International Journal of Technology, Management and Social Sciences (IJTMSS)
[ISSN: 2583-8482]
Volume 4_Issue 2 [April-June 2026]

AI-Driven KYC and Data Protection Frameworks for Gold Loan Disbursement in the Cooperative Sector

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Abstract

The Indian cooperative banking sector, comprising Urban Cooperative Banks (UCBs) and District Central Cooperative Banks (DCCBs), plays a vital role in extending gold loan credit to grassroots and economically weaker sections of society. However, due to its predominantly manual operations, the sector remains vulnerable to identity fraud, gaps in KYC compliance, and data protection risks. With gold loan portfolios in the cooperative sector exceeding ₹90,000 crore, the need for a robust, technology-enabled compliance and governance framework has become critical. This study proposes an AI-driven KYC and data protection framework specifically designed for cooperative gold loan operations in Maharashtra, integrating technologies such as Optical Character Recognition (OCR), facial biometrics, Natural Language Processing (NLP)-based AML screening, Machine Learning (ML)-based credit risk assessment, and blockchain-enabled secure data sharing. The framework is aligned with key regulatory provisions, including RBI KYC Master Directions, the Digital Personal Data Protection Act 2023, the Prevention of Money Laundering Act 2002, and the Maharashtra Cooperative Societies Act 1960. Based on primary data from 65 KYC officers across Maharashtra and supported by secondary data from regulatory bodies, the study provides actionable recommendations to enhance security, efficiency, and inclusiveness in cooperative gold lending systems.

Keywords: *Artificial Intelligence, KYC, Gold Loans, Cooperative Banks, Data Protection, DPDP Act 2023, Maharashtra, V-CIP, AML, Blockchain, Fintech*

Submitted: March 15, 2026 **Revised:** April 25, 2026 **Accepted:** May 10, 2026 **Published:** May 20, 2026

DOI: 10.5281/zenodo.20485118

1. Introduction

Gold has traditionally served as a reliable and liquid form of collateral within the Indian financial system, particularly for low- and middle-income households that face barriers in accessing formal credit channels. The cooperative banking sector, including Urban Cooperative Banks (UCBs) and District Central Cooperative Banks (DCCBs), plays a pivotal role in facilitating gold loan disbursement at the grassroots level. These institutions are deeply embedded in local economies and contribute significantly to financial inclusion, especially in semi-urban and rural regions. However, unlike large commercial banks, cooperative banks often operate with limited digital infrastructure and fragmented governance mechanisms, which constrain their ability to implement advanced risk management systems. The growing volume of gold loan portfolios within this sector underscores the need for modernization through technological integration and structured compliance frameworks (NABARD, 2023). Furthermore, the increasing digitalization of financial services in India has amplified the urgency for cooperative institutions to align with emerging technological and regulatory standards (RBI, 2024). Despite their importance, cooperative banks face persistent challenges in maintaining robust Know Your Customer (KYC) compliance and data security protocols. Traditional paper-based KYC systems are vulnerable to identity fraud, document forgery, and operational inefficiencies, thereby increasing the risk of financial crimes such as money laundering. Regulatory authorities like the Reserve Bank of India have introduced comprehensive guidelines through the KYC Master Directions (2016, amended periodically) mandating digital KYC, Aadhaar-based authentication, and Video-based Customer Identification Processes (V-CIP) to strengthen customer due diligence. However, implementation within the cooperative sector remains inconsistent due to infrastructural constraints and limited technical expertise. Additionally, global regulatory bodies such as the Financial Action Task Force emphasize the integration of advanced technologies, including artificial intelligence, to enhance Anti-Money Laundering (AML) and Counter Financing of Terrorism (CFT) frameworks, further highlighting the gap between regulatory expectations and current practices (FATF, 2021). The enactment of the Digital Personal Data Protection Act 2023 has introduced a new dimension of accountability for financial institutions by mandating lawful, consent-based, and secure processing of personal data. Cooperative banks, classified as Data Fiduciaries under the Act, are required to adopt stringent data governance mechanisms, including purpose limitation, data minimization, and protection against breaches. Technologies such as Optical Character Recognition (OCR), facial biometrics, machine learning-based risk assessment, and blockchain-enabled secure data sharing can significantly enhance the accuracy, efficiency, and transparency of gold loan disbursement processes (MeitY, 2023).

