“Smart contracts on blockchain for insurance and Takaful industry”

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SMART CONTRACTS ON BLOCKCHAIN FOR INSURANCE AND TAKAFUL INDUSTRY

Abstract

Blockchain technology can drastically reduce the costs associated with claim verification in the insurance and Takaful industry while increasing trust among involved parties through smart contracts and a shared source of truth. This study examines whether Takaful operators and insurance companies apply blockchain differently and explores the benefits of blockchain technology and smart contracts for both. It conducts a systematic review of relevant literature and a meta-analysis to assess how current studies describe and combine cases as evidence. The results indicate that Takaful and insurance companies that use smart contracts experience a reduction in fraudulent claims, increased transparency, enhanced connections between involved parties, and automation of claim payments with minimal human intervention. The analysis reveals no difference in the application of blockchain technology between the two types of operators, despite the distinct operating contracts of Takaful and conventional insurance.

Keywords blockchain, smart contract, insurance, Takaful, claims process

JEL Classification G22, G32

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INTRODUCTION

The insurance and Takaful industries provide risk management services for both companies and individual customers, offering protection against events ranging from operational losses, business interruptions, or individual incidents to major catastrophes. According to Takaful and insurance companies, their priority is to build trust and ensure they fulfill their obligations to policyholders in the event of unforeseen circumstances. However, a study conducted by the IBM Institute for Business Value in 34 countries between May and July 2020 revealed that consumer trust in insurance companies was not high, as 42% of the customers expressed that they did not have complete faith in their insurer because their claims as policyholders remained unprocessed. Blockchain technology has emerged as an approach to overcome these trust issues.

The Takaful and insurance industry can adopt blockchain technology using smart contracts to develop a more automated and trust-based system, discarding traditional paper-based dealings. "Blockchain" refers to a linked chain of finished blocks that cannot be changed retrospectively. The distribution of these blocks in the chain enables decentralized validation and review. Every entry in the blockchain register is stored in its own unique "block" and used to represent steps in a business process. Further, process steps from policy origination through final claims settlement can be mapped inside the value chain of an insurer using an industry standard that is yet to be developed.

This study identifies a research gap in the literature regarding the impact of blockchain on the insurance model and the Takaful industry. This gap is addressed by conducting qualitative case studies of insurance practices through a review. Consequently, the focus is shifted to the structures of the Takaful and insurance industries, illustrated through real case examples. The study demonstrates how blockchain influences both the Takaful and insurance industries. To the authors' knowledge, this is the first study to discuss this specific issue.

1. LITERATURE REVIEW

Blockchain, the technology behind the success of bitcoin in the cryptocurrency market, has led to significant advancements in the decentralization of information storage systems based on distributed storage and peer-to-peer networks. The primary benefit of blockchain technology is the traceability it offers in transaction maintenance, ensuring privacy between senders and recipients. Thus, the ability to track and employ private transactions between senders and receivers is a fundamental advantage of blockchain technology (Huang et al., 2020). In the insurance industry, blockchain technology has reduced administrative costs and streamlined insurance processes in several cases. Similar to how blockchain enables transactions among the unbanked, it can also cover the uninsured population of the world, increasing insurance accessibility. Improved productivity and lower operating costs can lead to more affordable and readily available insurance options. Blockchain or distributed ledger technology can be used to expedite insurance claim processing, enhance cybersecurity measures, and shorten payment times. In health insurance, a blockchain automatically activates claim payment if the claim complies with the criteria of the insurance company. The automatic execution of smart contracts can decrease fraud in insurance transactions and enhance assurance, confidence, and efficiency in the insurance industry, such as claims administration. Therefore, blockchain technology presents new business opportunities, inclusive insurance prospects, and increased efficiency compared to traditional insurance.

