to increase the size of the block on a block-chain. Ethereum can process only up to roughly 15 transactions per second. Block-chain networks can be slow and inefficient due to the high computational requirements needed to validate transactions.

B. Improving crop insurance based on index using blockchain technology

A private blockchain solution for the insurance industry might cut down on negotiation and quotation times by up to 90%. The insurers might establish more efficient reinsurance operations and expedite the process of estimating reserve values. Nevertheless, improved liquidity management and lower transaction costs are the primary benefits for all insurers. Index insurance does not need loss assessment at the individual level, it is more cost-effective than indemnity-based insurance since it depends on easily verifiable data, lowers the cost of processing claims, and lessens the possibility of fraud throughout the claims processing process.

Using blockchain technology ensures that all parties involved in the supply chain have access to accurate and tamper-proof information, enhancing trust and accountability[12]. Overall, implementing such a system can streamline the insurance process and provide better risk management for farmers and other stakeholders in the agricultural supply chain[11].

V. PROPOSED SOLUTION BASED ON BLOCKCHAIN

The proposed system aims to increase transparency, reduce fraud, and expedite claims processing through the integration of smart contracts and decentralized finance (DeFi) practices. Smart contracts on the Polygon network can automate the insurance process, triggering payouts based on predefined crop index parameters such as weather data or yield estimates[5]. This can reduce administrative costs and minimize the risk of fraud.

Utilize smart contracts on the Polygon network to create programmable agreements for crop insurance. These smart contracts can define the terms and conditions of the insurance policy, including triggers for payouts. Integrate real-time data sources, such as weather data or satellite imagery, into the smart contracts.

Define specific parameters in the smart contracts that will automatically trigger payouts when certain conditions are met. For example, if weather data indicates a drought has occurred in a specific region, the smart contract can automatically initiate a payout to affected farmers[10]. Implement decentralized governance mechanisms on the block-chain platform to ensure transparency and fairness in the insurance process[15]. This could involve token-based voting mechanisms for policy changes or disputes resolution.

Facilitate secure and instant payments using cryptocurrency or stablecoins on the Polygon network. This eliminates the need for intermediaries and reduces transaction costs associated with traditional payment methods. Immutable Record-keeping: Leverage the immutability of block-chain technology to maintain a transparent and tamper-proof record of insurance policies, payouts, and claims. Benefit from the scalability and low transaction fees offered by the Polygon network, making it cost-effective to process a large volume of insurance transactions.

By leveraging block-chain technology on the Polygon network, this automated crop insurance platform can streamline the insurance process, reduce administrative overhead, and provide timely financial support to farmers in need.

A) Proposed Methodology

Define the architecture of the platform, including components such as smart contracts, user interfaces, and data sources. Determine the role of the Polygon network in the platform architecture and identify integration points. Develop smart contracts to automate the insurance process, including policy creation, premium payments, and payout triggers. Ensure that smart contracts are compatible with the Polygon network and optimized for efficiency and security. Integrate real-time data sources, such as weather APIs or satellite imagery, into the platform to assess crop conditions and trigger payouts. Implement mechanisms to securely and efficiently retrieve and process data from external sources.

Conduct thorough testing of the platform to identify and address any bugs, vulnerabilities, or performance issues. Perform both functional and non-functional testing to ensure that the platform meets the requirements and standards. Deploy the smart contracts and other platform components on the Polygon network. Provide training and support to stakeholders to help them understand and effectively utilize the platform. Set up monitoring tools and processes to continuously monitor the performance, security, and availability of the platform.

Figure.2 describes the insurance firms store main words in the ledger, e.g., insurance forms, thus holding off-the-chain details to reduce the related overheads. Customers pick a proposal and sign a contract in the context of a smart contract which is held in the blockchain. The smart contract serves as the transaction of the inception, i.e., the first in a ledger process, and all such contract- related transactions are connected to the process of creation .

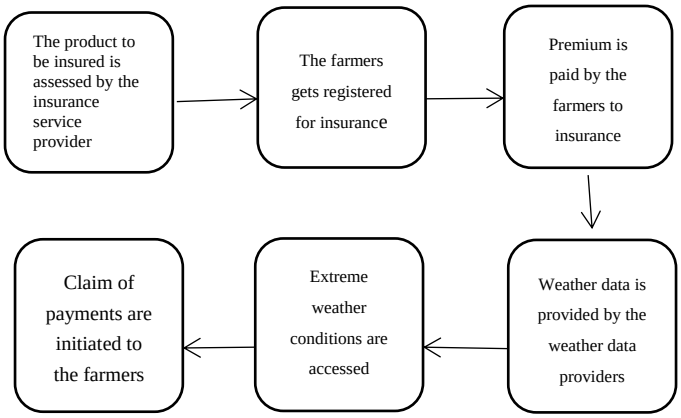


Fig.2 Workflow of the System.