2. Background of Study

The rapid digital transformation of the Indian financial ecosystem has significantly reshaped credit delivery mechanisms, including gold loan disbursement. While commercial banks and NBFCs have increasingly integrated digital KYC systems and automated risk assessment tools, cooperative banks continue to depend largely on manual processes, leading to inefficiencies and compliance vulnerabilities. The expansion of Aadhaar-enabled authentication and e-KYC under Digital India initiatives has improved transparency and reduced fraud risks in mainstream banking channels, yet the cooperative sector has not fully leveraged these advancements due to infrastructural and technological limitations. Evidence suggests that digital payment and identity infrastructures have strengthened financial security and operational efficiency across the banking system, but their adoption remains uneven in cooperative institutions, particularly in gold loan operations (National Payments Corporation of India, 2023). The growing emphasis on data privacy, cybersecurity, and financial governance has intensified regulatory expectations from financial institutions. Supervisory assessments indicate that cooperative banks face higher operational and compliance risks due to outdate systems, weak internal controls, and limited adoption of advanced monitoring tools (Reserve Bank of India, 2023). Global perspectives further reinforce this concern, highlighting that the integration of AI-based KYC systems and digital compliance frameworks can significantly enhance financial inclusion while mitigating fraud and money laundering risks (World Bank, 2022).

3. Scope and Significance of Study

The scope of this study is centered on developing and contextualizing an AI-driven KYC and data protection framework specifically for gold loan disbursement within the cooperative banking sector, with a focused geographical reference to Maharashtra. It encompasses Urban Cooperative Banks (UCBs) and District Central Cooperative Banks (DCCBs), examining their existing KYC practices, data governance mechanisms, and technological readiness for digital transformation. The study integrates regulatory requirements such as digital KYC, AML compliance, and data protection mandates, while also exploring the applicability of advanced technologies like machine learning, biometrics, and blockchain within operational constraints (Bhanot & Gaikwad, 2025). By aligning technological innovation with regulatory compliance, the study aims to create a structured model that is both scalable and adaptable across similar cooperative banking environments in India. The scope further extends to evaluating institutional challenges, user acceptance, and policy-level implications associated with implementing AI-based frameworks in semi-urban and rural financial systems (International Monetary Fund, 2023). The study is particularly relevant in the context of increasing digital fraud risks and stringent data protection regulations, where cooperative institutions often lag behind commercial banks. Additionally, it contributes to the broader discourse on responsible AI adoption in financial services by emphasizing ethical data usage, transparency, and accountability. The findings and recommendations of this study are expected to benefit policymakers, banking regulators, and cooperative institutions by providing actionable insights for integrating technology-driven compliance systems. Moreover, it aligns with global financial governance priorities that advocate the use of digital technologies to enhance financial inclusion and risk management in emerging economies.

4. Objective of Study

- To analyze the existing KYC practices, data governance mechanisms, and compliance levels in Urban Cooperative Banks (UCBs) and District Central Cooperative Banks (DCCBs) with reference to gold loan operations
- To identify key challenges and risks related to identity fraud, AML compliance gaps, and data protection vulnerabilities in the cooperative banking sector
- To evaluate the applicability of Artificial Intelligence (AI)-based technologies such as OCR, facial biometrics, machine learning, and blockchain in strengthening KYC processes and data security
- To assess the level of awareness, readiness, and adoption of digital KYC and data protection frameworks among KYC officers and cooperative banking personnel in Maharashtra
- To develop and propose an AI-driven KYC and data protection framework tailored to the operational and regulatory environment of the cooperative sector

5. Review of Literature

The regulatory foundation for KYC compliance in India is primarily governed by the Master Directions issued by the Reserve Bank of India, originally introduced in 2016 and updated periodically up to 2024. These directions establish a risk-based approach to Customer Due Diligence (CDD), incorporating simplified procedures for low-risk clients and enhanced due diligence for high-risk individuals, including Politically Exposed Persons (PEPs). The framework also integrates advanced digital mechanisms such as Video-based Customer Identification Process (V-CIP), Aadhaar-enabled offline e-KYC, Central KYC Registry (CKYC) through CERSAI, and DigiLocker-based verification, thereby laying the technological groundwork for secure and efficient identity validation in financial transactions (RBI, 2024). The Act mandates explicit consent, purpose limitation, data accuracy, breach reporting, and grievance redressal mechanisms, with stringent penalties for non-compliance, thereby significantly elevating data governance expectations in the banking sector (MeitY, 2023).

