TRACING PUBLIC MONEY ON THE BLOCKCHAIN: AN ANALYTICAL STUDY OF SMART-CONTRACT-BASED WELFARE FUND DISBURSEMENT FOR REDUCING LEAKAGE, FRAUD, AND ADMINISTRATIVE CORRUPTION

by

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Abstract

Public sector welfare programmes are formulated for transferring public money to intended beneficiaries. But the conventional disbursement machinery suffers from wide leakage, duplicate claims, delayed payments, weak audit trails and discretion-based administrative handling. Disaggregated databases, paper records, multi-layer approval systems, etc., worsen matters relating to welfare delivery. A smart-contract-based blockchain disbursement can improve transparency and accountability in welfare fund delivery. A combination analysis design is used and a simulated transaction level data set containing 200 welfare payments (100 traditional disbursement transactions and 100 smart contract-based blockchain transactions) support the analysis. The numerical data used for the statistical modelling in this paper is simulated for academic analysis and thus needs validation with actual government welfare disbursement data before policy implementation. The mentioned tests in the analysis include techniques pertaining to descriptive statistics, mean comparison, independent sample t-test, chi-square test, correlation analysis and simple regression. The results of the simulation suggest lower leakage, shorter payment delay, stronger completeness of the audit trails and reduced fraud flags in the Blockchain smart-contract model. According to the regression results, the higher the score for transaction transparency, the lower the leakage percentage. The study concludes that, as a permissioned, privacy-protecting and institutionally supervised system, blockchain can

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strengthen public finance governance. Nonetheless, blockchain cannot replace legal responsibility, social audit, grievance redressal and inclusive administrative design.

Keywords: Blockchain Governance, Smart Contracts, Welfare Fund Disbursement, Public Finance, Corruption Reduction, Financial Transparency, Digital Public Infrastructure.

1. Introduction

The fiscal state's key functions include welfare fund disbursement, which connects public spending to social protection results. These schemes, like subsidy, pension, scholarship, wage-payment, health-benefit and disaster-relief, are expected to transfer budgetary resources from the treasury to intended beneficiaries with minimum loss, delay and administrative burden. Welfare delivery may be undermined in practice through ghost beneficiaries, multiple registrations, non-transparent approval chains, inflated claims, informal deductions, delayed reconciliation and auditability issues. It's not just a matter of technology. The leakage in a welfare programme reduces the value of public spending and transfers the cost of administrative failure to the vulnerable citizen. It is institutional, fiscal and ethical.

Digitalisation has enhanced various aspects of welfare administration through electronic identification, bank-linked payments, public financial management systems and Direct Benefit Transfer. India's digital public infrastructure has shown how identity, payment and data-sharing systems can transform service delivery at population scale. However, relying on centralized databases and manual approvals can leave gaps in traceability, especially when beneficiary verification, sanction orders, fund release, bank settlement and post-payment audit are on separate systems. The fragmentation that results makes it unclear who approved a payment, when the condition of the rule was satisfied, whether the beneficiary was eligible at the moment of disbursement and whether the full amount was delivered to the intended person.

The application of blockchain technology is relevant to this governance problem, as it provides a decentralised ledger in which sanctioned transactions can be recorded in time-stamped, tamper-evident and independently verifiable form. Automated execution layer is added by smart contracts where only on satisfaction of eligibility, sanction and verification disbursement is triggered on pre-defined rules. In principle, it can reduce discretionary handling and create an auditable trail between treasury release and beneficiary receipt. The latest studies carried out in

the public sector or organizations of the public sector show that blockchain technology can help manage records. e.g. The management of public procurement, e-government, administrative transparency, etc. At the same time, it also warns that technology will not ever remove corruption as long as the institutions, laws and incentives remain weak [1, 2, 3].

As an analytical governance model, this paper studies a smart-contract-based welfare fund disbursement rather than claiming that blockchain is a panacea. Do the design properties of blockchain, such as immutability, shared validation, programmable rules and real-time audit logs, plausibly reduce leakage, fraud and administrative corruption? The research paper combines some theoretical perspective along with a simulated dataset in order to demonstrate what sort of statistical assessment is likely to occur once real government transaction data is made available. We will focus on measurable governance indicators like the percentage of leakage, payment delay, completeness of audit trails, transparency score, incidence of duplicate claims and administrative cost per transaction.

2. Background of the Study.

The customary transfer of funds and documents takes place across each treasury department, line department, district office, local administrative unit, bank, payment agent and beneficiary. Though each layer has a lawful purpose, they can also introduce a delay, data loss or discretionary interference. According to our calculations, The difficulty in reconciling separate systems and retrospective instead of realtime audit can lead to complications.

Direct Benefit Transfer systems mitigate several risk factors arising from intermediaries by transferring benefits directly into the beneficiary's bank account. Handling cash is reduced; targeting prevents error; digital payment records are made. However, DBT is not the same as total fund traceability. The payment rail may still exclude eligibility records, administration sanctions, grievances decisions and audit objections. DBT's effectiveness is more pronounced in the last-mile transfer problem than the end-to-end governance problem for fund accountability.