Some policyholders fail to provide accurate information because of their relatively low trust in the insurance industry (Tennyson, 1997; Peter & Ying, 2020), which frequently leads to data manipulation. This increases mutual mistrust between policyholders and insurers, making policyholders more likely to commit fraud. Such activities can be attributed to opaque procedures and misaligned incentives. Moreover, it makes underwriting and claims processing more difficult, expensive, laborious, and inefficient for all concerned parties. According to Yadav et al. (2023), insurance companies can increase security and identify fraudulent transactions that lead to invalid claims by utilizing blockchain technology and smart contracts. According to El Samad et al. (2023), adopting a blockchain with smart contracts has several advantages, including enhanced fraud detection and reduced administrative costs. Comparable results were observed by Kaafarani et al. (2023), who discovered a decision-making map technique to choose the best platform for applications that identify health insurance fraud. Thus, blockchain technology can enhance fraud mitigation, streamline and increase transparency in underwriting, expedite and ensure fair claims processing and settlement, and significantly simplify client onboarding.

To summarize the conclusions of these studies, blockchain-based platforms can boost user confidence in network data collection, because customers are willing to share their personal data by granting access to other network participants when they have confidence that their data will be used ethically. Blockchain platforms can help simplify implementation and dissemination because of the growing trust in the system regarding data quality and consumption. Blockchain-based networks support the establishment of trustworthy insurance markets by guaranteeing data security and expanding the membership base of the ecosystem to include clients, brokers, reinsurers, sellers, lenders, and regulatory agencies. These new approaches can disrupt insurance companies in the future because of the comprehensive knowledge of their long-standing clientele, access to pertinent data from their operations, their value chain partners, competitive positioning, and in-

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cumbents' distinct advantages over new entrants. Newer entrants to the insurance market are redefining the customer experience using blockchain, the Internet of Things (IoT), artificial intelligence, and other technologies. In this context, several studies have been investigating the role of blockchain in insurance, but real case studies are scarcely discussed (Zheng et al., 2020; Bagloee et al., 2021; Kar & Navin, 2021; Amini et al., 2024) or focus on healthcare (Al-Mutar et al., 2022; El Samad et al., 2023). The scarcity of studies on blockchain technology for the Takaful industry in international journals indexed by Scopus indicates potential for further research.

2. GENERALIZATION OF THE MAIN STATEMENTS

In this study, the search for research articles was divided between registrations and databases. To identify relevant articles, the authors used databases and registrations. Subsequently, the study utilized ScienceDirect to conduct a keyword search, entering the terms "blockchain Takaful" and "blockchain insurance." However, ScienceDirect did not retrieve studies on the term "blockchain Takaful," probably because research on blockchain technology is still in its nascent stages in this industry. Moreover, public records only spanned from 2017–2024. For the keyword "blockchain insurance," ScienceDirect identified 12 records, with review articles (1), research articles (9), and book chapters (2) among the recognized works. Another approach to finding relevant cases to address this gap (n = 15) was to use Google's search engine. Following the screening procedure, the process discarded reports that did not align with the objectives of the study. Upon a thorough examination of the remaining literature, the study selected 17 records – 7 articles and 10 cases – to discuss the research topic of the current uses of blockchain technology in the Takaful and insurance industry.

The result shows that, unlike manual insurance procedures, smart contracts in the blockchain can be used to track insurance claims and hold all parties accountable. Smart contracts utilize policyholder records to provide secure information, allowing them to instantly accept or refuse any insurance claims while preventing fraud or double claims. The system approves customer registration once the company has completed the administrative process and all required information has been obtained. Insurance companies can enable a fully transparent and equitable process, freely and unanimously agreed upon, through smart contracts that specify the exact procedure to be followed. Automated storage and backup across distributed networks provided by smart contracts can expedite the claims process and enable digital confirmation using real-time data. In addition, smart contracts are less prone to errors, quicker, and less expensive. For example, when an insured vehicle is damaged in an accident, the insurance company pays the claim once the system authorizes it, as the data are automated, and the payment contract can be completed via a smart contract on the blockchain. Another example is the event in which an insured person's flight is canceled. Here, the insurance company automatically and instantly pays them when the airline announces the cancelation. A similar process is followed during the filing of a life insurance claim, where the insurance smart contract executes the payment upon receiving a verified death certificate.

Figure 1 illustrates the main processes of claim submission, assessment, and approval.

1. Through a smart-contract platform developed for users, the insurer enables the insured to submit claims efficiently by first registering them with the insurance company, which collects information about potential clients using the same system, such as medical records received from health service providers. If the insurance has completed the underwriting process and obtained all required information, the system can approve the customer's registration.

2. After submission of the claim, the system initially verifies whether the insured has valid coverage, i.e., whether the policy has expired or is still in effect.