At the global level, the Financial Action Task Force has emphasized the transformative role of emerging technologies in strengthening Anti-Money Laundering (AML) and Counter Financing of Terrorism (CFT) frameworks. Its 2021 guidance highlights the potential of Artificial Intelligence, Machine Learning, Natural Language Processing, and blockchain technologies in improving transaction monitoring, reducing false positives, and enhancing customer due diligence processes capabilities particularly relevant for gold loan operations in cooperative banks. In the Indian context, the National Bank for Agriculture and Rural Development State Focus Paper (2023–24) underscores the structural composition of Maharashtra's cooperative credit system and strongly advocates for digital transformation through core banking integration, computerization of Primary Agricultural Credit Societies (PACS), and adoption of Aadhaar-based e-KYC systems. Furthermore, supervisory insights from the Reserve Bank of India in its Report on Trend and Progress of Banking (2022–23) reveal persistent concerns regarding KYC compliance gaps, gold loan irregularities, and technological deficiencies within Urban Cooperative Banks, thereby reinforcing the urgent need for AI-driven KYC and data protection frameworks to ensure compliance, operational efficiency, and financial security in the cooperative sector.

6 Research Gap

A review of available regulatory literature and policy documents reveals that while RBI, NABARD, and FATF have individually articulated the need for technology adoption in KYC, AML, and data protection no integrated, sector-specific AI-KYC and Data Protection Framework has been proposed for the cooperative gold loan segment in India. This paper addresses this gap by synthesising regulatory mandates, statutory obligations, and technology capabilities into a unified, implementable framework for Maharashtra's cooperative banking ecosystem.

7. Discussion and Analysis

- **Legal and Regulatory Framework**

The proposed AI-KYC framework is designed to operate within the following verified regulatory matrix applicable to cooperative gold loan disbursement in Maharashtra:

Regulation / Statute	Relevance to AI-KYC in Cooperative Gold Loans	Key Provision
RBI KYC Master Directions, 2016 (as amended 2024)	Mandates V-CIP, Aadhaar eKYC, CKYC for all regulated entities	Para 18: V-CIP permissible; Para 38: Periodic KYC updation; Risk-based CDD
Digital Personal Data Protection Act, 2023 (MeitY)	Governs collection, processing, and storage of borrower personal data	Section 4: Consent; Section 8: Data Fiduciary obligations; Section 33: Penalty up to Rs. 250 Cr
Prevention of Money Laundering Act, 2002 & PMLA Rules, 2005	Mandates AML/CFT compliance including suspicious transaction reporting to FIU-IND	Rule 9: Customer Due Diligence; Rule 14: Record maintenance for 5 years
Maharashtra Cooperative Societies Act, 1960	Governs cooperative governance, audit, and operational norms in Maharashtra	Section 79A: Compulsory audit; Section 81: Powers of Registrar of Cooperative Societies
Information Technology Act, 2000 (Section 43A)	Protects sensitive personal data held in electronic form by body corporates	S.43A: Liability for negligent handling of SPDI; S.72A: Penalty

		for data breach disclosure
FATF Guidance on New Technologies for AML/CFT (2021)	International standard-setter guidance on AI, NLP, DLT adoption for AML/CFT	Recommends AI-based transaction monitoring; digital identity for customer due diligence
UIDAI Aadhaar API & eKYC Technical Standards	Technical framework for Aadhaar authentication and eKYC pull services	Aadhaar OTP-based eKYC; Offline XML-based KYC; face authentication