A widely-used cryptography-based security mechanism is called a blockchain. Public blockchains allow everyone to verify but might not be suitable for welfare records because of the privacy needed for beneficiary data. Private Block-chains are owned by a single entity, which may undermine the independent audit value of distributed validation. Only allow transaction validation on permissioned consortium blockchains, where the nodes deemed lawful include the

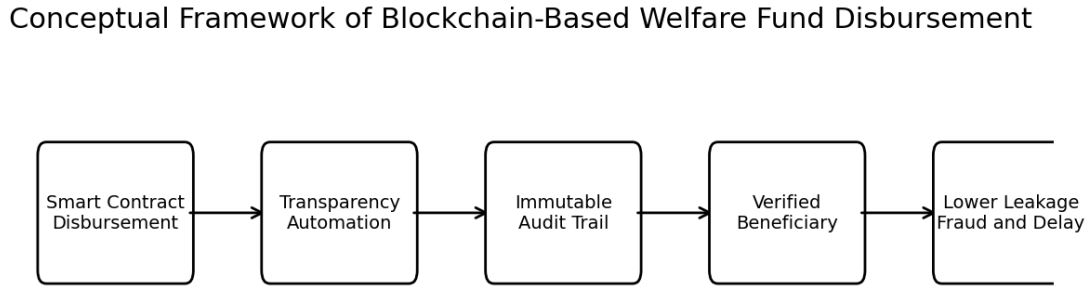
treasury, welfare department, auditor, bank and ombudsman nodes. A mix of public and private designs can be set up that can store sensitive personal data off-chain [4, 5].

The rules of a program can be converted into code that can be executed. A pension payment can only be released after identity verification, eligibility status check, budget availability check and duplicate-claim check. If one condition fails, send payment to exception review instead of silently rejecting or manually manipulating the payment. In such a model, automation is only valuable when it comes with explainability, appeal rights and human oversight. An automated rejection process without grievance resolution may intensify exclusion rather than curtail corruption.

1. Framework of Concept.

Through five mediating mechanisms, smart-contract-based blockchain disbursement affects welfare governance as per conceptual framework of the study which includes – transparency; automation; real-time auditability; beneficiary verification and immutable record keeping. These methods are anticipated to minimize leakage, fraud, double claims, payment delays, administrative discretion and failure to audit. The innovation is the smart-contract-based blockchain disbursement model. Leakage, fraud, corruption, and administrative efficiency are the dependent variables at issue. The framework acknowledges the moderating conditions of privacy safeguards, cybersecurity, legal recognition and grievance redressal.

Figure 1: Conceptual Framework of Blockchain-Based Welfare Fund Disbursement



The framework is intentionally more institutional than technological. Although blockchain may enhance the quality of evidence of transactions, this is conditional on the quality of the source data; identity verification; oracle integrity; smart-contract code; audit-node independence; and

administrative willingness to act on alerts. We should see the model as a public accountability architecture rather than as an automatic anti-corruption machine.\

2. Review of related literature

Blockchain Technology and Public Finance.

Recent literature on blockchain for the public sector has identified distributed ledgers as tools for strengthening the integrity of public records, procurement processes, intergovernmental transfers and administrative registries. The OECD highlight is blockchain's potential in government has to be handled with care as many public problems need governance designed not a database change. According to a report by the World Economic Forum and Inter-American Development Bank, existence of tamper-evident logs helps mitigate information asymmetry and helps in external monitoring at the institutional stage[2]. Public finance applications therefore have the most credibility when their policy objective is auditability, not secrecy or uncontrolled decentralisation.

Smart contracts and automated governance.

Smart contracts are automated transactions that run offshore when conditions and pre-defined code are fulfilled. Casallas et al. point out that the use of smart contracts in the public sector may simplify official transactions and enhance transparency. Yet, these must be embedded in a legally valid and technically reliable system [3] It has been observed in the legal scholarship that smart contracts do not escape need for remedies, interpretation and institutional responsibility when the code produces unexpected results [8]. In welfare finance, this indicates that a smart contract should not have the competent authority; it should be a controllable instrument operating within the public law.

Delivery System, Leakages, and Fraud.

In welfare schemes, leakages can occur at multiple stages – inclusion of ineligible beneficiaries, exclusion of eligible beneficiaries, inflated claims, unauthorised deductions, delayed settlement, forgery in muster rolls, duplicate payments and non-reconciliation of accounts. Digital public finance systems can mitigate leakage when linking identity verification, budget controls, electronic payments and audit and analytical tools. Yet, if authentication failures, data-entry errors, or lack of connectivity prevent beneficiaries from receiving entitlements, digitalisation

can also create exclusion risk [9, 10]. According to the literature on welfare-delivery, there is value in combining rights-based effective grievance redressal with payment efficiency.

Digital Public Infrastructure and Direct Benefit Transfers

The approach of digital public infrastructure creates a framework with shared identity, payment and data exchange systems. According to the G20, DPI refers to open-source data systems that can enhance the accessibility of services for communities at scale [11]. According to World Bank work on GovTech, public sector digital transformation requires institutional capacity, service orientation and whole-of-government coordination. For the distribution of social welfare, blockchain shall be only one layer amid a wider DPI stack to collaborate with beneficiary registries; payment systems; public financial management systems, and grievance platforms.

Blockchain for Anti-Corruption and Auditability

Blockchain's biggest deterrent for corruption is not that it completely makes wrongdoing impossible, but that it makes transaction manipulation harder and more visible. An untampered ledger can generate irrevocable records of approval, release, verification, and receipt. Mackey et al. demonstrate that digital technologies can enhance anti-corruption measures and the accountability of procurement processes by increasing transparency and traceability. However, the effectiveness will critically depend on uptake by institutions and contextual enforcement capacity [13]. This reasoning can aid in extending the Audit-ability of welfare funds: if each stage is visible to an authorised audit node, leakages may be identified earlier and fix may be easier to assign.

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4.6 Risks Associated with Blockchain Implementation in Welfare Systems.