3. Based on the policy data of the insured, the smart platform verifies if the coverage terms

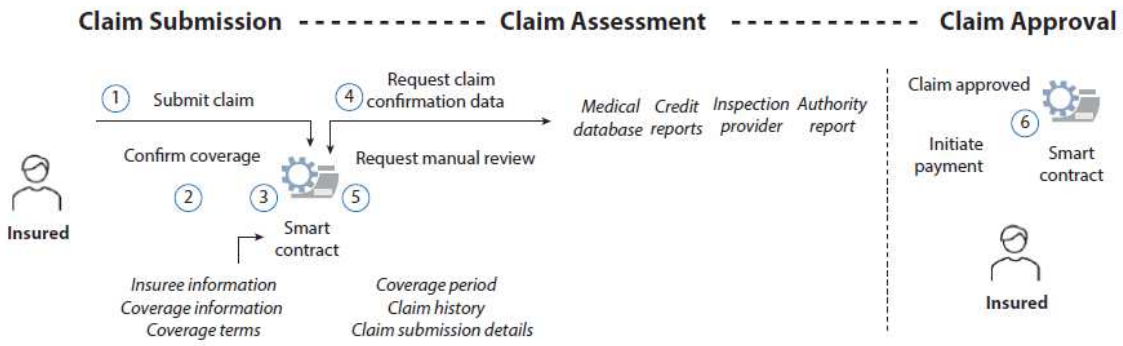

Figure 1. Insurance claims process via blockchain

match the identity and claim history of the insured.

4. Additional information regarding claims, such as medical reports and health concerns, is also handled when the claim enters the assessment phase.

5. Each concerned party, including the insured and insurer, and outside parties such as medical professionals, can access this single database, namely the blockchain ledger, which aggregates all the information needed to determine acceptable claims. Thus, increased transparency reduces the likelihood of fraud and conflict.

6. When insurance companies are prepared with their decision on a claim, their approval triggers the payment to be made to the award based on the sum determined by the instant payment systems connected to the smart contract platform.

In Islamic insurance or Takaful, with the application of blockchain, Islamic contracts are already more transparent from the policyholder's perspective, from price and policy specifics to the acceptance or rejection of claims. Figure 2 illustrates the automation of the coverage and disbursement of Takaful in the *Wakalah* Agreement by smart contracts. *Wakalah* fees, which represent the premium income, are accepted by the Takaful operator as a *wakeel* for policyholders. The Takaful operator invests the raised funds to generate a variety of earnings. While family Takaful (individual items) provides a fixed amount of the investment income directly to consumers, general Takaful (for non-