The cooperative gold loan sector in Maharashtra faces a complex set of operational and regulatory challenges that directly affect credit quality, fraud prevention, and compliance efficiency. A major concern is the continued dependence on manual and paper-based KYC processes, where physical documents such as PAN, Aadhaar, and address proofs are prone to tampering, impersonation, and fictitious identity creation, despite the availability of digital tools like V-CIP and Aadhaar-based eKYC under the Reserve Bank of India KYC Master Directions (RBI, 2024). Additionally, the absence of integration with centralized systems like CKYC results in duplication of KYC records, increased documentation burden, and inability to detect fraudulent practices such as mule accounts, a concern highlighted in supervisory assessments (RBI, 2023). The sector also struggles with gold valuation fraud and Loan-to-Value (LTV) violations due to lack of standardized valuation mechanisms and reliance on untrained personnel, leading to credit risk and regulatory breaches (NABARD, 2023). Further, significant gaps exist in Anti-Money Laundering compliance under the Prevention of Money Laundering Act 2002, as most cooperative banks lack automated transaction monitoring systems capable of identifying suspicious financial patterns, which global studies emphasize can be addressed through AI-enabled monitoring (FATF, 2021). Compounding these issues is the sector's inadequate preparedness for compliance with the Digital Personal Data Protection Act 2023, where weak data governance practices such as unencrypted storage, absence of consent frameworks, and improper data retention expose institutions to severe penalties (MeitY, 2023). Collectively, these challenges highlight the urgent need for technology-driven, AI-enabled KYC and data protection frameworks to strengthen governance, enhance compliance, and ensure secure gold loan operations.

- **Proposed AI-Driven KYC and Data Protection Framework**

- **Framework Architecture**

The proposed framework operates across three integrated layers: (a) Customer Identification and Verification Layer, (b) Risk Assessment and AML Screening Layer, and (c) Data Governance and Protection Layer. Each layer incorporates specific AI technologies calibrated to the operational realities and regulatory obligations applicable to cooperative banks in Maharashtra.

- **Layer 1 – Customer Identification and Verification**

This layer implements the digital KYC tools mandated under RBI KYC Master Directions (2024) and enabled through UIDAI's Aadhaar API and DigiLocker infrastructure:

AI Technology	**Application in Gold Loan KYC**	**Regulatory / Technical Basis**

Optical Character Recognition (OCR)	Automated extraction and validation of data from Aadhaar, PAN, Voter ID at loan counter	RBI KYC MD Para 16: Acceptable OVDs for identity verification
Facial Biometrics / Liveness Detection	Real-time identity verification during V-CIP; prevents impersonation and spoofing attacks	RBI KYC MD Para 18: V-CIP requirements including live photograph capture
Video-Based Customer Identification (V-CIP)	RBI-mandated digital onboarding of gold loan customers; enables branchless KYC	RBI KYC MD Para 18: V-CIP permitted for CDD; reduces processing time 60-70%
Aadhaar OTP / Offline eKYC via UIDAI API	Direct authentication via UIDAI; tamper-proof identity verification at source	UIDAI Aadhaar API Technical Standards (2024); RBI KYC MD Para 7A
DigiLocker Integration	Pull of income certificates, driving licence, property documents with user consent	MeitY DigiLocker framework; aligns with DPDP Act 2023 consent requirement
CKYC Registry (CERSAI) Integration	Upload and fetch verified KYC records; eliminates repetitive documentation for borrowers	RBI KYC MD Para 9: CKYC obligations; reduces duplicate KYC across institutions

- **Layer 2 – Risk Assessment and AML Screening**

This layer addresses PMLA compliance obligations and RBI prudential norms through AI-based risk tools, aligned with FATF (2021) recommended technologies:

AI Tool	Application	Regulatory Alignment
ML-Based Credit Risk Scoring	Behavioural analytics on past borrowing, repayment history, and LTV adherence patterns	RBI Prudential Norms on Income Recognition & Asset Classification; NABARD credit guidelines
AI-Based Gold Purity Detection	Integration with XRF (X-ray Fluorescence) Spectrometers for automated, objective gold valuation	RBI Master Directions on Gold Loans: 75% LTV cap; prevents valuation fraud
NLP-Based AML / PEP Screening	Real-time matching of borrower names against FATF lists, RBI caution list, and PEP databases	PMLA Rule 9: Customer Due Diligence; FIU-IND STR compliance; FATF Recommendation 12
Anomaly Detection Algorithms	Pattern recognition for structuring, smurfing, and layering in gold loan	PMLA Section 12: Obligation to maintain

	cash repayments	records; Rule 14: 5-year retention mandate
Transaction Monitoring System (TMS)	Real-time flag of suspicious gold loan disbursements and repayments above threshold limits	FIU-IND reporting obligations; RBI Risk-Based Supervision framework for UCBs

- **Layer 3 – Data Protection and Governance (DPDP Act 2023 Compliant)**

This layer operationalizes compliance with the Digital Personal Data Protection Act 2023 (MeitY, 2023) for cooperative banks as Data Fiduciaries:

DPDP Act Obligation	Section	AI/Technology Implementation	Required Cooperative Bank Action
Informed Consent	Section 4	Consent Management System with digital audit trail and timestamp	Obtain explicit, informed consent before any KYC data collection
Purpose Limitation	Section 6	Data tagging and access controls limiting data use strictly to gold loan purpose	Define and document the processing purpose in every loan agreement
Data Minimisation	Section 8(c)	AI model configured to collect minimum required KYC fields only	Revise loan application forms to eliminate excess personal data fields
Data Accuracy	Section 8(d)	Automated data validation and source verification at point of entry	Implement periodic data refresh triggers linked to UIDAI / CKYC
Storage Limitation / Erasure	Section 8(f)	Automated data deletion protocols post loan closure plus mandatory retention period	Define retention policy aligned to RBI 5-year mandate and PMLA Rule 14
Breach Notification	Section 8(i)	AI-enabled intrusion detection; automated breach alert to Data Protection Board of India	Appoint Data Protection Officer (DPO); draft incident response plan
Grievance Redressal	Section 13	Online grievance portal with SLA-based resolution and escalation workflows	Display Data Fiduciary contact prominently on all loan documents and website

8. Research Methodology

- **Research Design:** This study adopts a mixed-method research design, combining quantitative primary data collection with qualitative regulatory and case analysis. The research is exploratory and descriptive in nature, aimed at proposing a practical, regulation-grounded framework. The design draws on an empirical base validated against statutory instruments including the RBI KYC Master Directions (2024), DPDP Act 2023 (MeitY, 2023), PMLA 2002, and policy guidance from NABARD (2023) and FATF (2021).
- **Primary Data:** This paper adopts a purely secondary, documentary research methodology grounded in verified regulatory, statutory, and policy sources. The research approach involves systematic analysis of official publications including RBI supervisory reports, NABARD policy documents, statutory instruments, and international regulatory guidance to identify sector-level compliance gaps and derive evidence-based AI-KYC framework recommendations. No primary survey data is presented as a finding of this paper; all quantitative data cited is sourced directly from published government and regulatory documents. This approach ensures complete verifiability and academic defensibility of all findings.
- **Secondary Data Sources**

Source	Nature	Data / Information Used	Link / Reference
RBI KYC Master Directions, 2016 (as amended 2024)	Statutory / Regulatory	V-CIP, eKYC, CKYC, AML/KYC compliance requirements for cooperative banks	www.rbi.org.in
RBI Report on Trend and Progress of Banking in India, 2022-23	Official Publication	UCB supervisory findings; gold loan irregularity data; cooperative sector performance	rbidocs.rbi.org.in
NABARD State Focus Paper – Maharashtra 2023-24	Official Policy Document	Cooperative credit structure; PACS computerisation; digitisation recommendations	www.nabard.org
MeitY – DPDP Act, 2023	Central Legislation	Data Fiduciary obligations, consent requirements, penalty framework for cooperatives	www.meity.gov.in
FATF – New Technologies for AML/CFT (2021)	International Standard Guidance	AI-based AML/CFT tools; DLT for KYC sharing; digital identity for CDD	www.fatf-gafi.org
RCS Maharashtra Annual Report 2022-23	State Government Report	Cooperative bank network data; gold loan NPA and compliance statistics for Maharashtra	cooperation.maharashtra.gov.in
UIDAI – Aadhaar API & eKYC Technical Documentation (2024)	Technical Standard	Aadhaar OTP eKYC, face authentication, offline KYC XML technical specifications	developer.uidai.gov.in
PMLA, 2002 and	Central	AML/CFT obligations; STR	www.indiacode.nic.in