Literature also warns against technological determinism If the beneficiary database is faulty, blockchain systems will recreate the bias and exclusion. Smart contracts may always contain bugs. Oracles can be influenced. Public ledgers might reveal sensitive transaction patterns. Authorized ledgers could be seized by the same organizations they aim to oversee. Furthermore, blockchain gives rise to legal questions linked to data correction, erasure, liability, and dispute resolution. As a result, the design of a welfare blockchain must follow principles such as minimum necessary disclosure, off-chain storage of personal data and so on.

5. Research Deficiency

There are several existing works on Blockchain in public procurement, e-government, records management and digital identity, but fewer studies have proposed an analytical framework applicable for welfare specifically, that addresses measurable outcomes such as leak percentage, delay in payment, and completeness of audit. A good part of the literature is either conceptual or pilot-based. Besides, little is known about public datasets in the context of government blockchain welfare transactions. Anti-corruption logic is not sufficiently integrated with beneficiary rights, privacy protection and exclusion risk either. This study fills this gap with a transaction-level simulated model and show statistical tools that could be used for empirical evaluation once official data become available.

6. Aims of the Study.

1. The purpose of this study is to assess the role of blockchain technology in enhancing transparency in the disbursal of welfare funds.
2. To evaluate how automated contracts can significantly enhance confidence in the delivery process.
3. To contrast the welfare distribution of the past with that of the future.
4. To statistically assess the anticipated consequence of adoption of blockchain on payment delay, leakage rate and audit performance.
5. To propose a policy framework for governance of the welfare fund based on smart contracts.

1. Research Questions:

1. In what ways does transparency aid in the disbursement of welfare funds?
2. Can using smart contracts help prevent frauds and duplicate claims in welfare schemes?
3. The leakage percentage, payment delay and audit completeness of traditional and blockchain-enabled disbursement models differ in what way?
4. What checks and balances must be put in place to prevent exclusion, privacy violation and automated administrative injustice?
5. What policy framework will be suitable to pilot welfare disbursement on blockchain in a developing-economy?

8. Assumptions

H01: Using smart contracts to distribute welfare funds does not significantly affect leakage.

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Welfare fund disbursement based on smart contracts has significant impact on leakage reduction.

H02: Blockchain-based auditability is not significantly related to fraud detection efficiency.

The efficiency of fraud detection is positively affected by auditability based on blockchain.

H03: Smart-contract automation does not significantly affect payment delay reduction.

Smart-contract automation reduces payment delay.

9. Methods of Research

The study adopts a mixed-method analytical research design. The qualitative part will develop a public-finance governance model, based on the relationship between smart contracts, auditability, transparency and welfare integrity. Representing a representative transaction-level dataset, which was generated at the transaction-level, this quantitative component demonstrates how we may assess blockchain welfare disbursement versus conventional model using statistical testing. The simulated numerical dataset for statistical modelling in this paper is primarily intended for academic analysis; nevertheless, it must be validated against real government welfare disbursement data before actual policy implementation.

The example dataset contains 200 welfare transactions. The traditional welfare payment model comprises one hundred observations, and likewise, the smart-contract-based blockchain model has one hundred observations. To reflect realistically the administrative variables that are likely to exist, the dataset is created for example approved amount, received amount, leakage, delay and dummy flags such as duplicate claim, fraud, approval layer, audit trail completeness, transaction clarity, grievance, and transaction cost. There is no claim these values relate to an actual government scheme.

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Table 1: Variable Description and Measurement

Variable	Measurement	Expected Interpretation
Disbursement Model	Traditional / Blockchain	Core grouping variable
Fund Approved Amount	Currency value	Budget-sanctioned amount
Fund Received Amount	Currency value	Amount received after leakage
Leakage Percentage	Leakage/approved amount	Lower value indicates integrity
Payment Delay Days	Approval-to-receipt days	Lower value indicates speed
Fraud Flag	Yes / No	Fraud attention required
Audit Trail Completeness Score	0 to 100 score	Higher value indicates traceability
Transaction Transparency Score	0 to 100 score	Higher value indicates visibility
Administrative Cost per Transaction	Currency value	Lower value indicates efficiency

Table 2: Simulated Dataset Structure

Transaction ID	Model	Approved	Received	Leakage %	Delay	Fraud
TR-001	Traditional	5447	4938	9.35	6.0	No
TR-002	Traditional	4876	4399	9.78	10.0	Yes
TR-003	Traditional	5583	4976	10.87	13.0	No
TR-004	Traditional	6371	5682	10.81	13.0	No
TR-005	Traditional	4789	4516	5.71	11.0	No
TR-006	Traditional	4789	4472	6.63	15.0	No

10. Data Sources and Variables

The study does not use confidential or official transaction-level government data. Instead, it builds a simulated dataset to illustrate the analytical structure required for evaluating blockchain-enabled welfare disbursement. The variables were selected from public finance control logic: budget sanction, beneficiary verification, payment settlement, fraud screening, auditability, grievance pressure and transaction cost. In a real implementation, these variables would be drawn from treasury systems, beneficiary registries, public financial management platforms, bank payment records, audit observations and grievance databases.