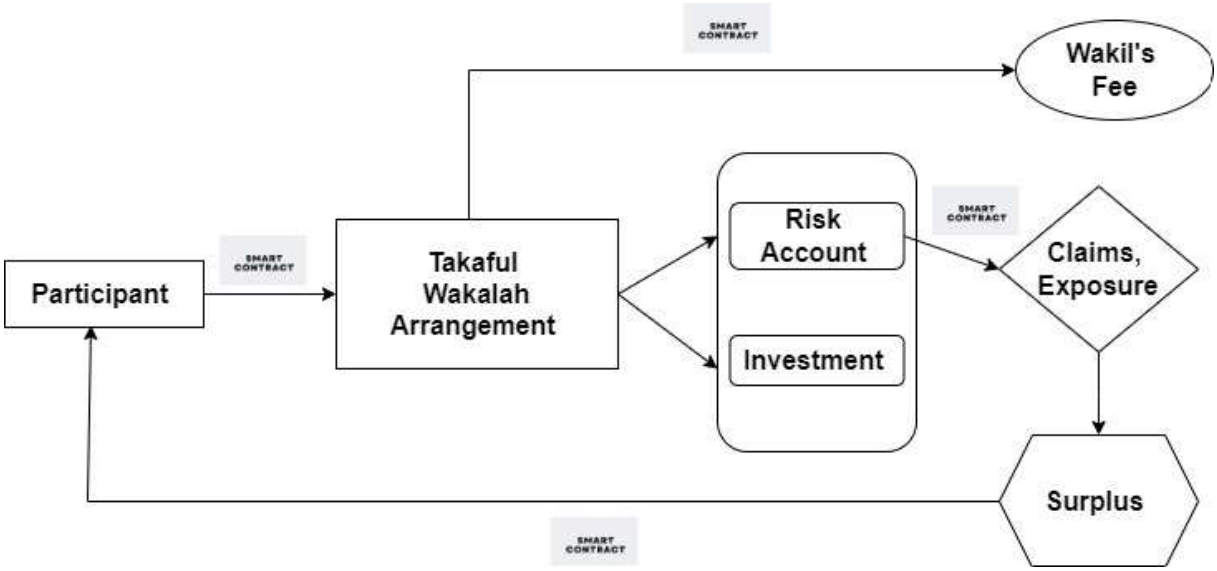

Figure 2. Takaful flowchart in a *Wakalah* (agent-based) agreement

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individual objects) includes revenue in the *tabarru'* fund that is utilized to disburse claims. Takaful operators may also receive performance bonuses as rewards for their success in managing client funds.

To clarify how insurance and Takaful companies have adopted blockchain technology, the study reviews ten cases from the UAE, the US, China, and some European countries to demonstrate how blockchain transactions may be used in the insurance industry. Although smart contracts are not fully developed, insurance software is evidently evolving owing to the adoption of blockchain. Together with conventional insurance providers such as Al Wathba National Insurance, three Islamic insurers in Dubai (i.e., Aman Insurance, Noor Takaful, and Watania (National Takaful Company)) have collaborated with InsurTech company Addenda to integrate the blockchain platform. After completing the second acceleration cohort of Fintech Hive at the Dubai International Centre in 2018, Addenda, which is a start-up, was granted a license recently. In addition to the three Islamic insurance companies, Emarat Takaful is also utilizing blockchain technology; it is the first in the company to become an international member of the B3i in 2017 (Table 1). These insurance companies identified smart contracts as the key driver of the shift from traditional companies into an innovative approach in which the global insurance market income was projected to exceed USD 1 billion by 2023.

The adoption of technology in the UAE region can reduce margins and unfair competition and enable companies to cooperate more efficiently, remove intermediaries, and increase the claims process. Further, it can resolve historical issues and serve as a model for digital insurance technology in Middle Eastern countries. With the help of smart contracts, these Takaful companies can automate their policies and services, lower the costs of handling paperwork and processing claims, improve transparency, and prevent fraud. In addition, blockchain insurance projects can price and underwrite insurance contracts more effectively, with vast amounts of data amassed by insurance companies over the past few years.

For example, Watania International Holding (Table 1), which is one of the first companies in the UAE to adopt blockchain to handle claims from other insurance providers, reduces the amount of time and materials needed to process such transactions. With the help of smart contracts, Watania International Holding has become the fastest system for policy issuance and quotations for motor companies in the UAE. This company focuses on settling claims in a steadfast and hassle-free manner. Consequently, the company's profit increased from AED 9.4 million in 2018 to AED

Table 1. Summary of use cases of smart contracts in Takaful

Company	Specific Purpose	Type	Lead Actors	Sources
Takaful Emarat	Encourage the establishment and administration of property catastrophe insurance policies to evaluate the post-placement procedures, ranging from contract setup to automated claim payment calculations	Distributed ledger technology	B3i	IFN Fintech (2017)
Al Wathba Insurance	Improve cash collection and turnaround times, reduce the number of human tasks now performed by at least 30%, minimize the time spent on paperwork for recovery of claims – from an average of four to seven days – and drastically reduce claim response times. Execute transaction applications to simplify and secure activities related to multiparty insurance	Distributed ledger technology	Addenda	News Desk (2020)
Noor Takaful Insurance	Prioritize technology for distribution and services to enhance claims	Distributed ledger technology	Addenda	Anaesoronye (2023)
Watania Takaful	Use smart contract to process insurance claims from different companies, which could result in conservation of time and capital	Distributed ledger technology	Addenda	IM Insights (2020)
Aman Insurance	Enable insurance companies in the MENA region to cooperate efficiently and remove intermediaries and increase the process of claims	Distributed ledger technology	Addenda	News Analysis (2019)

13.1 million in 2019. In addition, this company guarantees its investors a return on their shares that competes with those of other insurance companies. Policyholders can anticipate Watania International Holding to offer a competitive solution, as the company sets itself apart from the competition by implementing smart contracts.