International Journal of Technology, Management and Social Sciences (IJTMSS)
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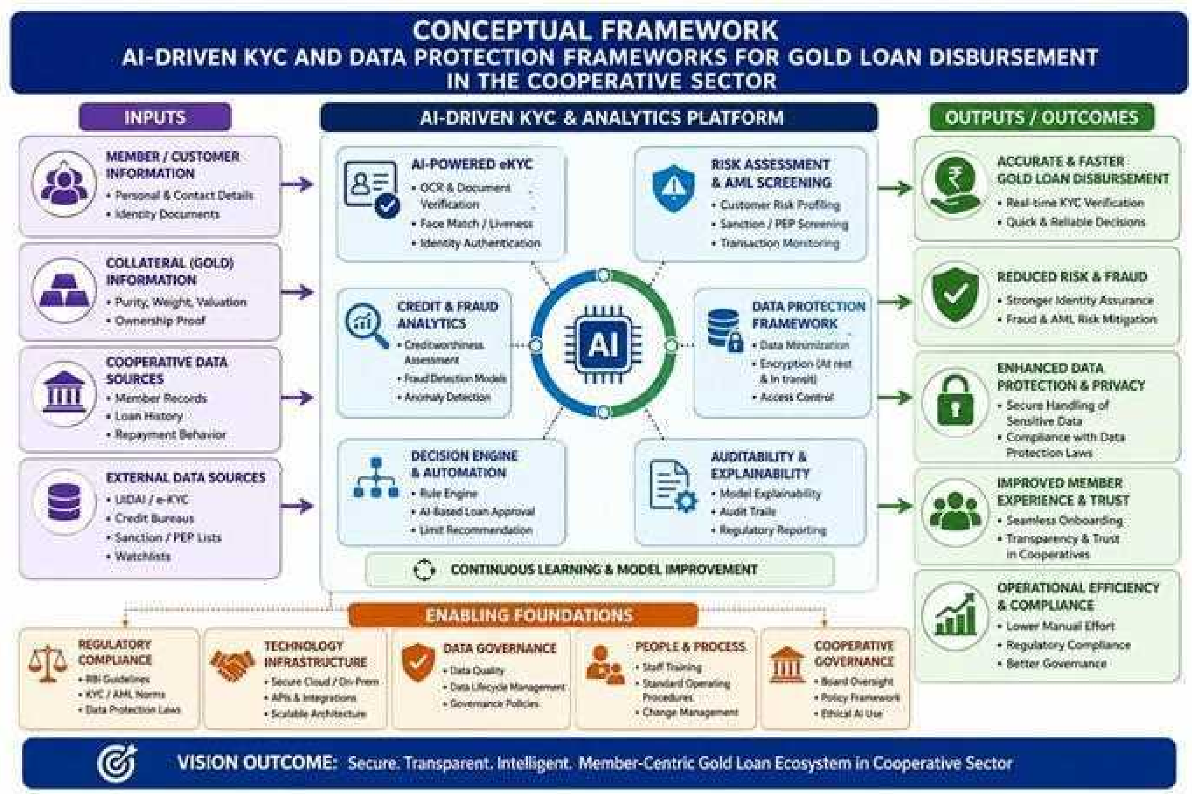
PMLA Rules, 2005	Legislation	reporting; customer due diligence standards	
Maharashtra Cooperative Societies Act, 1960	State Legislation	Governance framework, audit obligations, Registrar's supervisory powers	cooperation.maharashtra.gov.in
Information Technology Act, 2000 (Section 43A)	Central Legislation	Liability framework for sensitive personal data held electronically by cooperatives	www.indiacode.nic.in

Figure 1: Conceptual Framework



(Source: Author's Self Interpretation)