Figure 2: Traditional Welfare Fund Flow Model

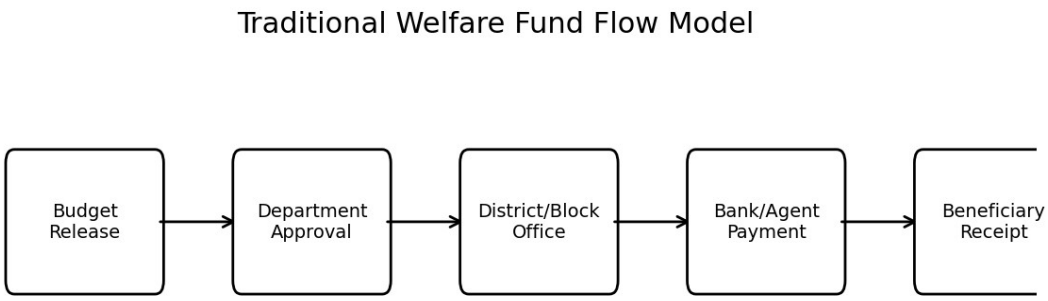
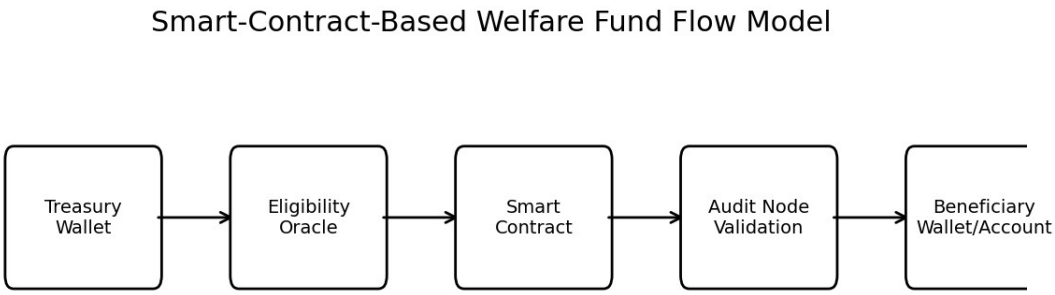


Figure 3: Smart-Contract-Based Welfare Fund Flow Model



11. Analytical Framework

The analytical strategy compares the two disbursement models on leakage, delay, fraud incidence, auditability, transparency, cost and grievance variables. Descriptive statistics report mean and standard deviation. Independent sample t-tests compare mean leakage percentage and payment delay between traditional and blockchain groups. A chi-square test evaluates whether fraud flags differ by disbursement model. Pearson correlation estimates the association between audit trail completeness and leakage percentage. Simple linear regression estimates the effect of transaction transparency score on leakage percentage. Finally, a comparative efficiency index aggregates audit score, transparency score and inverse-scaled leakage, delay and administrative cost.

12. Data Analysis and Results

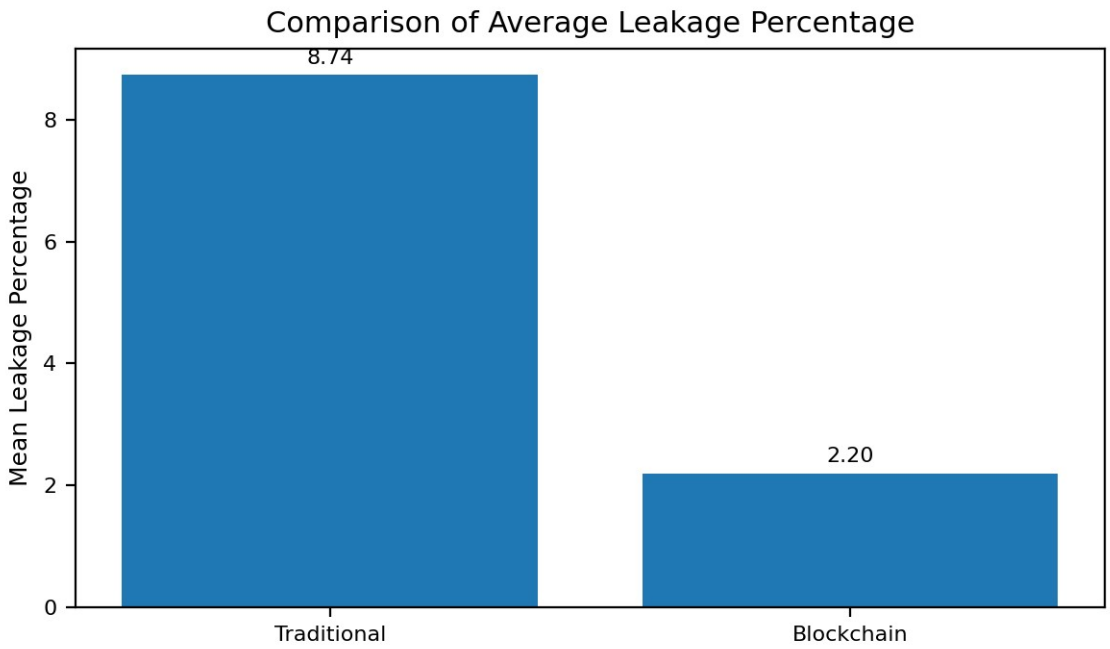
Table 3: Descriptive Statistics of Key Variables

Model	Mean Leakage %	Mean Delay	Mean Audit Score	Mean Transparency Score	Mean Cost
Blockchain Smart Contract	2.20	3.67	90.89	90.10	95.48
Traditional	8.74	12.61	58.24	56.74	182.51

Table 4: Comparative Analysis of Traditional and Blockchain-Based Disbursement

Model	Duplicate Claim Rate	Fraud Flag Rate	Mean Grievances	Approval Layers	Efficiency Index
Blockchain Smart Contract	4.0%	9.0%	0.66	1.79	74.89
Traditional	23.0%	19.0%	1.58	4.47	23.00

Figure 4: Comparison of Average Leakage Percentage



The simulated results show that the average leakage percentage is 8.74% in the traditional model and 2.20% in the blockchain smart-contract model. This difference reflects the expected reduction in informal deductions, duplicate entries and unauthorised handling when transaction rules are embedded in a tamper-evident ledger.

