

APPLICATION OF BLOCKCHAIN TECHNOLOGY IN CROP REINSURANCE

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ABSTRACT: This paper presents a Blockchain-based methodology and its application in Insurance Industry, which leads to a new type of business that combines traditional insurance processes with technological advancements to improve the way insurance is traditionally assembled, acquired, and experienced. These applications have the potential to improve crop transparency and yield quality control via IoT. As evidenced by data gathered from Agricultural Insurance Corporation of India from the year 2016 to 2020.

Keywords: Blockchain, Digital Ledger and Smart contracts, encryption, Crop Insurance and reinsurance

1. INTRODUCTION:

Agriculture is a growing industry. crop reinsurance should serve the clients along the value chain in both developed and developing countries. As a global leader in agricultural reinsurance, protecting the capital required to boost output with financial transparency. Nakamoto created the first blockchain in 2008, which is a distributed decentralised database that maintains track of linked nodes confirmed data entries. [27] Blog, R. and Concern et.al. (2021) says that all the data is maintained in a public ledger that contains all of the transactions. Over 70% of India's population is reliant on agriculture in some form or another. [2] Atzori, M (2015) says that the blockchain is a peer-to-peer network that shares and agrees on a distributed database. [12] Herweijer .C, et.al, (2018) says the blockchain consists of a series of blocks that contain time-stamped transactions protected by public-key cryptography and confirmed by the network community. Once a piece is put to the blockchain, it becomes an immutable record of prior transactions that cannot be modified. [4] Falco et.al, (2014) says that, the Crop insurance is unquestionably a viable answer to the losses incurred as a result of these occurrences. Until now, there has been little attention paid to the distinction between consortium blockchain and entirely private blockchains, in fact that it is critical. [8] Bolt.J (2019) reveals Crop insurance is, without a doubt, a feasible solution to the losses experienced as a result of these events. Despite its importance, the distinction between consortium

blockchains and completely private blockchains has received little attention thus far.[13] Andoni M et.al, (2019) reveals that, the farmer is better described as a traditional centralised system with some decentralisation. The latter, on the other hand, is a combination of public blockchain "low-trust" and private blockchain "one highly-trusted entity" paradigms. [11] Hans, R et.al, (2017) says that, A consortium blockchain, which can be used as a shared ledger, may be advised if multiple organisations require data access.

[29]According to the Netherland's Ministry of Foreign Affairs (2018) the Organizations frequently develop permissioned blockchains to meet their specific needs. Partially decentralised blockchains are those that will probably surely integrate with the company's existing applications. [14] Andreevich G.K et.al (2018) reveals theCrop insurance can help farmers mitigate the negative effects of climate change, such as increased droughts, floods, and hail. However, insurance procedures might take so long that some farmers who have enrolled may never obtain coverage.[23] Wamba S.F (2019),as per the result, each transaction is time-stamped and linked to a sequence that is shared all the network participants. These transactions can be saved using either public or private keys, allowing people to remain anonymous while allowing third parties to verify their identity.[2] Atzori M (2015) says, the Blockchain technology is a method of governance that is decentralised that has the potential to revolutionise present civic, authority, and democratic frameworks. It allows transactions to take place without the involvement of third parties such as banks or notaries. [3] Baker & Steiner, (2015)says that, the database is the technology, and it is well-known for its capacity to lower transaction costs, improve provenance, and increase traceability and transparency.[18] Caro M.P et.al (2018) reveals that, the Blockchain technology has the potential to upend traditional agreements by providing legal clarity and reducing the need for trust and financial risk.It has the potential to improve uptime and overall security, as well as lower operating costs and reputational risk, and increase transparency and auditability by providing executives, clients, and regulators with instant access. [24] Chitchyan R et.al (2018) says that, during the generation process, a blockchain is a decentralised ledger in which actors take turns recording information about the buying, selling, and using of a product or service. All parties involved manage the ledger together, usually through a peer-to-peer network. Before a new record can be added to the blockchain, it must be validated by the network. Any changes to the recorded data should be settled by consensus, which requires the majority of the persons concerned to agree. Furthermore, every change to one record affects all subsequent records in the chain. As a result, changing data in a blockchain is nearly difficult in practice. Sharples and Domingue, proposed using blockchain to create a visible, easily shared, and long-lasting record of such educational recordings and rewards. It also discusses the potential of an "Educational Reputation Currency," which would be distributed to participating institutions first and foremost based on any current statistic. [15] Angraal S et.al (2017) says, the transactions can be completed without the assistance of third parties such as banks or notaries. This suggests that blockchain could be beneficial in situations where transactions are hampered by distrust or weak governance. Furthermore, according to the report of US health system Medical claim fraud is socially wasteful, resulting in needless costs of more than \$250 billion across the world.[26] Blog, R et.al, says that, the