Table 2 represents the cases of insurance companies adopting smart contracts to advance their business operations. One of Europe's largest insurers, Allianz, utilizes the blockchain platform, which has been deployed across 23 European subsidiaries and has handled more than 145,000 transactions with over 10,000 international accident claims. Allianz utilizes a single data source to handle claims from various countries, reducing time and expenses to expedite the settlement process for each customer. Another example is China Life Insurance, which has a brand value of RMB 485.567 billion and is listed among the 500 most influential brands worldwide. In 2022, China Life Insurance's consolidated assets surpassed RMB 6 trillion, with the revenue reaching RMB 1 trillion, driven by a strategic technology decision. China Life has adopted a similar strategy over the years through several strategic technology partnerships, collaborations, investments, and developments. To provide China Life data centers with access to intelligent operating data statistics and analytics for handling claims, the company partnered with Aurora Mobile in 2020 and utilized the latter's big data analytics platform.

A comparable example is Berkshire Hathaway Inc., a multinational corporation that uses blockchain to improve workflow efficiency. With enhanced efficiency, the company anticipates a 30% reduction in costs. Blockchain has allowed it to maintain control while enabling a single source of truth. This is because efficient data sharing is essential in the insurance industry as it involves multiple par-

Table 2. Summary of use cases of smart contracts in insurance

Company	Specific Purpose	Type	Lead Actors	Sources
Berkshire Hathaway Inc.	Allow effective data sharing. This is crucial because Berkshire Hathaway Inc. integrates several stakeholders (insured, broker, underwriter, and reinsurer) and experiences frequent changes in coverage and claims	Distributed ledger technology	Ledger Insights	Ledger Insights (2024)
Corda	Provide an avenue for insurers to work together to improve fraud detection systems while protecting consumer and corporate privacy. ClaimShare uses a blockchain platform named Corda to detect dubious claims and subsequently match customers' private data for verification. They can share their public claims data in real time in an immutable manner. Corda is a blockchain platform that delivers privacy, scalability, and security built for highly regulated institutions. Additionally, ClaimShare uses Corda for insurers to backtest data immediately without the need for any integration or deployment	Distributed ledger technology	Intel Software Guard Extensions (Intel SGX)	MoData (2024)
Allianz	Utilize blockchain to synchronize international claims between regional entities, ensuring efficient cross-border claim resolution for customers. For example, if a customer is insured by Allianz UK and gets involved in a car accident in the US, the claim will involve both Allianz UK and Allianz US, which are two separate legal entities. This approach will eliminate the typically ensuing back-and-forth email communication between the countries about the details of the claim, which can otherwise take months	Distributed ledger technology	Allianz Technology	Hayer (2022)
Ping An	Leverage blockchain to access secured comprehensive trade information in real time to conduct risk assessment and reduce financial costs using digital methods in claims applications	Distributed ledger technology	OneConnect	Ping An Group (2018)
China Life Insurance	Use blockchain to digitally transform operations and enhance digital preparedness in a competitive landscape	Distributed ledger technology	VeChain	Global data (2022)

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ties, namely the insured, broker, underwriter, and reinsurer. The cases presented in this review reveal that the use of smart contracts by Takaful and insurance companies will positively influence their business processes.

3. DISCUSSION

The result showed how smart contracts have replaced the claims processing component of traditional insurance contracts with automated execution, based on highly transparent and reliable measures that provide tamper-proof evidence in any arbitration. Improved, faster, less expensive, and more efficient operational capabilities enable decentralized insurance protocols to facilitate expeditious insurance claims, mediation, and settlement (Chen et al., 2021). The initial review revealed how smart contracts on blockchain have been used in the Takaful and insurance industry to support the claims process. Further, smart contracts can automate a substantial portion of the insurance process, enhancing fairness and transparency while significantly reducing costs and payout delays. Blockchain enables bulk client claims to be paid directly and almost instantly once approved. With smart contracts, the insurance industry can reduce expenses associated with labor-intensive data entry, administrative and legal fees, and claims processing. Customers can benefit from these cost savings in the form of lower premiums and faster payouts. Several insurance contracts can gradually replace backend operations using the Boolean logic of smart contracts. In contrast to traditional insurance contracts, which are interpreted by claims processors, smart contracts can be executed directly from the data. For example, weather information can trigger crop insurance payouts, automate the process, and eliminate the need for employee input. This study confirmed and corroborated the results of earlier research by Jena et al. (2022) and Zhang et al. (2022).