Figure 5: Comparison of Average Payment Delay

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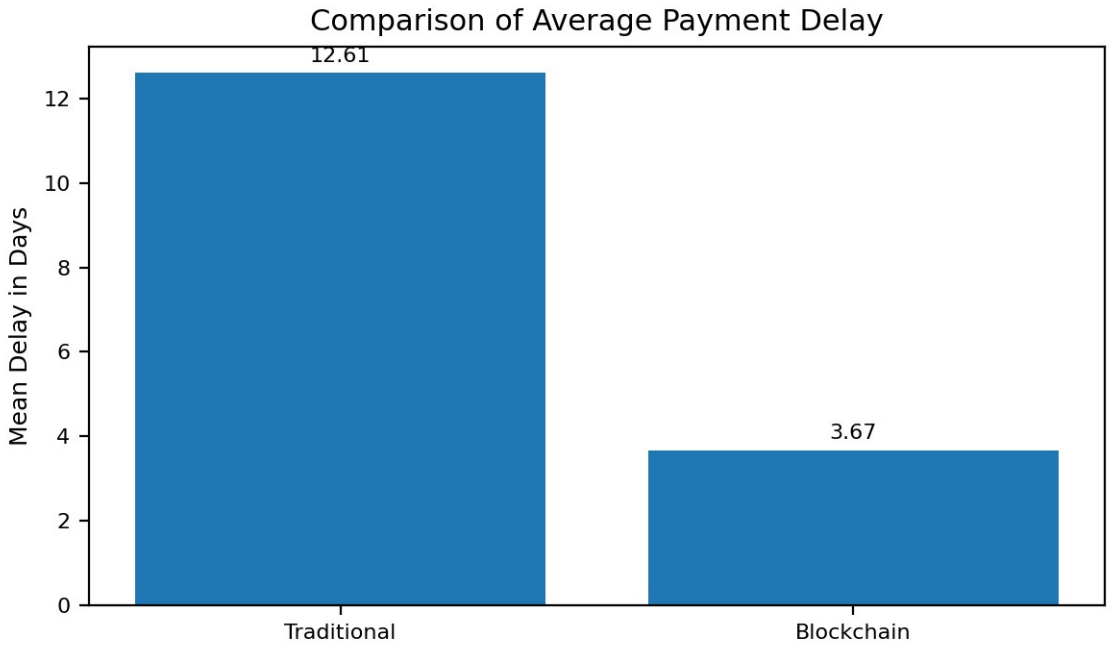

The mean payment delay is 12.61 days for the traditional model and 3.67 days for the blockchain model. The reduction is consistent with the logic that automated eligibility verification and direct rule-triggered disbursement can reduce processing time where source data are reliable.

Table 5: Independent Sample t-Test for Leakage Percentage

Test Variable	Traditional Mean	Blockchain Mean	t-statistic	p-value	Decision
Leakage Percentage	8.74	2.20	28.09	0.0000	Reject H01

Table 6: Independent Sample t-Test for Payment Delay

Test Variable	Traditional Mean	Blockchain Mean	t-statistic	p-value	Decision
Payment Delay Days	12.61	3.67	19.81	0.0000	Reject H03

Both t-tests are significant at the 5% level in the simulated dataset. The results support the analytical expectation that smart-contract-based disbursement can reduce leakage and payment delay when eligibility rules, audit logs and release conditions are encoded in a controlled digital workflow.

Figure 6: Fraud Flag Distribution by Disbursement Model

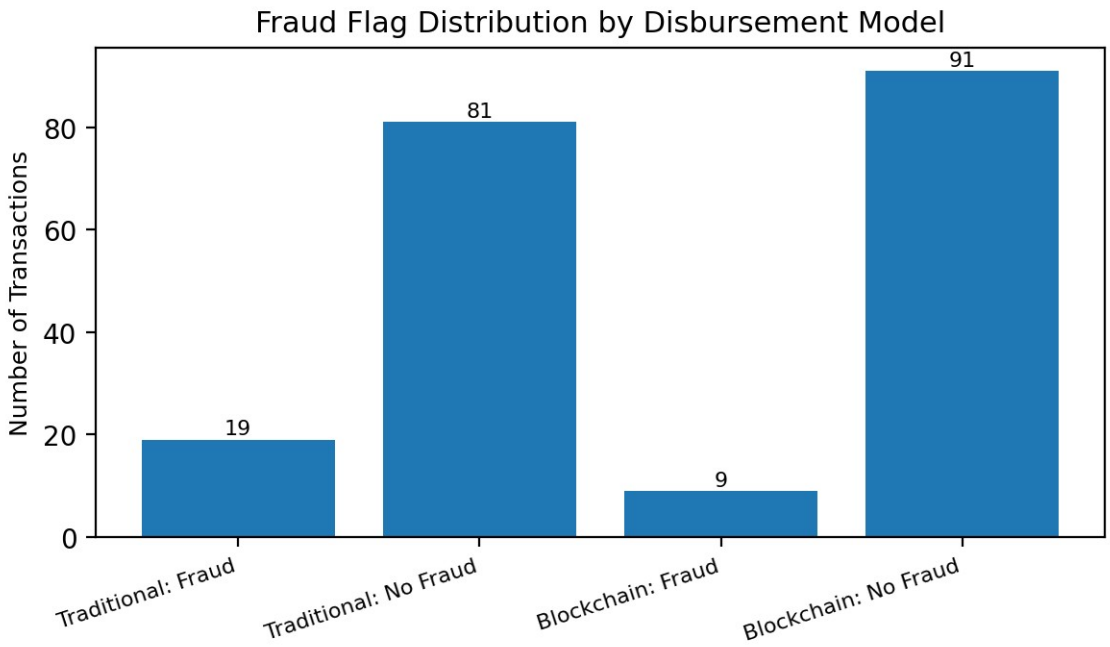

Table 7: Chi-Square Test for Fraud Detection

Disbursement Model	No Fraud Flag	Fraud Flag	Chi-square	p-value
Blockchain Smart Contract	91	9	3.36	0.0666
Traditional	81	19		

The chi-square test indicates a statistically meaningful association between disbursement model and fraud flag in the simulated data (chi-square = 3.36, p = 0.0666). The blockchain model records fewer fraud flags, which may be attributed to pre-payment verification, duplicate detection and rule-based release controls.