technology is a database, and it is well-known for its potential to reduce transaction costs, improve provenance, and improve traceability and transparency. The insurance industry is currently dealing with a number of difficulties, including meet the required that must be accurately analysed in order for the insurer to minimise risk, as well as widespread digitalization. According to a quantitative study conducted by Simon-Kutcher in August of 2017, the following are the prime causes driving insurers to switch insurers: 29 percent price is too expensive, 20 percent premiums are increasing without justification, 16 percent given cover is not adapted to insurer's needs, and 7 percent claim is mismanaged, and so on. Whereas, according to the same survey, the benefits of obtaining a digital insurance policy include a 53 percent lower price, 51 percent greater simplicity and speed, and 23 percent more tailoring of the offer to the client's needs.

In this paper deals that the potential of the blockchain technology to upend the traditional crop insurance and Reinsurance agreements with providing legal clarity and reducing the need for trust and financial risk.

1. CROP INSURANCE PROCESS UNDER BLOCKCHAIN METHODOLOGY:

2.1 PROCESS MAP FOR PILOT PHASE:

This is the initial phase for the implementation of blockchain technology in crop insurance. The main components in this phase include:

- Insurance Company
- Farmer
- Service Provider

Insurance company provides the product as insurance policies, farmers are insured and the service provider acts as the Trusted Third Parties.

- The Trusted Third Parties agrees the flow of cash between insurance company and farmer when the conditions are met and thus acts with smart contract.
- The service provider acts as a mediator who pays for the claim at first and then request for reimbursement from the insurance company and thus it creates the Duplicate Risk Pool.
- The User Interphase provides the information for both insurance company and farmer regarding the policy and payment history.
- The application layer actually implements the premium transaction and claim settlement as well as pay reimbursement.

The application layer does the job based on the block chain layer which consists of the smart contracts and other databases which determines the flow of cash.

2. REINSURANCE PROCESS UNDER BLOCKCHAIN METHODOLOGY

Under the Reinsurance process, the insurance company is responsible for paying the claim to the farmers who are covered. When one insurer is unable to absorb the large number of claims losses that occur as a result of a disaster, the insurer transfers their risk to another.

Notations used under Reinsurance Contract:

- **X** – Total Claim amount
- **I** – Claim amount paid by Insurance Company
- **R** – In relation of a single claim, the amount paid by the reinsurer in accordance with the contract.

We can express the random variables I and R in terms of X for a certain reinsurance arrangement.

General formula: $X = I + R$

The total claim amount includes the amount paid by the insurer (I) and the amount paid by the reinsurer (R).

Illustration, assume that a reinsurer has agreed to make the following payments to a direct insurer in respect of individual claims:

Assume that a reinsurer has agreed to make the following payments in the event that a direct insurer has created individual claims:

- When the claim(X) is smaller than the deductible, the reinsurer has nothing to pay. $\forall X \leq M$
- When the claim is between M and L ($M < X \leq L$) dollars, the full claim amount is decreased by \$ $X - M$ dollars.
- When the claim is between X and ∞ ($L < X \leq \infty$) dollars, half ($\frac{X}{2}$) of the whole claim amount is paid.
- When a claim surpasses the ∞ -dollar ($X > \infty$) limit, the insurer pays \$M to the claimant.