In the application of this industry, several insurance and Takaful companies, such as Ping An, China Life Insurance, Takaful Emarat, and Claim Share, use smart contracts to monitor the emergence of digitally signed computable agreements among two or more parties with reliable, high-quality data sources to maintain the integrity of the trust built without any intermediaries. These insurance companies can evaluate and process claims using open sources of relevant policyholder data because of the autonomous nature of smart contracts. The blockchain with smart contracts ensures that any contractual deviation results in compensation for the aggrieved party and mandates the disclosure of all relevant information, thereby fostering mutual confidence between the parties. A Takaful smart contract captures precise procedures to enable a completely transparent process during any dispute. For example, connected IoT devices and trusted data sources can be used to create a dependable source of truth that can conclusively reveal the behavior of automobile insurance policyholders immediately before an incident. Each of these listed companies encodes their insurance policies via decentralized smart contracts, enabling users to consent to an insurance company that can assist in covering their future medical bills.

Transactions in insurance companies also feature transparent records and enhance accessibility by including previously unreachable parties. For example, Allianz and China Life have adopted strategies to collaborate with stakeholders from various countries using a single data source, so that they can obtain data on prospective customers, including medical records obtained from healthcare providers. These companies expand their networks with international initiatives to meet efficiency requirements because of the unique nature of the insurance industry's products and procedures. Moreover, the differing contracts between Takaful operators and insurance companies do not affect the way they adopt smart contracts, as the technology can be customized to fit the needs of either system.

CONCLUSION

This study investigated the role of smart contracts on the blockchain in the Takaful and insurance industry and assessed if these companies use distinct approaches to adopt smart contracts on the blockchain. The findings demonstrate how smart contracts connect various international stakeholders, including hospitals, auto repair shops, police, fire, and emergency departments, and lowers fraud while promot-

ing transparency and expediting claims processing. For instance, smart contracts link patients, insurers, and hospitals in the context of health insurance, facilitating the exchange of medical data without disclosing identity, thereby fostering mutual trust. Thus, it reduces administrative costs and streamlines processes by eliminating intermediaries and increasing transparency. In addition, it automates the payment of claims with minimal human intervention. Further, Takaful contracts can be made considerably more transparent from the perspective of the policyholder by utilizing smart contracts, from the acceptance or rejection of claims to the costs and details of policies. A specifically designed industry standard should facilitate the mapping of several process steps within the insurer's value chain, from the origin of the policy to the final settlement of claims.

This study also examines the functions of blockchain technology in both the Takaful and insurance industries to identify areas of overlap. Further, industry practices are ascertained and the effects of blockchain technology on insurance and Takaful business models are discussed. Except for the distinct guidelines between Takaful and insurance companies, the study discovered no difference in smart contract applications between them. While this result provides strategic conclusions and can be used by insurance companies and other financial companies, it also has limitations, e.g., websites such as ScienceDirect provide scant data on blockchains for Takaful. Thus, only a few case studies could be conducted. In the future, this research should be carried out directly via comprehensive interviews with representatives from companies that provide smart contracts on the blockchain and the insurance companies that use them.

AUTHOR CONTRIBUTIONS

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Formal analysis: Hazik Mohamed, Lutfhi Nur Rosyidi.
Funding acquisition: Siti Zulaikha, Hazik Mohamed, Lutfhi Nur Rosyidi.
Methodology: Siti Zulaikha, Hazik Mohamed.
Project administration: Siti Zulaikha, Lutfhi Nur Rosyidi.
Resources: Lutfhi Nur Rosyidi.
Supervision: Siti Zulaikha, Hazik Mohamed.
Validation: Siti Zulaikha, Hazik Mohamed, Lutfhi Nur Rosyidi.
Visualization: Hazik Mohamed.
Writing – original draft: Siti Zulaikha, Hazik Mohamed.
Writing – review & editing: Siti Zulaikha, Hazik Mohamed.

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