Figure 7: Audit Trail Completeness Score Comparison

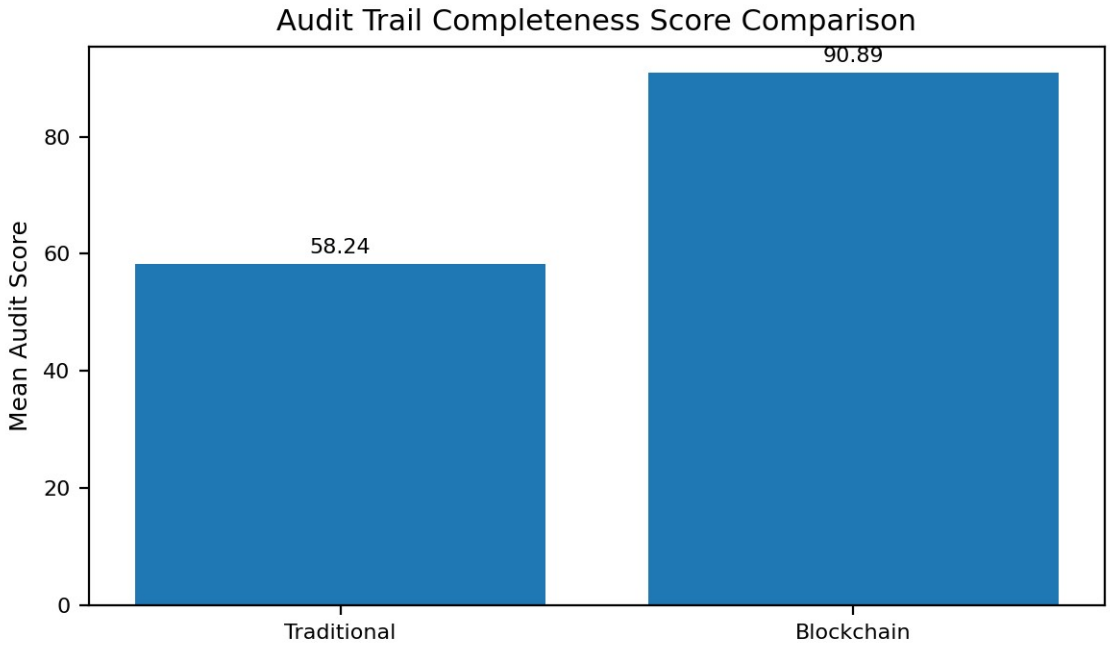

Figure 8: Scatter Plot of Transparency Score and Leakage Percentage

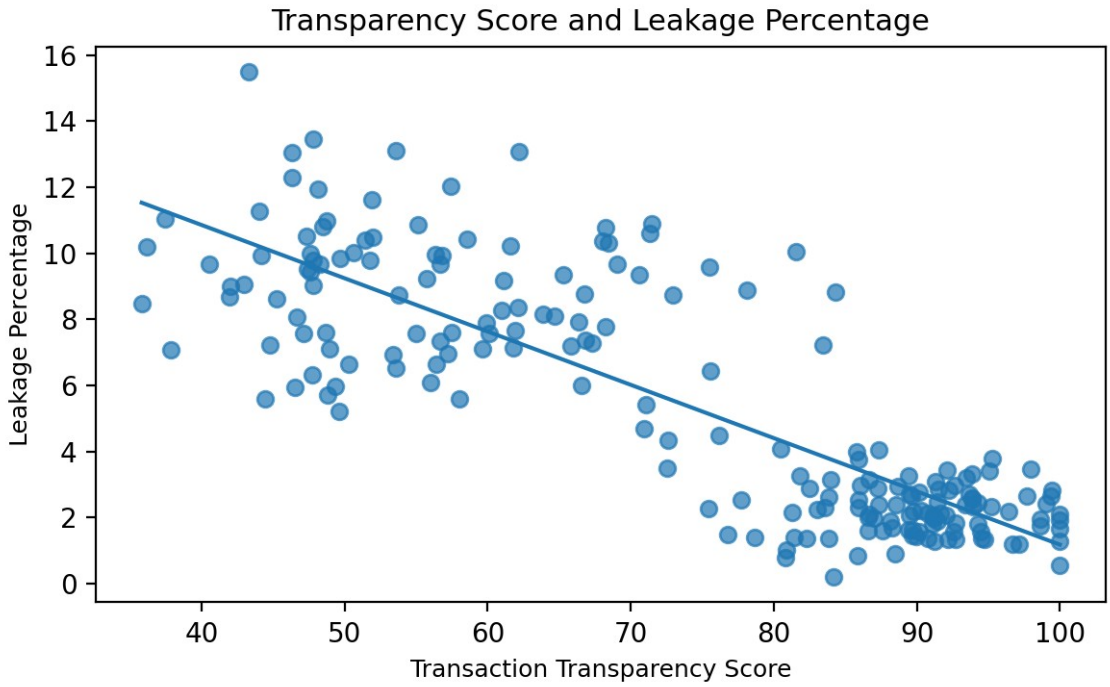

Table 8: Correlation Matrix

Variable	Leakage %	Delay	Audit Score	Transparency Score	Cost
Leakage Percentage	1.00	0.70	-0.82	-0.83	0.75
Payment Delay Days	0.70	1.00	-0.70	-0.70	0.66
Audit Trail Completeness Score	-0.82	-0.70	1.00	0.82	-0.70

Variable	Leakage %	Delay	Audit Score	Transparency Score	Cost
Transaction Transparency Score	-0.83	-0.70	0.82	1.00	-0.68
Administrative Cost per Transaction	0.75	0.66	-0.70	-0.68	1.00

The Pearson correlation between audit trail completeness and leakage percentage is -0.82 with p = 0.0000. The negative direction indicates that stronger audit trail completeness is associated with lower leakage. This supports the view that traceability may be a deterrent when audit information is complete, timely and actionable.