Reinsurer Point of view:

3.1 Premium calculation of Reinsurance:

As per the above arrangements, the reinsurer's participation in each and every claims are as follows,

$$\begin{cases} 0 & \text{if } X \leq M \\ X - M & \text{if } M < X \leq L \\ M & \text{if } X > \infty \end{cases}$$

The expected claim amount will be calculated by using the following way,

$$E(Y) = \int_M^L (X - M) fX(x) dx + l \int_M^{\infty} fX(x) dx$$

E(Y) is the premium layer to the reinsurer. To break even, a premium will be levied. To arrive at the office premium, the reinsurer would generally add charges for cost of equity, management fees,

and a profit loading to the technological price. The deterministic technique to charging surplus of loss cover is to solve $E[Y]$ numerically, as this always produces the same solution.

3.2 CROP REINSURANCE PROCESS MAP FOR SCALE-UP PHASE:

This is the phase where the pilot phase is improved and scaled up to meet the requirements of both insurance company and the insured farmer. This phase contains Reinsurance arrangement to reduce the huge amount of claim burden of the insurance company. It would help to secure the utmost good faith on insurance.

Here the service platform comprising user Interface, application layer and blockchain layer acts as the point of contact for all the components and none can take over the other in case of any uninformed changes without the knowledge of the other.

It also removes the duplicate risk pool and the payment is done by the insurance company directly to the farmer based on the smart contract farmers pay the premium directly through the platform to the insurance company and part of premium goes to reinsurance company based on arrangement as following flow chart.

It also not depends on only one service provider instead makes use of separate service provider based on the requirement of the policy.

By validating coverage between corporations and reinsurers, blockchain has the potential to help simplify claims operations. It will also streamline the reimbursements between participants for claims, lowering insurance firms' administrative costs. From expediting the claims settlement and increasing timing to enabling improved visibility in agreements and securing data, blockchain has the potential to alter various operations in the insurance industry. It will create a platform to reducing the process time and claim settlement duration.

3. IMPLEMENTATION PHASE:

The Blockchain application was implemented in two stages: a pilot phase and a scale-up phase.

4.1 Pilot phase Implementation:

The instrument will be created by a software business that specialises in providing blockchain-based digitalization and automation solutions for reinsurance products. The insurance firm for policies and farmers as potential consumers support this. The pilot phase takes approximately 2 to 3 years to take off and then will be ready to scale up. Here the service provider will create the data for weather and handles payment as well. The duplicate risk pool will create the trust on the service provider for both farmer and insurance company and thus it will build a good partnership among the components. It targets around 10 million farmers across India in that stipulated time.

4.2 Scale –up phase Implementation:



After the successful pilot phase implementation, the scale up phase kicks starts. Here due to strong partnership, the platform takes full responsibility of communication among service provider, insurance company, data providing firm, and farmer. The scale up phase will take 2 to 3 years to expand into a benefitting activity for the insurer and the insured. The reach of the blockchain technology also may increase form 10 million to 25 million farmers. With the help of digital platforms across India and the continuous support from the central Govt of India will result in complete coverage of all farmers after the scale up phase and it is the main objective of this implementation.

4. STRUCTURES OF PREMIUM EQUATION

5.1 Drawbacks of Traditional premium calculation Method:

- Crop insurance only adds a reserve load and a catastrophic loss load.
- Due to loads, the actual premium will be increased from 40% to 70% using the traditional premium calculation technique. It will have an impact on farmers' perceptions of crop insurance, as well as their degree of contentment.

This drawback can be rectified by Blockchain Technology.

5.2 Premium – Blockchain Technology:

- **General Premium rate = premium / liability**
- **Private-sector total premium rate = Actuarially-fair rate + loads.**
 - In Block Chain Methodology Loads reflect factor of administrative cost alone to maintain Fintech expenses regarding the estimate of E (Loss Cost).
 - As a result, the premium value will be reduced by up to 40% (based on an assumption).
 - Because the application of Blockchain technology is still in its early stages. As a result, there is no true data available.
 - Other expenses should not be included as a loading factor.