VI. RESULT

The block-chain based automated payout-enabled crop insurance platform is a robust and innovative solution that revolutionizes the way crop insurance is administered and managed. The paper delivers a fully functional platform built on blockchain technology, enabling automated payouts for crop insurance policies. The platform is user-friendly and accessible to farmers, insurers, and other stakeholders. The platform leverages the security and scalability of block-chain technology to safeguard sensitive data and handle a large volume of transactions efficiently. The chosen block- chain network, such as Polygon, provides low transaction fees and high throughput, making the platform cost-effective and scalable.

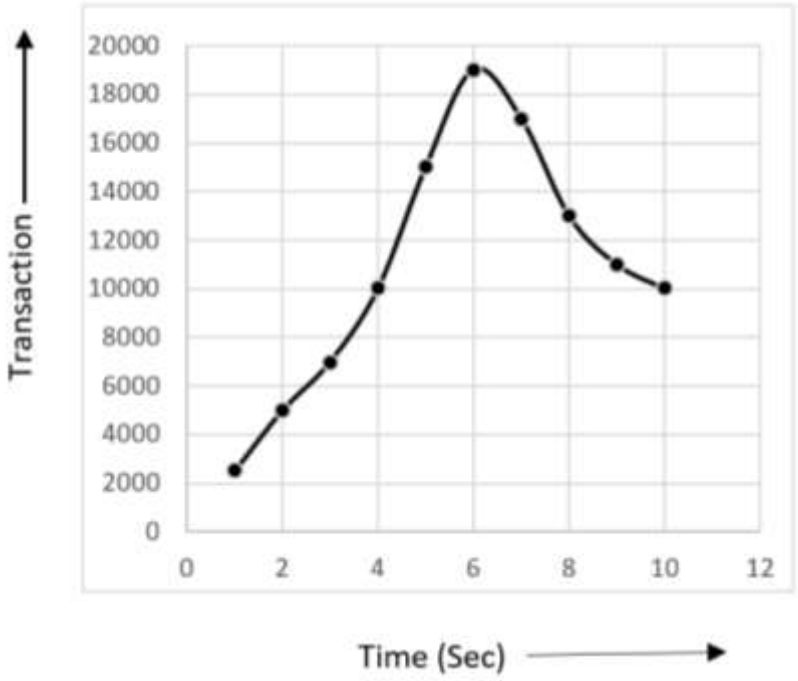


Fig.3 Transaction processing and its variation with time.

VII. DISCUSSION

The crop index solution we offer in this paper is based on private blockchain technology and enables reliable and secure communication between insurers and smallholder farmers. Our goal in putting up this solution is to encapsulate the essential exchanges that occur between these parties. In this section,we provide a qualitative comparison.

A. Qualitative comparison

Table 1 describes the compares our work to other relevant solutions .Based on the attributes developed by the authors of these papers, this comparison illustrates the advantage of our proposed approach compared to other approaches in simplifying the crop index insurance process.It can be observed from Table 1 that decentralized storage isn't supported by some of the solutions, such as [9], [13] and [14]. Also, it was found that none of these solutions were based on a private framework, and they lacked the presence of a reward system. Moreover, some of these solutions [9], [13] did not provide DApp support.

Featurres	TQ et al [13]	Iyer et al [14]	Jha et al [9]	Our solution
Crop Index based insurance	Drought based	Rainfall Based	Weather based	Weather based
Blockchain platform	NEO	Ethereum	Ethereum	Polygon
Smart contract	✓	✓	✓	✓
Decentralized storage	**X**	**X**	**X**	✓
Reward system	**X**	**X**	**X**	Reputation based
DApps	**X**	✓	**X**	✓
Private network	**X**	**X**	**X**	✓

Table.1 Comparison with state-of-the- art

VII.CONCLUSION

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 utilization of smart contracts within our private blockchain ensures that only registered stakeholders can interact, amplifying security and trust within the ecosystem.

VIII. FUTURE ENHANCEMENT

Utilizing Polygon's network can enhance data security and privacy for all parties involved in crop index insurance. By leveraging cryptographic techniques and secure channels, sensitive information such as farmer identities, farm locations, and financial transactions can be protected. One of the significant benefits of using Polygon is its ability to significantly reduce transaction costs compared to Ethereum's main network. This is particularly important for crop index insurance, where the margins can be thin, and high transaction fees.To implement these future enhancements effectively, it would involve collaboration with data providers, regulatory bodies, insurance companies, and the farming community to ensure the solution meets the diverse needs of all stakeholders. Furthermore, continuous technological advancements in the Polygon ecosystem could provide additional opportunities for innovation in block-chain based crop index insurance.

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