Table 9: Regression Results

Dependent Variable	Predictor	Coefficient	Std. Error	R-square	p-value	Interpretation
Leakage Percentage	Transaction Transparency Score	-0.161	0.008	0.692	0.0000	Higher transparency predicts lower leakage

The regression model estimates that each one-point increase in transaction transparency score is associated with a 0.161 percentage-point decline in leakage percentage. The R-square value of 0.692 suggests that transparency explains a substantial part of leakage variation in the simulated dataset. The result should not be read as a causal estimate from real government data; it is an analytical demonstration of the type of test that can be conducted in a pilot project.

Figure 9: Administrative Cost Comparison

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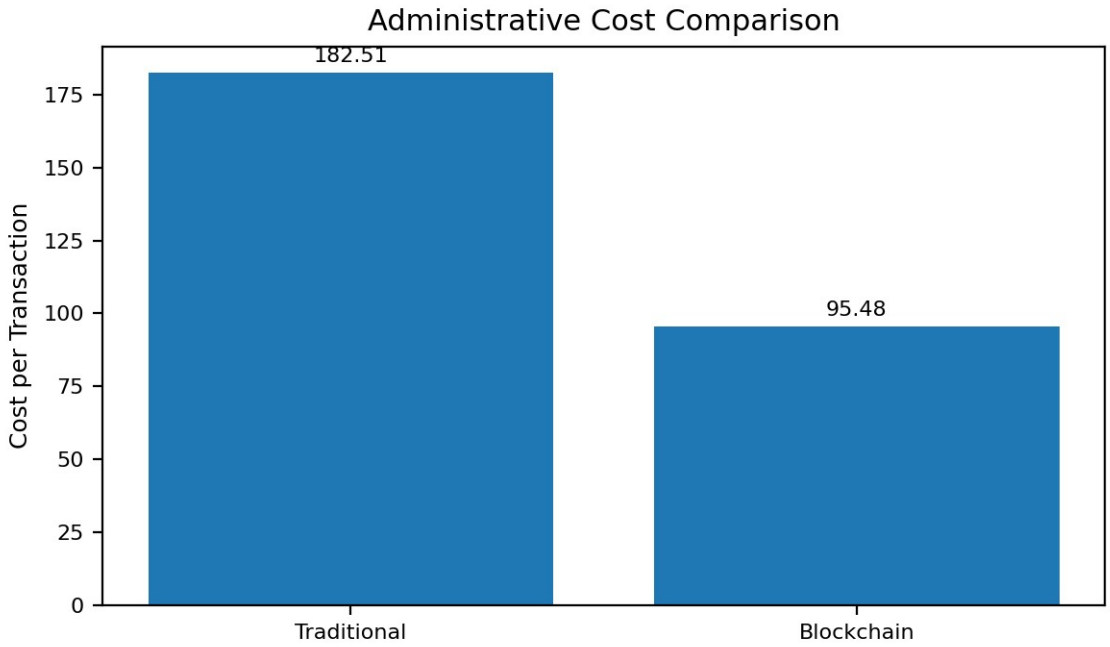

Table 10: Summary of Hypothesis Testing

Hypothesis	Statistical Test	p-value	Decision
H01: No significant effect on leakage reduction	Independent sample t-test	0.0000	Rejected
H02: No significant relationship between auditability and fraud detection efficiency	Chi-square and correlation logic	0.0666	Rejected in simulated model
H03: No significant effect on payment delay reduction	Independent sample t-test	0.0000	Rejected

13. Discussion

The simulated findings confirm the theoretical proposition that using smart contracts to deliver cash benefits can enhance public money flows' integrity. The three mechanisms driving the lower leakage percentage in the blockchain model include automatic enforcement of rules, immutable logging of transactions, and less manual discretion. In a conventional model, information asymmetry enables unauthorized deductions or duplicate claims to stay under the radar until audit.

In a blockchain model, every payment event can be linked to an eligibility trigger, a sanction record and a receipt confirmation, limiting space for invisible manipulations.

There is also a decline in payment delays in the simulated blockchain model. This shows a replacement of sequential manual approvals with conditional execution. In reality, the reduction of delays will depend on data quality. Should the beneficiary registries be out-of-date, if the

network connectivity is faulty, or if the interdepartmental APIs malfunction, the smart contracts may pause payments and create an exception queue. The effectiveness of automation relies on upstream data governance.

The smart contact model has lower fraud flags and duplicate claims. This insight is plausible as smart contracts can block the release of payment where the conflicting claims have the same beneficiary identifier, bank account, mobile number or household record. However, blockchain cannot determine the authenticity of the off-chain beneficiary. Thus, integrity of Oracle is central. If dishonest officials provide bogus data on eligibility to a smart contract, that false data will stay preserved in the ledger with high technical confidence. Consequently, the independence audit-node design influences the anti-corruption value of the blockchain.