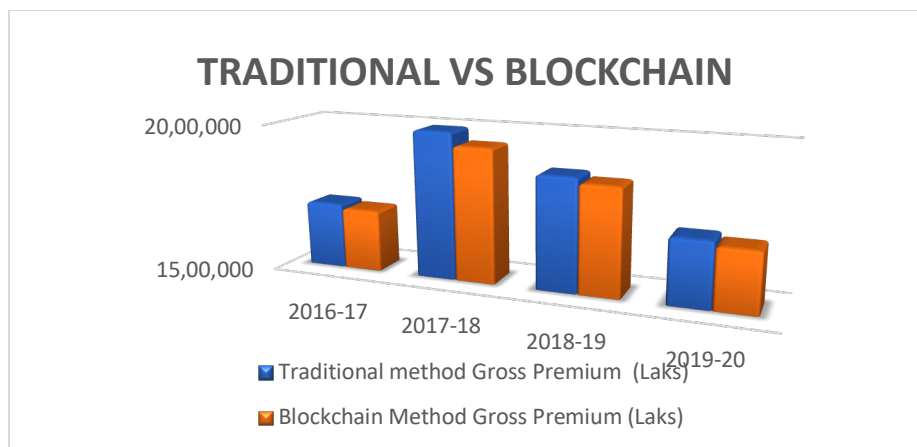
5. TRADITIONAL VS BLOCKCHAIN TECHNOLOGY:

Traditional insurance and reinsurance contracts carry a number of risks, including those connected to farmer enrolment, financial risk, and claim resolution risk. And the Policy information to be communicated with inefficient manner. It also leads the farmers in to trouble. And same thing the traditional method having lot of chances to making fraud land and delaying the claim settlement. So, it will affect the farmers continue cultivation. But the blockchain can help insurers better analyse and price risks. While these systems are effective, the possibility of human mistake and misuse can result in information being lost, tampered with, or misread. And also, it will reduce the premium contribution by farmers with avoiding the unwanted risks. In terms of security,

efficiency, and customer happiness, the Block chain technique leaves a lot to be desired, which are issues that blockchain might assist fix. While these systems are effective, the possibility of human mistake and misuse can result in information being lost, tampered with, or misread. In terms of security, efficiency, and customer happiness, the Block chain technique leaves a lot to be desired, which are issues that blockchain might assist fix. This work considers the dataset of Agricultural Insurance Company's gross and net premiums from 2016 to 2020.

6.1 COMBINATION OF TRADITIONAL AND BLOCKCHAIN TECHNOLOGY:

Year	Traditional method		Blockchain Method		Differences of Gross premium between Traditional and Block chain method
	Gross Premium (Laks)	Net Premium (Laks)	Gross Premium (Laks)	Net Premium (Laks)	Differences of Gross premium(Laks)
2016-17	17,22,093	16,95,421	17,08,757	16,95,421	13,336
2017-18	19,96,696	19,07,214	19,51,955	19,07,214	44,741
2018-19	18,79,498	18,41,638	18,60,568	18,41,638	18,930
2019-20	17,18,711	16,85,741	17,02,226	16,85,741	16,485



Blockchain can reduce the loading expenses like renewal and administrative expense for insurers and slash insurance prices for clients. Expenses loading factor was varying and it depends on the sum assured and number of farmers insured. As per the analysis under blockchain methodology nearly 2% to 4% of gross premium rate was reducing compare with traditional method. In the middle year 2019 alone having 4% loading factor, because number of farmers enrolls was high compare with other years.

CONCLUSION:

From the analysis the Block chain technology will be a significant breakthrough in crop insurance and reinsurance. Weather data triggers pay-outs immediately, allowing farmers to respond to weather occurrences quickly rather than waiting for claims to be processed. Because claims are processed fast using this method, a one-week payment may be achievable. It will encourage and incentivize farmers to get crop insurance, as well as boost farmers' confidence in crop insurance. The percentage of erroneous claims has also decreased with 2% to 4% for per policy. But that low rate will be creating a big impact in the huge number of policy. It can be possible only through the smart contract. Similarly, the increased speed of blockchain technology will increase the level of consumption by farmers. The insurance sector will profit more as a result. In the crop insurance industry, the decentralised blockchain methodology is becoming more popular. This system provides greater transparency in all areas, including data management, avoiding unnecessary spending, claim processing, and claim settlement. As a result, the crop insurance platform will strengthen the farmer's protection shield.

The further scope will be based on a single algorithm dubbed the Artificial Intelligence Object Classification Model, which will improve accuracy. With this blockchain technological solution, resources are properly utilised and expenditures are reduced. This blockchain technology can also be used in conjunction with a government-sponsored insurance programme.

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