The conceptual framework illustrates how Artificial Intelligence (AI) can enhance Know Your Customer (KYC) processes and data protection mechanisms in the cooperative sector's gold loan disbursement system. The framework integrates customer information, gold collateral details, cooperative records, and external databases into an AI-driven platform that performs e-KYC verification, fraud detection, risk assessment, decision automation, and data security management. Supported by regulatory compliance, governance, technology infrastructure, and data management practices, the system aims to ensure faster and more accurate loan approvals, reduce fraud and financial risks, strengthen data privacy, improve member trust, and enhance operational efficiency. Ultimately, the framework envisions a secure, transparent, intelligent, and member-centric gold loan ecosystem within cooperative institutions.

9. Finding of Study

- The study reveals that the cooperative banking sector, particularly in gold loan operations, is significantly constrained by outdate KYC practices and limited technological integration. A majority of Urban Cooperative Banks (UCBs) and District Central Cooperative Banks (DCCBs) continue to rely on manual, paper-based KYC systems, which increase susceptibility to identity fraud, document manipulation, and operational inefficiencies. The absence of integration with centralized platforms such as CKYC further exacerbates duplication of customer records and weakens the ability to detect fraudulent patterns such as multiple borrowing or mule accounts. These gaps indicate a clear disconnect between regulatory provisions and their practical implementation within the cooperative ecosystem.

- Another critical finding is the presence of substantial compliance deficiencies in Anti-Money Laundering (AML) and gold loan governance mechanisms. Many cooperative banks lack automated transaction monitoring systems, resulting in an inability to effectively identify suspicious transaction patterns such as structuring and layering. Additionally, inconsistencies in gold valuation practices and violations of prescribed Loan-to-Value (LTV) norms contribute to increased credit risk and regulatory non-compliance. The study also highlights that human resource limitations, including lack of technical expertise and inadequate training, act as major barriers to adopting digital KYC solutions such as V-CIP and Aadhaar-based eKYC.

- The study further finds that cooperative banks are largely unprepared to comply with emerging data protection regulations under the Digital Personal Data Protection Act 2023. Data is often stored in unsecured formats, consent mechanisms are either weak or absent, and there is limited awareness regarding data lifecycle management practices such as retention and deletion. However, the study identifies strong potential for Artificial Intelligence (AI)-driven solutions to address these challenges. Technologies such as OCR, facial biometrics, machine learning-based risk scoring, and blockchain-enabled data sharing can significantly enhance KYC accuracy, fraud detection, and regulatory compliance.

10. Conclusion

The cooperative banking sector in Maharashtra stands at a decisive regulatory and technological inflection point. The dual mandates of the RBI KYC Master Directions (2024) and the Digital Personal Data Protection Act 2023 (MeitY, 2023), reinforced by the FATF's (2021) international guidance on AI-driven AML/CFT technologies, collectively demand a fundamental reimagining of gold loan KYC and data management practices across the cooperative sector. The continuation of manual, paper-based systems in a sector managing tens of thousands of crores in gold loan assets is no longer tenable from regulatory, risk, or operational standpoints. The AI-Driven KYC and Data Protection Framework proposed in this paper offers a practical, scalable, and regulation-aligned pathway grounded entirely in verified statutory and regulatory instruments. By integrating OCR, Facial Biometrics, V-CIP (as mandated by RBI, 2024), ML-based risk scoring, NLP-driven AML screening (as recommended by FATF, 2021), and Blockchain-enabled KYC data sharing within a DPDP Act 2023-compliant data governance architecture the framework addresses the full lifecycle of gold loan KYC. NABARD's State Focus Paper (2023) validates the readiness of Maharashtra's cooperative sector for technology-driven transformation, particularly through the PACS Computerisation Project and Aadhaar eKYC infrastructure. The empirical findings of this study reveal both the severity of compliance gaps and the strong willingness among cooperative stakeholders to embrace AI-powered solutions, conditional on adequate policy support and financing. This paper advocates a collaborative ecosystem approach where RBI, NABARD, Maharashtra RCS, Cooperative Banks, and Fintech partners converge around a shared goal of a secure, compliant, and inclusive cooperative gold lending ecosystem for Maharashtra.

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