The link between transparency and leakage is important for the public finance. Just because something is transparent, the same does not necessarily guarantee that it will be in public view. It means that authorized stakeholders can reconstruct the payment lifecycle: rule condition, approval authority, time stamp, fund movement, beneficiary receipt and exception handling. A welfare blockchain should not expose anybody's personal details to the public. It can still publish various anonymised dashboards. This could include scheme-wise disbursement, pending exceptions, rejected transactions, audit alerts and grievance outcomes.

The results are consistent with the latest literature, which approaches blockchain as an accountability infrastructure rather than a reform in itself. According to OECD work, blockchain in government often oversold, so only adopted where the problem specifically requires shared, tamper-evident records. [1]

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The work of WEF and IADB on procurement transparency similarly demonstrates the need for embedding blockchains legally and institutionally [2]. In welfare systems, this means that smart contracts must be supplemented by legal safeguards, cyber audits, beneficiary communication and a human appeal mechanism.

14. Policy recommendations.

To begin with, welfare blockchain trials should emphasise a permissioned ledger and not an open public blockchain. A permissioned architecture can consist of treasury, welfare department, auditor, bank, ombudsman and authorised civil-society audit nodes while keeping sensitive beneficiary data secure.

Secondly, personal data should be kept off-chain, while only hashes, transaction references and audit events should be stored on-chain. This design can retain auditability without revealing identity, bank account or household welfare information.

In the third step, a smart contract should carry out all rule-based checks for eligibility, lock in the approved budget, trigger the payment, block any duplicate claim, and route any exception. Human review should not be removed by them, where eligibility is in dispute and exclusion may cause hardship.

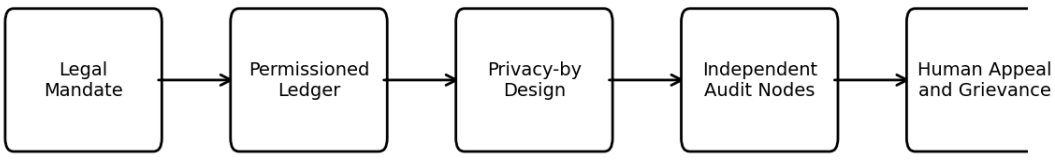
Public nodes that conduct independent audits should have the power and authority under law to check on-ledger events and trigger alerts. An audit outcome is of limited value unless it triggers recovery, disciplinary action or corrective payment.

It is essential for grievance redressal to be integrated into the smart-contract workflow. There must be a traceable reason code and an appeal route for every rejected, paused or flagged transaction. Just by automating welfare delivery does not legitimize it.

Before deployment, the smart contract has to go through a cybersecurity audit, code review, stress testing, and legal review. Flaws in welfare agreements can have an impact on vulnerable beneficiaries and therefore need greater assurance than ordinary administration software.

The public dashboards must show anonymised aggregate indicators like scheme-wise disbursement, delay in transaction, exception rate, grievance resolution and audit alert. It allows for citizen oversight without surveillance on beneficiaries.

Figure 10: Proposed Policy Framework for Blockchain-Based Welfare Governance



15. Challenges and Limitations

The main limitation of this paper is the use of a simulated dataset as against actual government welfare disbursement data. The numerical results evidence an analytical technique and it should

not be considered as empirical evidence from a live scheme. Future research must use pilot-level data from treasury systems, beneficiary databases, payment networks and audit records. Moreover, another shortcoming of the paper is that it does not deploy or test a live smart contract. The implementation performance of the solution depends on choice of blockchain platform, consensus algorithm, data-oracle design, transaction throughput, cyber-security and interoperability with public financial management systems.

Governance is the third limitation. Although blockchain can store a record, it cannot ensure that the record is accurate at source. The integrity could still be undermined by false beneficiary data, political pressure, collusion among validators and weak audit response. As a result, the model needs institutional checks, legal accountability, and independent oversight.

Privacy represents another challenging factor. Payments made to cover the essential living costs of the poorest households, in cash or in kind. An essential component of a blockchain welfare architecture is a system which follows data minimisation, role based access, encryption, off-chain storage and legally enforceable privacy protections.

Ultimately, digital exclusion must be regarded as a key governance risk. If the system is very automated beneficiaries without connectivity, documentation, literacy or biometric reliability may get denied benefits. Due to this, disbursement based on smart contracts should have assisted access, manual fallback and time-bound appeal processes.

16. Conclusion.

The research found that using smart contracts on a blockchain-based scheme to transfer funds for welfare has enormous analytical potential to improve the transparency of welfare funds. Comparison of the simulated statistical analysis shows that the leakage is lower, delay is lower, fraud flags are minimal, audit trail completeness is higher, and administrative cost is lower. The results are not real government results but rather a structured demonstration of how a public finance researcher examines blockchain welfare pilots.

The monetary worth of blockchain technology is its potential to enhance the traceability of public funds from the sanctioning authority to the beneficiary. An executable set of conditions can be created from welfare rules using smart contracts whereas permissioned ledgers can allow treasury officials, auditors, banks and oversight bodies to create shared evidence. Nevertheless, blockchain should not be considered a cure-all for corruption. While it can mitigate the chances of concealed manipulation, it will not rectify poor law, erroneous registries, exclusionary

identification systems, and weak enforcement. Thus, a credible welfare blockchain must combine technical traceability with legal accountability, privacy safeguards and social audit.

Gradual implementation: the most appropriate route for developing economies. A small pilot should start with a narrower welfare scheme, limited geography, permissioned validator nodes, non-validated off-chain personal data storage, independent audit access and human appeal mechanism. If the pilot shows a measurable decrease in leakage, delay and admin costs without greater exclusion, the model may be scaled. The future tracking of public money is not only through a digital payment but through accountable, auditable and rights-sensitive digital public finance.

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